

THE QUANTITY SURVEYOR'S HANDBOOK

5th Edition – Published January 2022
(Revision 5.3)





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PREFACE FIFTH EDITION

The first edition of this handbook (July 1976) hoped that the information and guidelines contained within will be a useful contribution to the practical applications of metrics for the New Zealand building construction industry.

The Fourth Edition (1992) retained extensive imperial information from the First Edition 'because it becomes useful from time to time for interpreting old drawings and specifications'. This edition was revised in 2004.

Twelve years later this, (the Fifth), Edition includes significant additional content in the form of trade labour constants, sample labour rate calculations, practice and administration topics of feasibility studies, procurement systems and contract types, Life Cycle Costing and Value Management. It has been structured into three parts [1] Measurement, [2] Trade Materials & Labour Constants and [3] Practice Administration.

Some of the additional content has been supplied by *QV costbuilder*, an online subscription based platform that contains the latest construction cost information and data. For more information visit qv.costbuilder.co.nz

Many imperial references have been removed. Hyperlinks have begun to be added. Some sections have been completely reviewed and updated, others only partially reviewed and updated. Many sections have only been reviewed and scheduled for updating in future revisions. Rome was not built in a day. Future revisions are planned to complete the review of the Fourth Edition, to update existing content, add missing Trades, add hyperlinks to more extensive online data resources, introduce BIM measuring coding systems and cross reference these to traditional trade packages and complete the addition of labour and plant constants.

"Notwithstanding that every care has been taken in the preparation of this handbook, individuals and firms must accept responsibility for ascertaining precisely the intentions of other parties, including the suppliers of the components themselves and no responsibility in respect of the information given rests within the New Zealand Institute of Quantity Surveyors (Inc.) or its members." (Reprint from the First Edition preface 1976).

Matthew Ensoll FNZIQS Reg.QS

Editor, The QS Handbook

Revision Ref	Date	Revision Outline
5 th Edition 1 st Issue Rev, 5.0	April 2016	Part 4 th Edition update. Added labour constants and new practice and administration topics. Extensively reformatted.
5 th Edition 2 nd Issue Rev, 5.1	January 2018	Notes introduction of the new joint <i>Australia and New Zealand Standard Method of Measurement 2018</i> (ANZSMM 2018) to replace the former NZS 4202–Standard Method of Measurement of Building Works. Added 2016 Statistics NZ Cost Indices.
5 th Edition 3 rd Issue Rev, 5.2	June 2019	Corrections to kg/m calculations on P28 for Rolled Steel Joists, Taper Flange and Parallel Flange
5 th Edition 4 th Issue Rev, 5.3	January 2022	Correction to Retentions table in Cashflow Example on P140

Whilst every care has been taken in compiling this Handbook, NZIQS accepts no responsibility for any errors and omissions herein.



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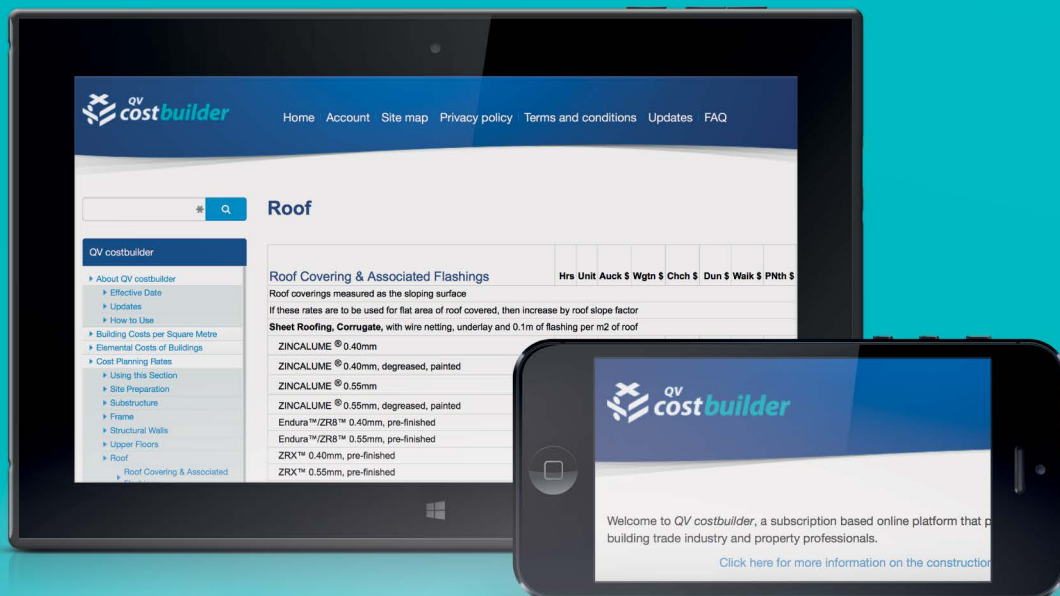
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PART ONE – MEASUREMENT

MEASUREMENT OF BUILDINGS

PHYSICAL CONTENT

Schedule of Quantities. A schedule of quantities is a document which is procured when measuring the physical content of a building. It is set out in sections either by trade, element or physical location and describes the individual items of work which make up a complete building. The quantity of each item is also given where applicable. Its main use is for tendering purposes, assessment of variations and progress claims and cost analysis of building projects.

Schedule of Provisional Quantities. Similar to the above, a provisional schedule gives only an assessment of the quantities involved as it may not be possible to determine them accurately at the time of preparation. Actual quantities are then recorded when each item of work has been completed.

Specified Schedule of Quantities. Accurate quantities are given in the normal manner as per the normal schedule and are complemented by a detailed specification of the items, which is included either as a preamble to each section or as a part of the description of each item.

Methods of Measurement. It is necessary for a standard to be employed when measuring the quantities for each item. In 2018 the New Zealand Institute of Quantity Surveyors and Registered Master Builders Association, in conjunction with the Australian Institute of Quantity Surveyors, introduced a new joint Australasian Method of Measurement –the *Australian and New Zealand Standard Method of Measurement 2018 (ANZSMM 2018)*.

Information about the ANZSMM 2018, including how to order copies, is on the New Zealand Institute of Quantity Surveyors website www.nziqs.co.nz

Until the introduction of ANZSMM 2018, the previous guideline for the measurement of building works was from Standards New Zealand NZS4202 – The Standard Method of Measurement of Building Works 1995. This standard may still be in use in New Zealand.

GROSS FLOOR AREA (GFA)

This method has been adopted for use by the New Zealand Institute of Quantity Surveyors for the purpose of building cost analysis. A full explanation of the method is given in The NZIQS *“Elemental Analysis of Costs of Building Projects”* Handbook (www.nziqs.co.nz)

Unit of measurement: square metres (m²)

The gross floor area is measured over all the external walls of the building, over partitions, columns, internal structural or party walls, stair wells, lift wells, ducts, enclosed roof top structures and basement service areas. All exposed areas such as balconies, terraces, open floor areas and the like are excluded.

Generally, projections beyond the outer face of the external walls of a building such as projecting columns, floor slabs, beams, sunshades and the like shall be excluded from the calculation of gross floor areas.

Where the outer face of the external walls of a building are not regular vertical surfaces, the overall measurements shall be taken at floor levels and a note made of the vertical profile of the wall line.

Where mezzanine floors occur within a structure the gross floor area of this mezzanine shall be added to all other complete floor areas and become a constituent part of the gross area.

RENTABLE AREA

This method has been adopted for use by the Property Council of New Zealand Inc., for the purpose of determining rental values, based on the publication “Guide for the Measurement of Rentable Areas”. Portions of this guide are reproduced with the permission of [Property Council of New Zealand Inc.](#)

The guide is primarily directed to the measurement of floor space in commercial, industrial and retail buildings and may be used for such purposes as determining rentable areas, project feasibility, building efficiency, operating and cost apportionment and other related matters.

Applicable throughout New Zealand, the guide is invaluable to property owners, developers, investors, lessees and all those involved in the provision and utilisation of space.

The method of measurement is broken down into four categories to simplify its application to different building types and various lease arrangements.

Unit of measurement: square metres (m²). Measurements are generally taken at a height of 1.5 metres above the floor.

Method of Measurement 1. Office Accommodation—Entire Building/Whole Floor

This category of accommodation is intended to apply to modern multi-storey office buildings. This method of measurement can be applied to any office accommodation in an office building of similar type. It may be used for measuring the rentable area of an entire building or the rentable area of a whole floor. This recommended guide is based on the principle that any office building will have the same total rentable area whether it is leased as an entire building, or on a whole floor or part floor basis.

The rentable areas of a building is the total of all the rentable areas.

Method of Measurement 2. Office accommodation—Part Floor

This category of accommodation is found in modern multi-storey office buildings where one or more floors are sub-divided to facilitate leasing to more than one lessee on any floor. The sum of the rentable area for each part floor lessee shall equal the total rentable area of that particular floor, had it been leased on a whole floor basis. In order to determine the rentable area for each part floor suite, it is necessary to measure the nett area for each suite to which is added an apportioned pro rata share of the total service area on that floor.

The nett area for each suite shall be measured to the centre of partition walls. Other wall measurements shall be taken as for method 1.

Method of Measurement 3. Retail Premises

This method of measurement is intended to apply to all retail premises whether freestanding, individual premises comprising a group of premises, or part of a shopping complex/shopping centre, as well as those retail areas which may form a component of a commercial office building or multiple use complex.

The rentable area is the floor space confined within the building and available for exclusive use by the lessee.

Method of Measurement 4. Industrial Type Buildings

This category covers a wide section of commercial and industrial uses but the types of building envisaged bear a similarity in that they are mostly, though not necessarily, a single storey freestanding structure with office accommodation built in, attached or adjacent.

This category consists of those buildings or premises in which more than 50% of the total rentable area is used for industrial, warehousing, storage or similar use.

METRIC MEASUREMENT AND SCHEDULING

To take-off from metric drawings, it is necessary to write down drawing dimensions when:

1. Calculating in side casts (or waste calculations)
2. Entering in the dimension columns of take-off sheets.

SIDE CAST CALCULATION DIMENSIONS

These dimensions consist of the build-up of girths and the like that will be used for main dimensions. As far as possible, the build-up to every main dimension should be set down as a side cast in order that the origin of a dimension can easily be traced.

Drawing dimensions are written with:

- Millimetres in whole numbers
- Metres to three decimal places.

In dealing with these dimensions in side casts, be consistent in the writing down procedure to avoid the possibility of error. All dimensions in side casts should, therefore, be written in metres to three decimal places. Thus a dimension written on the drawings in whole numbers (millimetres) should be converted to and written down as decimal parts of a metre.

Place a zero (0) before the decimal point where no quantity exists. A zero makes it clear that a digit has not been omitted.

Fill all three places after the decimal point. The examples below show how writing three decimal figures avoids errors.

- 12 metres should be written 12.000
- 12 metres 500 millimetres should be written 12.500
- 12 metres 50 millimetres should be written 12.050
- 12 metres 5 millimetres should be written 12.005

DIMENSION COLUMN DIMENSIONS

These dimensions are the main dimensions used to arrive at the total quantities for the schedule items.

In side-cast calculations, all dimensions are taken to three decimal places. In entering dimensions in the dimension columns, however, take all dimensions to two decimal places, which is the practice recommended overseas. When taking dimensions direct from the drawings or from a total of a side cast, write them down to the nearest two decimal places, that is, to the nearest 10 mm. Treat 5 mm and over as 10 mm, and ignore less than 5 mm.

If the result of a side cast is 2.778, round off to the nearest 10 mm and write 2.78 in the dimension column. If the result is 2.773, write 2.77.

With cubic measure, the difference is greater but since most quantities measured in cubic metres are to be expressed as whole cubic metres, the accuracy of 0.01 m³ for individual extensions is thought to be sufficient.

Place zero (0) before and after the decimal point where no quantities occur. E.g. 50 mm would be written as 0.05.

Having set down dimensions in metres to two decimal places, use the same format for setting down dimensions and squaring.

SCHEDULING

For normal items (quantities in unit column).

- a. Generally to be rounded off to the nearest whole unit of billing, i.e. expressed in metres (m), square metres (m²), cubic metres (m³), kilograms (kg), or number (No).
- b. Where the unit would be less than one whole unit, it is recommended that the item be numbered and the quantity stated within the description.
- c. An exception may be made for concrete under 10m³ which may be given corrected to one decimal place.

Quantities given within the description (this will apply to joinery, precast concrete and similar numbered items which have detailed quantities within the description) may be given corrected to one decimal place except for quantities of mass which shall be in whole kilograms.

The above is a definition of principle rather than a directive and the Quantity Surveyor is expected to use their discretion and adopt appropriate methods for special requirements provided that the principles are observed.

SYMBOLS

The following symbols will be used in Schedules of Quantities:

mm	millimetres
m	metres
m ²	square metres
m ³	cubic metres
kg	kilograms
No	number
Unit	Symbol
Single dimension	200 mm
Two dimensions	200 × 200 mm
Three dimensions	200 × 200 × 200 mm

\When writing symbols:

- a. Write the correct symbol.
- b. Use the same symbol for singular and plural.
- c. Write metric symbols in lower case (small letters).
- d. Never put a full stop or punctuation after a symbol except at the end of a sentence.
- e. Leave a space between the quantity and the symbol.

- f. Write units in full if you think a symbol might be confusing.

Because of the possible confusion between t for tonne, l for litre and the figure one, these units are written in full. Their use should be restricted to the description column.

TYPING, PRINTING, WRITING AND PRONUNCIATION WITH METRIC UNITS

Metric notations are not abbreviations, but are symbols in their own right. From this, a number of points follow:

The unit symbols do not have plural forms. Thus, the symbol for millimetres is mm not mms.

The unit symbols are not followed by a full stop except at the end of a sentence. Thus mm not mm. is the correct way to write the symbol for millimetres.

The unit symbols are to be treated mathematically, in the same way as other symbols. Thus, cubic metres should be written m³ not cu.m; cubic centimetres should be written cm³ not ccs; square kilometres should be written km² not sq.km; cubic metres per second should be written m³/s not as cu secs.

Unit symbols in small letters cannot be written in capitals, and vice versa. Thus, even when the rest of the text is in capitals (for example, a heading) the unit symbol remains unaltered; e.g. km cannot be written as KM.

Note: that the symbols which begin with a capital are those of units which are named after people, but the name of the unit does not have a capital – for example, V for the volt, named after Volta.

Note: also that while the prefix m signifies milli, a factor of 10⁻³, the prefix M signifies mega, a factor of 10⁶.

Spellings adopted in New Zealand are as shown; the spelling of meter, liter and gramme will not be used.

Capitals

- When written in full, the names of ALL units start with a small letter, except at the beginning of a sentence, when a capital is used in the ordinary way.
- Except when derived from the names of persons, unit symbols have a small letter.
- Except for tera (T), giga (G) and mega (M), all symbols for numerical prefixes have a small letter. When written in full, all prefixes have a small letter.

For example:	For metre	write m
	" pascal	" Pa
	" gram	" g
	" volt	" V
	" milligram	" mg
	" mega pascal	" MPa
	" mega gram	" Mg

Plurals

- When written in full, the names of units are made plural when necessary. Decimal fractions are always singular.
- Symbols for units are NEVER made plural.
Examples: 1.5 grams and 0.5 gram
35 kilometres = 35 km

The Decimal Point

- The decimal point may be placed either on the line (as a full stop) or in a mid-line position.
Example: Either 25.4 or 25·4 may be written.
- When writing numbers less than one, a zero must be written before the decimal point.
Example: For writing "point five four" put 0.54.

Grouping of Numbers

- a. For separating groups of three figures, the comma should not be used. Instead a space is left. (This change has been made in order to avoid confusion, since some European countries use a comma for the decimal point).
- b. Where only four figures are involved, the use of the space marker is optional, except in tabulation, when the space should always be used.
- c. Groups of figures on either side of the decimal point should be separated by the space, where necessary.

Examples:	for	4,720,525	write	4 720 525
	for	0.52875	write	0.528 75
	for	6,875	write either	6875 or 6 875

However, in Schedules of Quantities, Quantity Surveyors may prefer to block together all their figures in the quantity column as a space could give rise to doubts as to whether or not a figure is missing.

Spacing

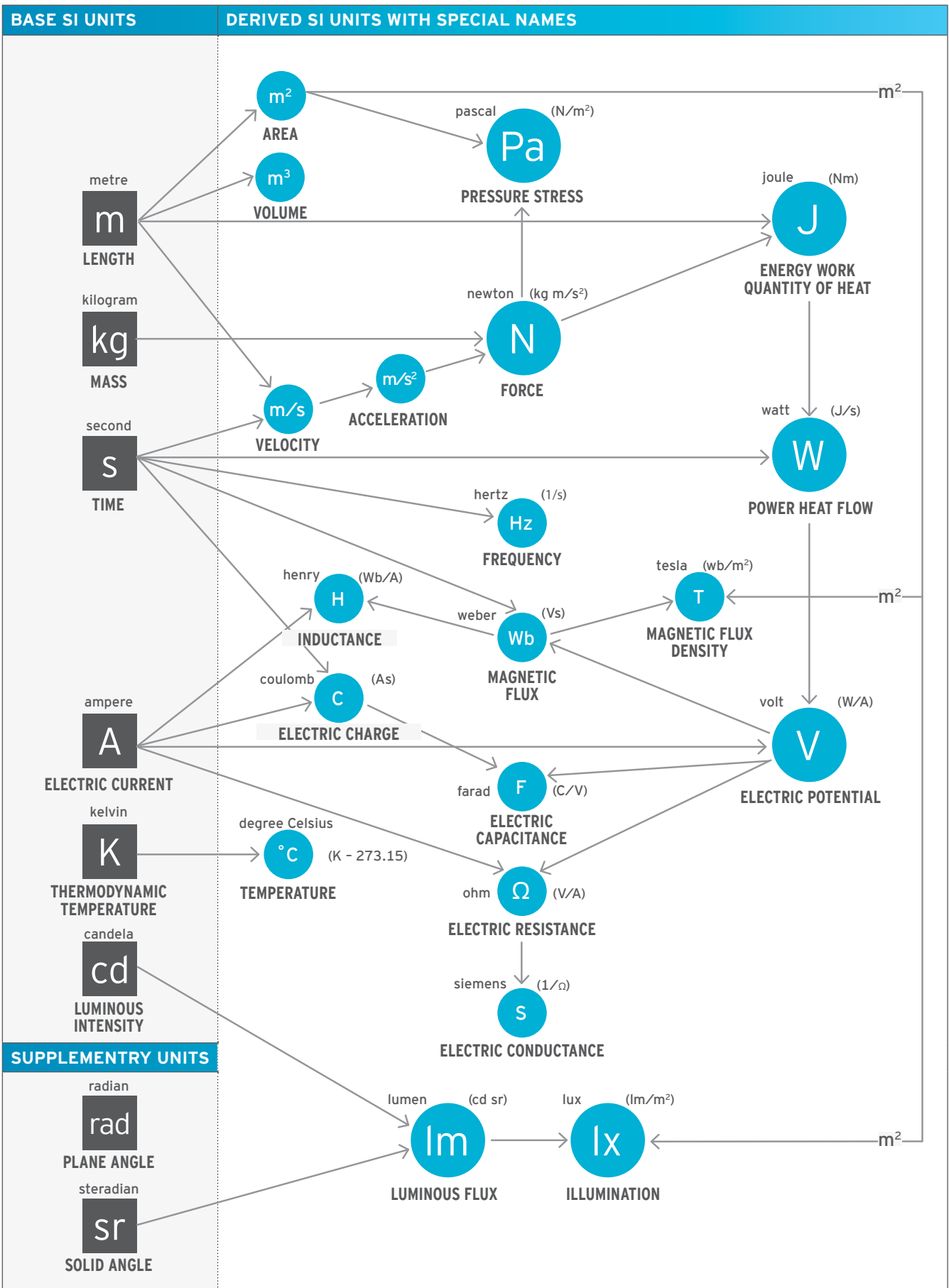
- a. When writing symbols for units having prefixes (e.g. kilopascal or milligram), no space is left between letters making up the symbol.
- b. When writing a symbol after a number to which it refers, a space is left between the number and the symbol.

Examples: 455 kHz 22 mg

The pronunciations agreed by the Metric Advisory Board are as follows:

giga	GIG-ger
candela	CAN-dil-a
mole	mole (as for the animal)
radian	RAID-ee-an
steradian	ste-RAID-ee-an
pascal	PAS-kill (as like ass)
siemens	sea-mens
hectare	HEK-tair
decare	DEK-air
litre	LEET-a
tonne	to rhyme with John
weber	VAY-ba
tesla	TEZ-la
joule	jewl

SI Units



INTERNATIONAL SYSTEMS OF UNITS (SI)

New Zealand had adopted the International System of Units (SI). The SI is based on seven base units, namely:

Quantity	Unit	Symbol
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
temperature	kelvin	K
luminous intensity	candela	cd
amount of substance	mole	mol
Supplementary units		
plane angle	radian	rad
solid angle	steradian	sr

TABLE 1 – SELECTED MULTIPLES AND SUB-MULTIPLES OF SI UNITS

Multiplication Factor	Prefix	Symbol
1 000 000 000 000	10 ¹²	tera T
1 000 000 000	10 ⁹	giga G
1 000 000	10 ⁶ *	mega M
1 000	10 ³ *	kilo k
100	10 ²	hecto h
10	10 ¹	deca da
0.1	10 ⁻¹	deci d
0.01	10 ⁻²	centi c
0.001	10 ⁻³ *	milli m
0.000 001	10 ⁻⁶ *	micro μ
0.000 000 001	10 ⁻⁹	nano n

* Adopted as preferred prefixes in the New Zealand building construction industry.

TABLE 2 – SELECTED DERIVED UNITS

Group A: Units expressed in terms of Base and Supplementary Units only.

Quantity	Unit	Symbol
area	square metre	m ²
volume	cubic metre	m ³
density	kilogram per cubic metre	kg/m ³

Group B: Selected Units which have Special Names.

Quantity	Unit	Symbol
frequency	hertz	Hz
force	newton	N
work, energy/quantity of heat	joule	J
power, heat flow rate	watt	W
luminous flux	lumen	lm
illumination	lux	lx
pressure, stress	pascal	Pa
volume, capacity	litre	l
mass	tonne	t
area	hectare	ha

Litres and tonnes should be written in full and the use of the symbols l and t should be avoided because of the possible confusion with 1 (one). A litre is 0.001 m³ or 1 000 000 mm³. A tonne is 1000 kilograms and a hectare is 10 000 m².

Group C: Units expressed in terms of other derived units only or other derived units and base units.

Quantity	Unit	Symbol
torque, moment of force	newton metre	N.m
thermal conductivity	watt per metre kelvin	W/m.K
coeff of heat transfer	watt per square metre kelvin	W/m ² .K
luminance	candela per square metre	cd/m ²

Group D: Electrical Units

Quantity	Unit	Symbol
electric charge/quantity of electricity	coulomb	C
electric potential/electromotive force	volt	V
resistance	ohm	Ω
capacitance	farad	F
inductance	henry	H

TEMPERATURE

The kelvin is only used for scientific work. The degree Celsius (usually called Centigrade) is used for everyday purposes. An interval of one degree on the Celsius scale is the same as a degree on the kelvin scale, but the two scales have different bases:

0°C is the freezing point of water and 0°K is absolute zero (-273.15°C).

DENSITY

	kg/m ³
Air at sea level (20°C)	1.22
Water	1000
Concrete	2310
Aluminium	2675
Steel	7850
Copper	8938

COEFFICIENTS OF EXPANSION

Material	Coefficient of Linear Expansion (Unit: m/m.K)	
Aluminium	0.000 025	
Brass	0.000 018	
Ceramics	0.000 003	to 0.000 009
Concrete	0.000 010	to 0.000 015
Copper	0.000 016	6
Glass	0.000 008	to 0.000 009
Iron:		
Cast	0.000 010	6
Wrought	0.000 011	7
Lead	0.000 029	
Tin	0.000 020	
uPVC	0.000 081	
Zinc	0.000 035	
Steel	0.000 012	1

Linear expansion = Coeff × length × temperature difference (K).

Note: If length is in metres – expansion will also be in metres.

COMMON CONVERSION FACTORS

(E) = Exact

	Metric to Imperial	Multiply by	Imperial to Metric	Multiply By
Length	mm to inches	0.03937	Inches to mm (E)	25.4
	mm to feet	0.003281	feet to mm (E)	304.8
	m to feet	3.281	feet to m (E)	0.3048
	mm to yards	0.0011	yards to mm (E)	914.4
	m to yards	1.0936	yards to m (E)	0.9144
Area	m ² to square feet	10.764	square feet to m ²	0.0929
	m ² to square yards	1.196	square yards to m ²	0.8361
Volume	m ³ to cubic feet	35.315	cubic feet to m ³	0.02832
	m ³ to cubic yards	1.308	cubic yards to m ³	0.7646
Mass	kg to lbs	2.2046	lbs to kg	0.4536
	kg to cwt	0.0197	cwt to kg	50.8023
	tonne to cwt	19.68	cwt to tonne	0.0508
	tonne to ton	0.9842	ton to tonne	1.0161
Capacity	litres to gallons	0.220	gallons to litres	4.546
	litres to pints	1.76	pints to litres	0.5683

TRIGONOMETRICAL RATIOS

Read down 1 to 45 degrees, up 45 to 89 degrees

°	tan	cot	sin	cos	sec	cosec	°
1	0.0175	57.2899	0.0175	0.9998	1.0002	57.2987	89
2	0.0349	28.6362	0.0349	0.9994	1.0006	28.6537	88
3	0.0524	19.0811	0.0523	0.9986	1.0014	19.1073	87
4	0.0699	14.3007	0.0698	0.9976	1.0024	14.3356	86
5	0.0875	11.4301	0.0872	0.9962	1.0038	11.4737	85
6	0.1051	9.5144	0.1045	0.9945	1.0055	9.5668	84
7	0.1228	8.1443	0.1219	0.9925	1.0075	8.2055	83
8	0.1405	7.1154	0.1392	0.9903	1.0098	7.1853	82
9	0.1584	6.3138	0.1564	0.9877	1.0125	6.3925	81
10	0.1763	5.6713	0.1736	0.9848	1.0154	5.7588	80
11	0.1944	5.1446	0.1908	0.9816	1.0187	5.2408	79
12	0.2126	4.7046	0.2079	0.9781	1.0223	4.8079	78
13	0.2309	4.3315	0.2250	0.9744	1.0263	4.4454	77
14	0.2493	4.0108	0.2419	0.9703	1.0306	4.1336	76
15	0.2679	3.7321	0.2588	0.9659	1.0353	3.8637	75
16	0.2867	3.4874	0.2756	0.9613	1.0403	3.6280	74
17	0.3057	3.2709	0.2924	0.9563	1.0457	3.4203	73
18	0.3249	3.0777	0.3090	0.9511	1.0515	3.2361	72
19	0.3443	2.9042	0.3256	0.9455	1.0576	3.0716	71
20	0.3640	2.7475	0.3420	0.9397	1.0642	2.9238	70
21	0.3839	2.6051	0.3584	0.9336	1.0711	2.7904	69
22	0.4040	2.4751	0.3746	0.9272	1.0785	2.6695	68
23	0.4245	2.3559	0.3907	0.9205	1.0864	2.5593	67
24	0.4452	2.2460	0.4067	0.9135	1.0946	2.4586	66
25	0.4663	2.1445	0.4226	0.9063	1.1034	2.3662	65
26	0.4877	2.0503	0.4384	0.8988	1.1126	2.2812	64
27	0.5095	1.9626	0.4540	0.8910	1.1223	2.2027	63
28	0.5317	1.8807	0.4695	0.8829	1.1326	2.1301	62
29	0.5543	1.8040	0.4848	0.8746	1.1434	2.0627	61
30	0.5774	1.7321	0.5000	0.8660	1.1547	2.0000	60
31	0.6009	1.6643	0.5150	0.8572	1.1666	1.9416	59
32	0.6249	1.6003	0.5299	0.8480	1.1792	1.8871	58
33	0.6494	1.5399	0.5446	0.8387	1.1924	1.8361	57
34	0.6745	1.4826	0.5592	0.8290	1.2062	1.7883	56
35	0.7002	1.4281	0.5736	0.8192	1.2208	1.7434	55
36	0.7265	1.3764	0.5878	0.8090	1.2361	1.7013	54
37	0.7536	1.3270	0.6018	0.7986	1.2521	1.6616	53
38	0.7813	1.2799	0.6157	0.7880	1.2690	1.6243	52
39	0.8098	1.2349	0.6293	0.7771	1.2868	1.5890	51
40	0.8391	1.1918	0.6428	0.7660	1.3054	1.5557	50
41	0.8693	1.1504	0.6561	0.7547	1.3250	1.5243	49
42	0.9004	1.1106	0.6691	0.7431	1.3456	1.4945	48
43	0.9325	1.0724	0.6820	0.7314	1.3673	1.4663	47
44	0.9657	1.0355	0.6947	0.7193	1.3902	1.4396	46
45	1.0000	1.0000	0.7071	0.7071	1.4142	1.4142	45
°	cot	tan	cos	sin	cosec	sec	°

$$\sin(\theta) = \frac{O}{H}$$

$$\cos(\theta) = \frac{A}{H}$$

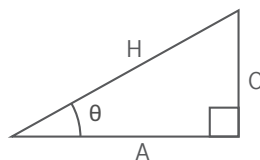
$$\tan(\theta) = \frac{O}{A}$$

$$\text{cosec}(\theta) = \frac{H}{O}$$

$$\sec(\theta) = \frac{H}{A}$$

$$\cot(\theta) = \frac{A}{O}$$

Where
 O = opposite
 H = hypotenuse
 A = adjacent

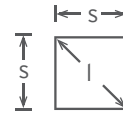


MENSURATION

A = area	n° = degrees
b = base	p = perpendicular
c = circumference	r = radius
d = diameter	s = side
h = height	V = volume
l = length	w = width
	π = 3.14159

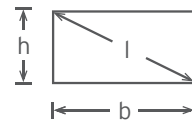
SQUARE

Area	A = s^2
Side	s = \sqrt{A}
Length of Diagonal	l = $s \times \sqrt{2}$
Diameter of circumscribing circle	d = $s \times 1.4142$
Circumference of circumscribing circle	c = $s \times 4.443$
Diameter of circle of equal area	d = $s \times 1.128$



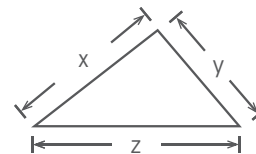
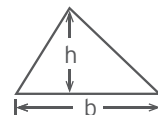
RECTANGLE

Area	A = $b \times h$
Base	b = $\frac{A}{h}$
Height	h = $\frac{A}{b}$
Length of diagonal	l = $\sqrt{b^2 + h^2}$
Length of base	b = $\sqrt{l^2 - h^2}$
Length of height	h = $\sqrt{l^2 - b^2}$



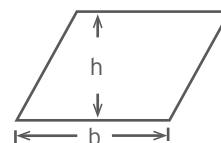
TRIANGLE

Area	A = $\frac{b \times h}{2}$
Area of triangle when length of each side is known:	
Let	U = half sum of the 3 sides
∴	U = $\frac{x + y + z}{2}$
then	A = $\sqrt{U(U-x)(U-y)(U-z)}$



PARALLELOGRAM

Area	A = $b \times h$
------	-------------------------

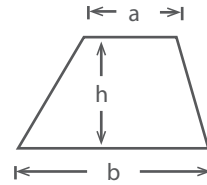


TRAPEZIUM

(2 sides parallel)

Area

$$A = \frac{a + b}{2} \times h$$

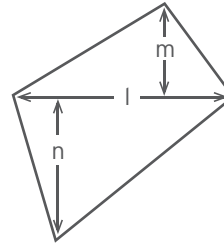


QUADRILATERAL

Area is length of diagonal multiplied by half length of the perpendicular of the opposite triangles.

Area

$$A = l \times \frac{m + n}{2}$$

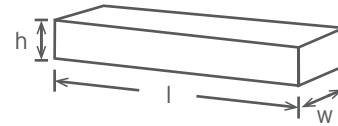


RECTANGULAR PRISM

Volume = Area of base × height

Volume

$$V = l \times w \times h$$

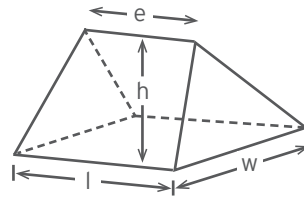


WEDGE

Volume

$$V = \frac{wh(2l + e)}{6}$$

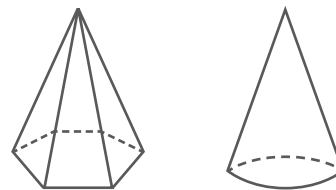
where h = perpendicular distance between the back and the edge (e).



PYRAMID OR CONE

Volume of any pyramid equals area of base multiplied by one-third vertical height.

$$V = \text{area of base} \times \frac{h}{3}$$



$$A = \frac{\text{Perimeter of base} \times \text{slant height}}{2} + \text{area of base}$$

CIRCLE

Circumference

$$c = \pi d$$

$$= 2 \pi r$$

Area

$$A = \pi r^2$$

or $A = d^2 \times 0.7854$

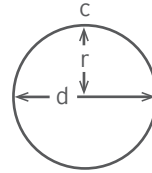
or $A = 0.5 cr$

Side of equal square

$$= 0.8862 d$$

Side of inscribed square

$$= 0.7071 d$$



Area of circle is approx. 0.7854 of area of enclosing square.

SECTOR OF CIRCLE

Area

$$A = \pi r^2 \times \frac{n^\circ}{360}$$

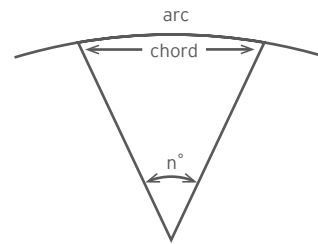
or $A = 0.5 r \times \text{length of arc}$

Length of arc

$$l = 0.0174533 n^\circ r$$

Length of chord

chord $= d \sin \frac{n^\circ}{2}$



SEGMENT OF CIRCLE

Area

$$A = \text{Area of sector} - \text{Area of triangle}$$



ELLIPSE

Let

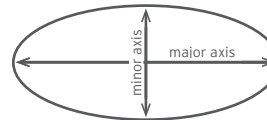
$$x = \text{half major axis}$$

$$y = \text{half minor axis}$$

Area

$$A = \pi \times y$$

or $A = 0.7854 \times \text{enclosing rectangle (approx)}$



Circumference of Ellipse:

1. approximately

$$c = \pi (x + y)$$

2. more nearly

$$c = \pi \left[\frac{3}{2}(x + y) - \sqrt{xy} \right]$$

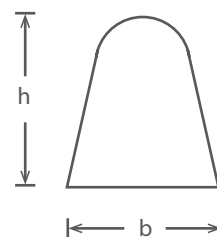
3. or

$$c = \pi \left[\frac{\sqrt{x^2 + y^2}}{2} - \frac{(x + y)}{2} \right]$$

PARABOLA

Area

$$A = \frac{2bh}{3}$$



CYLINDER

Area

$$A = 2\pi r^2 + 2\pi rh$$

Volume

$$V = \pi r^2 h$$

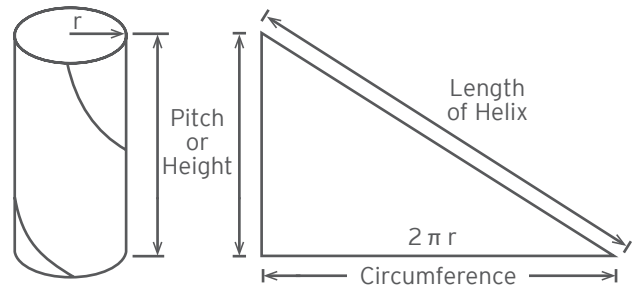


HELIX

Calculate the Length of a Helical Curve.

$$n \times \sqrt{[h^2 + (2\pi r)^2]}$$

where n = number of turns,
h = height of pitch, r = radius



FRUSTUM OF CONE

Surface area of Frustum

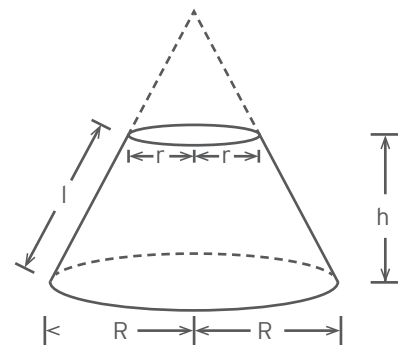
$$A = \pi l (R + r)$$

Volume

$$V = \frac{\pi h}{3} [R^2 + (R \times r) + r^2]$$

and A is area of small circle

$$V = \frac{h}{3} (A + a + \sqrt{A \times a})$$



SPHERE

Surface area of Sphere

$$A = 4\pi r^2$$

or $A = d^2 \pi$

Volume of Sphere

$$V = \frac{4\pi r^3}{3}$$

or $V = \frac{d^3 \pi}{6}$

Surface area of convex part of frustum of a sphere:

Area

$$A = \pi d \text{ (of sphere) } h$$

$$= 2\pi r \text{ (of sphere) } h$$

Surface area of whole of frustum of a sphere:

$$= 2\pi r \text{ (of sphere) } h + \text{area of top and bottom circles}$$

Volume of frustum:

$$V = \pi r^2 (k \mp h) - \frac{\pi}{3} (k^3 \mp h^3)$$

where

r = radius of the sphere

k = distance of outer face of the frustum from the centre

h = distance of inner face of the frustum from the centre

The upper (–) sign is used if both faces are on the same side of the centre and the lower (+) sign if on opposite sides of the centre.

IRREGULAR AREAS AND VOLUMES

Simpson's Rule

To find the AREA of an irregular figure, divide the base line into an even number of equal parts to produce an odd number of ordinates spaced a distance 'S' apart. The formula reduces to:

$$\text{Area} = \frac{S}{3} (A + 4B + 2C)$$

where

A	=	sum of 1 st and last ordinates
B	=	sum of even ordinates
C	=	sum of odd ordinates

Trapezoidal Rule

Divide the figure into any number of parts by parallel lines (or offsets) at equal distances apart.

Area = ½ the distance between any two adjacent offsets × (first offset + last offset + twice the sum of all the other offsets).

Prismoidal Formula

$$\text{Volume} = \frac{l}{6} (A_1 + 4A_2 + A_3)$$

where l is the length, A₁ and A₃ are the areas of the end, and A₂ is the area of the middle section.

METRIC DRAWING PRACTICE

BUILDING DRAWING PRACTICE

NZS 5902: 1976: Building Drawing Practice

- Part 1: General and Architectural
- Part 2: Structural – Concrete, Steel and Timber
- Part 3: Services – Mechanical and Sanitary
- Part 4: Services – Electrical

This standard complies with ISO and IEC documents.

SCALES

Information on drawing scales is contained in:

NZS 5931: 1972 – Architects', Engineers' and Surveyors' Scales.

This table gives the metric replacements of imperial scales and the preferred scales for use in the production of building drawings.

Imperial Scales	Representative Fraction	Metric Replacements
1/16 inch to 1 ft	1 : 192	1 : 200
1/8 inch to 1 ft	1 : 96	1 : 100
1/4 inch to 1 ft	1 : 48	1 : 50
3/8 inch to 1 ft	1 : 32	–
1/2 inch to 1 ft	1 : 24	1 : 20
3/4 inch to 1 ft	1 : 16	1 : 20
1 inch to 1 ft	1 : 12	1 : 10
1 1/2 inch to 1 ft	1 : 8	1 : 10
3 inch to 1 ft	1 : 4	1 : 5
Half full size	1 : 2	1 : 2
Full size	1 : 1	1 : 1

LOCATION DRAWINGS

Location drawings are the floor plans, elevations and sections of the building, and the metric scales used are:

1 : 50, 1 : 100, and 1 : 200

The range of location drawings includes site plans. Because of the size of the overall project, the scale of 1 : 500 is often used for the site plans.

In addition to site plans, the overall project may require block plans, which may have scales of 1 : 1250.

COMPONENT DRAWINGS

Component drawings show complete fabricating information that manufacturers need for the part of the building that will be made off-site.

Scales for showing the range of components are:

1 : 20 and 1 : 50.

For showing how the component parts are put together scales are:

1 : 1, 1 : 2, 1 : 5 and 1 : 10.

ASSEMBLY DRAWINGS

Assembly drawings show how the various parts of the building will be assembled and fixed on site, and normally have the larger scales in the range:

1 : 1, 1 : 2 and 1 : 5.

When dealing with scales and scale rules, always remember:

- All scales are in millimetres.
- Dimensions will be shown on drawings in two ways:

600 = 600 millimetres

1.600 = 1.600 metres

INTERNATIONAL PAPER SIZES, AREA/LINEAR RATIO SCALING

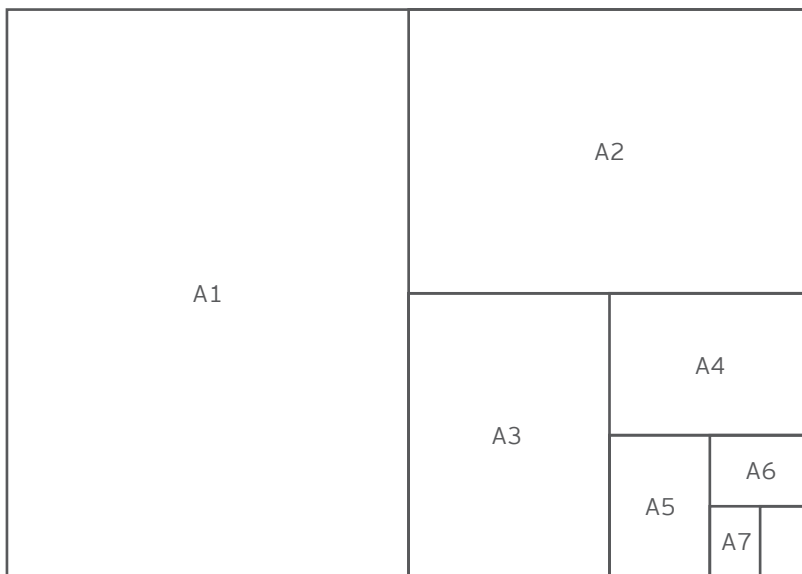
International paper sizes are based mainly on the A series with C series used primarily for envelope sizes.

The A and C series transition one step in size i.e. A4 to A3 on a $\frac{1}{2}$ or $\frac{3}{4}$ "area ratio" depending on direction of transition.

The area of A4 is $\frac{1}{2}$ the area of A3 and A3 is twice the area of A4. To achieve this "area ratio" the Long edge length of any size is 1.4142 times (square root of 2) longer than the short edge length.

When a drawing is reduced or enlarged by one step in size, the scale at which linear distances was originally drawn changes by 1.4142 or 0.7071 depending on the direction of transition. But if a drawing is reduced or enlarged by two steps in size, (i.e. A3 to A1, or A1 to A3) the scale at which it is originally drawn changes by $1.4142 \times 1.4142 = 2.0$ or $0.7071 \times 0.7071 = 0.50$ depending on the direction of transition.

An original scale of 1:100 becomes either 1:50 if enlarged two sizes or 1:200 if reduced two sizes.



A & C Series (Trimmed Sizes)			
A Series	Millimetres	C Series	Millimetres
4A	1682 × 2378	C0	917 × 1297
2A	1189 × 1682	C1	648 × 917
A0	841 × 1189	C2	458 × 648
A1	594 × 841	C3	324 × 458
A2	420 × 594	C4	229 × 324
A3	297 × 420	C5	162 × 229
A4	210 × 297	C6	114 × 162
A5	148 × 210	C7	81 × 114
A6	105 × 148	C8	57 × 81
A7	74 × 105		
A8	52 × 74		
A9	37 × 52		
A10	26 × 37		

PART TWO – TRADE MATERIALS AND LABOUR CONSTANTS

EXCAVATION

BULKING OR SWELL FACTORS FOR SOME COMMON MATERIALS

Materials	Density at the Borrow (kg/m ³)	Bulking Factor (%)
Basalt / rock	2.4 – 3.1	75 – 80
Limestone	2.7 – 2.8	75 – 80
Granite	2.6 – 2.8	75 – 80
Sandstone	2.1 – 2.4	75 – 80
Clay	1.8 – 2.6	20 – 40
Gravel, wet	2	20 – 30
Gravel, dry	1.8	20 – 30
Sand, wet	1.95	20 – 30
Sand, dry	1.6	20 – 30
Earth / topsoil	1.2 – 1.6	20 – 30

Source: http://www.engineeringtoolbox.com/soil-rock-bulking-factor-d_1557.html

WORKING SPACE ALLOWANCE

ANZSMM 2018 NZ Guidelines: Evacuation Measurement procedure

Minimum allowance for working space from wall or projecting footing face	
Depth of excavation from commencing level (m)	Working space (m)
Not exceeding 0.5	0.2
0.5 to 1.0	0.4
1.0 to 2.0	0.6
2.0 to 3.0	1
exceeding 3.0	1.3

AGGREGATES

Nominal sizes in millimetres		
225	35	10
150	25	8
100	22	7
75	20	5
65	16	3
50	14	2
40	11	1.5

Type of Aggregates

- SC Single sized chip (or sealing chip)
- GC Graded chip (between two limits)
- AP All passing (below one limit)
- BM Blended mix (e.g. Builders mix)

Quality of Aggregate

- P Premium (concrete agg., seal chips, etc.)
- NRB National Roads Board – basecourse quality
- G General (Second grade basecourse, etc.)
- SB Sub–base (low grade)

Local Quality

e.g. S Scoria

Uncrushed Shingle

SR Sized Rounds

GR Graded Rounds

Note: add % crushed if partly crushed and partly rounded.

Other letter codes may be used for particular local products, e.g. AA Asphaltic mix aggregate, RR River run material. Supply will generally be to a detailed specification. The standard sieve sizes for such specifications are the ISO R40/3 series (37 mm, 9.75 mm etc).

Further information: [The Aggregates & Quarry Assn of NZ Inc](http://www.aqa.org.nz/)
<http://www.aqa.org.nz/>

CONCRETE WORK

READY-MIXED CONCRETE – COMPRESSIVE STRENGTHS IN MPa

7.5	15	25	40
10	17.5	30	45
12.5	20	35	50

MASS OF CONCRETE WITH SAND AND GRAVEL AGGREGATE

		Approximate kg/m³
Concrete, unreinforced		2310
Reinforced concrete	in walls, floors	2370
	in beams, footings	2420
	in columns (up to 3 storey)	2450
	in columns (up to 7 storey)	2500

Aggregates

Refer to Excavation section.

PERLITE INSULATING CONCRETE

www.perlite.co.nz/perlite/concrete/

CEMENT

Ordinary and Rapid Hardening 40 kg bag.

CLASSES OF SURFACE FINISH

NZS 3114 Table 1 Classes Of Surface Finish

Finish	Description	Typical Uses
F1	Surfaces where roughness is not objectionable. No surface treatment is required other than filling tie holes and repair of defective concrete. Colour variations and certain physical irregularities permitted.	Concealed surfaces which are to be covered as in foundations, or in walls to be strapped and lined. Upstream faces of dams that will normally be under water.
F2	Surfaces which provide a key for plaster and other thick surface coverings.	All types of interior or exterior surfaces.
F3	All permanently exposed surfaces smooth or textured which are not prominent or subject to close or frequent scrutiny.	Surfaces of buildings and civil engineering structures which will not be seen, or observed only from a distance.
F4	All smooth or textured surfaces of structures where appearance and accurate alignment is of moderate importance as they will be subject to frequent observation.	Walls, panels, columns, beams, etc, in areas of secondary importance such as basements, workshops.
F5	All smooth or textured surfaces of structures where appearance and accurate alignment is important as they will be exposed to frequent close scrutiny.	Walls, panels, columns, beams, bridge fascia, piers, soffits, parapets and railings, etc, in areas of greater importance such as office areas, foyers, public areas but where the concrete does not form a feature of the space.
F6	All smooth or textured surfaces of structures where appearance or accurate alignment and evenness of surface are of the greatest importance.	Architectural or feature panels and high velocity water channels where it is essential to prevent the destructive effects of water action.

Exposed aggregate finishes F4E, F5E, F6E and U5E are also defined in NZS 3114.

NZS 3114 Table 2 Classes of floor, exterior pavement, and invert finishes

Class	Finish	Technique	Examples
U1	Screeded	Hand sawing motion with straight-edge or mechanical vibrating screed.	Finishes covered by backfill or concrete. Footpaths, yards and driveways. First stage for placement.
U2	Floated	Wood or bull float, or both. Generally manual but power driven equipment may be used.	As for U1 where a higher standard of finish is required. Floors to receive carpets with underlay or similar coverings. Inverts of syphons, flumes, floors of canal structures, spillways outlet works and stilling basins. Surfaces which are intended for use by ambulant or wheelchair-bound persons.
U3	Trowelled	Manual or mechanical steel trowelling of floated finish after the concrete is sufficiently hardened, to prevent excess fine material and water being worked to the surface, may be done in one or two stages depending on degree of smoothness required.	Direct wearing floors such as factories, warehouses and processing plants. Floors to receive thin sheet coverings, carpet and similar coverings. Inverts of water tunnels and tunnel spillways. Not generally used for pedestrian or vehicular traffic where a smooth finish could be dangerous in ice or wet conditions. Is not suitable even when dry, for surfaces which are intended for use by ambulant disabled or wheelchair-bound persons. See U2.
U4	Machine screeded	Vibrating or oscillating screed or vibrating plate, or both, which may be supplemented by long handled metal, wooden or rubber floats.	Used for durability where resistance to erosion and cavitation under action of high velocity water is especially required; and as first and second stage finishing for roads and airfield pavements prior to texturing with U5, U6 or U8 finishes.
U5	Shallow textured	Hard or soft bristled brooms.	Footpaths, yards, driveways, roads, pavements for aircraft.
U6	Deep textured	Wire broom or rubber tyning.	Surface to receive a subsequent bonded concrete topping. Roads and runways where greater frictional resistances are required than can be obtained by U5 finish.
U7	Grooved	Saw cutting or flailing by mechanical means.	Treatment to existing roads and runways to provide frictional resistance and drainage paths for run-off to minimize aquaplaning.
U8	Grooved	Mechanical grooving the fresh concrete surface.	Roads and runways after compaction and surface screeding techniques.
U9	Scabbled	Mechanical hammering of hardened concrete.	Can be used on any pavement surface to produce a textured effect or to reduce high surfaces to the correct level or to rectify out-of-tolerance pavements.
U10	Special textured	The use of equipment to give special effects.	Architectural effects on pavements and slabs, produced by rollers with drums of expanded metal, or profiled tempers on screedboards, and the like.
U11	Ground finish	Low speed coarse stone grinding to remove thin weak surface layers/minor ridges and to produce an even "glasspaper" textured surface, that is, not a polished surface. Used as a second stage finish to U2 approximately 36 to 48 h after laying.	Direct wearing floors such as factories and warehouses.

LABOUR CONSTANTS - CONCRETE WORK & FORMWORK

		Unit	Tradesman Hours	Labourer
Concrete				
Concrete , unreinforced readymix, placed in	Blinding layer 50mm thick	m ³		2.20
	Column and pier foundations	m ³		1.20
	Strip footings	m ³		1.30
Concrete , reinforced readymix, placed in	Column and pier foundations	m ³		1.50
	Strip footings	m ³		1.60
	Slabs and thickenings on fill	m ³		1.75
	Suspended slabs 150/300mm thick	m ³		2.00
	Walls 150/300mm thick	m ³		2.00
	Columns	m ³		2.90
	Attached beams	m ³		2.25
	Isolated beams	m ³		3.00
	Surface Finishes			
	Hand Trowel	m ²		0.15
	Power Float	m ²		0.18
	Broomed Finish	m ²		0.12
Joints				
Keyed construction joint in	Hand Trowel	m ²	0.15	
	Power Float	m ²	0.18	
	Broomed Finish	m ²	0.12	
Expansion joint in	150mm slab	m	0.50	
	300mm slab	m	0.60	
	150mm wall	m	0.60	
	300mm wall	m	0.70	
Waterstops				
Waterstop , double bulb, cast in, excluding angles and intersection	150mm wide	m	0.25	
	200mm wide	m	0.275	
Formwork				
Specification Notes	<ul style="list-style-type: none"> • Constants assume five uses of formwork. • Where the number of uses is less, the constants should be adjusted by percentage shown: 			
	Four uses	Add	+2.5%	
	Three uses	Add	+6.0%	
	Two uses	Add	+12.5%	
	One use	Add	+20.0%	
	Rates include fabrication, fixing in place and striking.			

		Surface Finish	Unit	Tradesman Hours	Labourer
Formwork to sides of	Column/pier foundations	F1	m ²	1.20	
	Strip footing	F1	m ²	1.20	
	Attached beam	F4	m ²	2.45	
		F1	m ²	2.20	
	Column	F4	m ²	2.90	
		F1	m ²	2.65	
	Lintels and beams	F4	m ²	3.50	
		F1	m ²	3.25	
	Wall	F4	m ²	2.60	
		F1	m ²	2.20	
	Formwork to soffit of	Suspended slab	F4	m ²	2.35
		F1	m ²	2.00	
Stairs and landings		F4	m ²	4.00	
		F1	m ²	3.50	
Formwork to edges, vertical or horizontal	0-100mm high	F4	m	0.75	
	100-200mm high	F4	m	0.75	
	200-300mm high	F4	m	1.00	
	Form groove , 25mm × 25mm		m	0.13	0.04
	Form rebate , 100mm × 50mm		m	0.20	0.07
Form hole/opening in concrete 100/200mm thick, size:	100mm × 100mm		No	0.24	0.08
	300mm × 300mm		No	0.40	0.14
	500mm × 500mm		No	0.60	0.20
Form hole/opening in concrete 200/300mm thick, size:	100mm × 100mm		No	0.30	0.10
	300mm × 300mm		No	0.50	0.17
	500mm × 500mm		No	0.65	0.22
Tube formers , cardboard, including stripping	300mm ID (internal diameter)		m	0.95	0.32
	500mm ID		m	1.15	0.38
Spirally wound plastic tube , including stripping	300mm ID		m	1.00	0.34
	500mm ID		m	1.20	0.40

REINFORCING STEEL

REINFORCING BAR MASS

Diameter (mm)	Mass (kg/m)
6	0.222
10	0.617
12	0.888
16	1.578
20	2.466
24	3.551
28	4.834
32	6.313
40	9.865

WELDED REINFORCING FABRIC

Standard Mesh Pitch

Nominal Sizes: 150 mm, 75 mm.

Standard Sheet Sizes

$4.050 \times 1.090 = 4.41 \text{ m}^2$

$4.650 \times 1.990 = 9.25 \text{ m}^2$

Mesh Type	Nominal Pitch (mm)	Main and Cross Wire Diameter (mm)	Mass (kg/m ²)
661	150	7.50	4.551
662	150	7.10	4.079
663	150	6.30	3.211
664	150	6.00	2.913
665	150	5.30	2.273
666	150	5.00	2.023
668	150	4.00	1.294
6610	150	3.15	0.803
333	75	6.30	6.422
334	75	6.00	5.825
335	75	5.30	4.545
338	75	4.00	2.589
3310	75	3.15	1.606

BENDING ALLOWANCES

Bending allowances for ends, hooks, stirrups and laps in reinforcing bars:

For ends, hooks and laps the extra length given should be added to the overall length of the bar (=L).

For stirrups the extra length given should be added to the total internal girth of the shape.

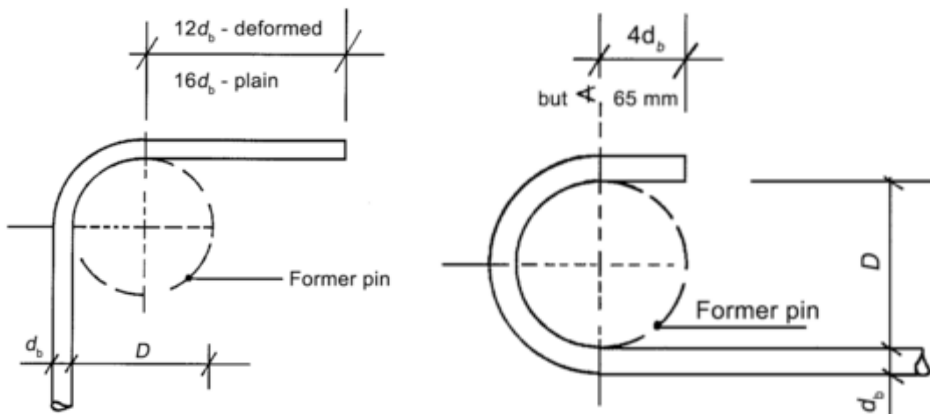
All extra lengths have been rounded to the next 10mm above.

Table Of Extra Lengths (in mm)

PLAIN GRADE 300						DEFORMED GRADE 300					DEFORMED GRADE 430			
mm	End	Hook (main bar)	Hook (link)	Stirrup	Lap	End	Hook (main bar)	Hook (link)	Stirrup	Lap	End	Hook (main bar)	Lap	mm
6	110	110	90	170	-	80	110	100	180	-	90	120	-	6
10	180	130	100	230	780	140	130	120	210	390	150	160	580	10
12	210	140	100	270	940	160	140	130	240	470	170	180	700	12
16	280	160	110	360	1240	220	160	150	320	620	230	220	930	16
20	350	200	140	450	1540	270	200	180	400	770	290	270	1160	20
24	420	240	-	-	1920	320	240	-	-	960	360	370	1390	24
28	490	280	-	-	2400	370	280	-	-	1200	410	430	1660	28
32	560	360	-	-	2940	440	360	-	-	1470	470	490	2030	32
40	700	440	-	-	**	540	440	-	-	**	590	620	**	40

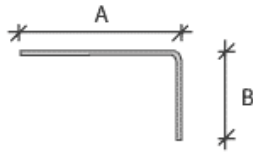
** Laps in bars 40 diameter and over not permitted unless approved by Engineer.

For full details of measurement of various bent shapes of bar reinforcement see NZS 3109.



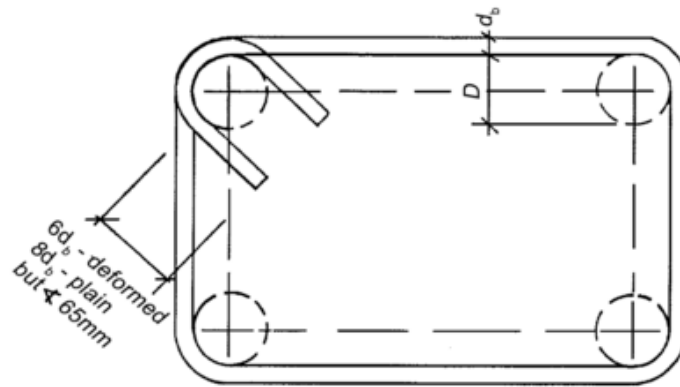
For Grade 300: Length = A + B - 2d

For Grade 430: Length = A + B - 3d



C

6mm	=	10mm
10mm	=	25mm
12mm	=	30mm
16mm	=	40mm
20mm	=	50mm
25mm	=	70mm
32mm	=	90mm

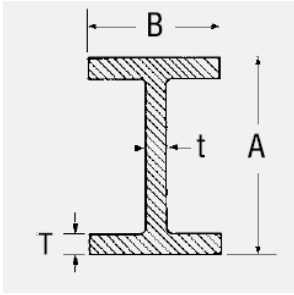


LABOUR CONSTANTS – REINFORCING STEEL

	Unit	Tradesman Hours	Labourer
Mesh Reinforcement,			
placing and fixing in			
Slabs, small areas	m ²	0.12	
Slabs, large areas	m ²	0.08	
Walls	m ²	0.12	
Bar Reinforcement, placing and fixing			
6mm–12mm stirrups	tonne	30.00	
16mm–32mm bars in slabs	tonne	18.00	
16mm–32mm bars in walls	tonne	20.00	
16mm–32mm bars in columns and beams	tonne	20.00	

STRUCTURAL STEEL

UNIVERSAL BEAMS



Specifications:

Australia AS3679–300 AS3679–350 (on indent only)

Size Designation:

Depth of Section 'A' (mm), × Mass per Metre (kg/m)

Size (mm)	Mass per Metre (kg/m)	Depth of Section A (mm)	Width of Section B (mm)	Flange Thickness T (mm)	Web Thickness t (mm)
150 × 14	14.0	150	75	7.0	5
150 × 18	18.0	155	75	9.5	6
180 × 18	18.1	175	90	8.0	5
180 × 22	22.2	179	90	10.0	6
200 × 18	18.2	198	99	7.0	4.5
200 × 22	22.3	202	133	7.0	5
200 × 25	25.4	203	133	7.8	5.8
200 × 30	29.8	207	134	9.6	6.3
250 × 26	25.7	248	124	8.0	5
250 × 31	31.4	252	146	8.6	6.1
250 × 37	37.3	256	146	10.9	6.4
310 × 32	32.0	298	149	8.0	5.5
310 × 40	40.4	304	165	10.2	6.1
310 × 46	46.2	307	166	11.8	6.7
360 × 45	44.7	352	171	9.7	6.9
360 × 51	50.7	356	172	11.5	7.3
360 × 57	56.7	359	172	13.0	8.0
410 × 54	53.7	403	178	10.9	7.6
410 × 60	59.7	406	178	12.8	7.8
460 × 67	67.1	454	190	12.7	8.5
460 × 75	74.6	457	190	14.5	9.1
460 × 82	82.1	460	191	16.0	9.9
530 × 82	82.0	528	209	13.2	9.6
530 × 92	92.4	533	209	15.6	10.2
610 × 101	101	602	228	14.8	10.6
610 × 113	113	607	228	17.3	11.2
610 × 125	125	612	229	19.6	11.9

Stock lengths vary according to the size of the column. Length range is 6, 9, 12, 15, 18 metre. Other lengths available on indent. Other sizes of sections are also available on an indent basis. For more detailed information and additional properties, please contact Fletcher Easysteel. <http://www.easysteel.co.nz/>

UNIVERSAL COLUMNS

Size mm	Weight, Length, Area		
	kg/m	m/t	m ² /m
100 UC15	14.8	67.5	0.576
150 UC23	23.4	42.7	0.889
150 UC30	30.0	33.3	0.900
150 UC37	37.2	26.9	0.924
200 UC46	46.2	21.6	1.190
200 UC52	52.2	19.2	1.212
200 UC60	59.5	16.8	1.221
250 UC73	72.9	13.7	1.480
250 UC89	89.5	11.2	1.523
310 UC97	96.8	10.3	1.790
310 UC118	118.0	8.5	1.810
310 UC137	137.0	7.3	1.830
310 UC158	158.0	6.3	1.850

H BEARING PILES

(Other sizes available)

HP1010x10	250 × 250	62.5
HP1212x12	300 × 300	110.1
HP1313x13	325 × 325	129.5
HP1414x14	350 × 375	174.1

ROLLED STEEL JOISTS

Taper Flange Beams

Size mm	Weight, Length, Area	
	kg/m	m ² /t
100 × 45 × 7	7.2	134.4
125 × 65 × 13	13.1	74.6

Taper Flange

Size mm	Weight, Length, Area	
	kg/m	m ² /t
TF75 × 40 × 5mm	6.92	144.5
TF100 × 50 × 5mm	9.35	107.0

Parallel Flange

Size mm	Weight, Length, Area	
	kg/m	m ² /t
PF75 × 40 × 6.1mm	5.92	168.9
PF100 × 50 × 6.7mm	8.33	120.3
PF125 × 65 × 7.5mm	11.90	84.0
PF150 × 75 × 9.5mm	17.70	56.5
PF180 × 75 × 11.0mm	20.90	47.9
PF200 × 75 × 12.0mm	22.90	43.7
PF230 × 75 × 12.0mm	25.10	39.8
PF250 × 90 × 15.0mm	35.50	28.0
PF300 × 90 × 16.0mm	40.10	25.0
PF380 × 100 × 17.5mm	55.20	18.1

CHANNELS

MILD STEEL ANGLES

Equal Angles

Size mm	Weight, Length, Area		
	kg/m	m/t	m ² /m
13 × 13 × 3	0.56	1785.7	
20 × 20 × 3	0.89	1123.6	
25 × 25 × 3	1.11	900.9	0.0953
25 × 25 × 5	1.77	565.0	0.0953
30 × 30 × 3	1.36	735.3	0.115
30 × 30 × 5	2.18	458.7	0.115
40 × 40 × 3	1.83	546.4	0.155
40 × 40 × 5	2.97	336.7	0.155
50 × 50 × 3	2.31	432.9	0.195
50 × 50 × 5	3.48	287.4	0.195
50 × 50 × 6	4.47	223.7	0.195
50 × 50 × 8	5.82	171.8	0.195
60 × 60 × 6	5.42	184.5	0.255
60 × 60 × 8	7.09	141.0	0.255
60 × 60 × 10	8.71	114.8	0.255
80 × 80 × 6	7.34	136.2	0.292
80 × 80 × 8	9.65	103.6	0.292
80 × 80 × 10	11.90	84.0	0.292
100 × 100 × 6	9.18	108.9	0.392
100 × 100 × 8	11.80	84.7	0.392
100 × 100 × 10	14.20	70.4	0.392
100 × 100 × 12	17.70	56.5	0.392
125 × 125 × 10	18.00	55.6	0.499
125 × 125 × 12	22.50	44.40	0.499
150 × 150 × 10	21.90	45.7	0.600
150 × 150 × 12	27.30	36.6	0.600

FLOOR PLATE SECTIONS

Size mm	Weight, Length, Area	
	kg/m ²	m ² /t
3mm thick	25.6	39.06
4mm thick	31.4	31.85
5mm thick	41.3	24.21
6mm thick	49.1	20.37
8mm thick	64.8	15.43
10mm thick	80.5	12.42
12mm thick	96.2	10.40
16mm thick	121.7	8.22
20mm thick	164.8	6.07
22mm thick	192.3	5.20
25mm thick	206.0	4.85
32mm thick	263.6	3.79
40mm thick	329.7	3.03
50mm thick	412.1	2.43
60mm thick	494.5	2.02
65mm thick	535.7	1.87
70mm thick	549.5	1.82
80mm thick	659.4	1.52
90mm thick	741.8	1.35
100mm thick	824.2	1.21
120mm thick	1027.8	0.97
150mm thick	1236.4	0.81

Unequal Angles

Size mm	Weight, Length, Area		
	kg/m	m/t	m ² /m
65 × 50 × 6	5.16	193.8	0.225
75 × 50 × 6	5.63	177.6	0.245
100 × 75 × 6	7.98	125.3	0.342
100 × 75 × 8	10.30	97.1	0.342
100 × 75 × 10	12.40	80.6	0.342
125 × 75 × 6	9.16	109.2	0.392
125 × 75 × 8	11.80	84.7	0.392
125 × 75 × 10	14.20	70.4	0.392
150 × 90 × 10	17.30	57.8	0.474
150 × 100 × 10	18.00	55.5	0.499
150 × 100 × 12	22.50	44.4	0.499

FLAT PLATE SECTIONS

Thickness	Width							
	10mm kg/m	20mm kg/m	30mm kg/m	40mm kg/m	50mm kg/m	60mm kg/m	70mm kg/m	80mm kg/m
3mm	0.236	0.471	0.707	0.94	1.18	1.41	1.65	1.88
4mm	0.314	0.628	0.942	1.26	1.57	1.88	2.20	2.51
5mm	0.393	0.790	1.180	1.57	1.96	2.36	2.75	3.14
6mm	0.471	0.940	1.410	1.88	2.36	2.83	3.30	3.77
8mm	0.628	1.260	1.880	2.51	3.14	3.77	4.40	5.02
10mm	0.785	1.570	2.360	3.14	3.93	4.71	5.50	6.28
12mm	0.942	1.880	2.830	3.77	4.71	5.66	6.59	7.54
16mm	1.260	2.510	3.770	5.02	6.28	7.54	8.79	10.05
20mm	1.570	3.140	4.710	6.28	7.86	9.42	10.99	12.56
25mm	1.960	3.930	5.890	7.85	9.82	11.78	13.74	15.70
28mm	2.200	4.400	6.590	8.79	10.99	13.19	15.39	17.58
32mm	2.510	5.020	7.540	10.05	12.56	15.07	17.58	20.10
40mm	3.140	6.280	9.420	12.56	15.70	18.84	21.98	25.12
50mm	3.930	7.860	11.780	15.70	19.63	23.55	27.48	31.40
60mm	4.710	9.420	14.130	18.84	23.55	28.26	32.97	37.68
70mm	5.500	10.990	16.490	21.98	27.48	32.97	38.47	43.96
80mm	6.280	12.560	18.840	25.12	31.40	37.68	43.96	50.24
100mm	7.850	15.700	23.550	31.40	39.25	47.10	54.95	62.80

Thickness	Width							
	90mm kg/m	100mm kg/m	200mm kg/m	300mm kg/m	400mm kg/m	500mm kg/m	1000mm kg/m	2000mm kg/m
3mm	2.12	2.36	4.71	7.07	9.42	11.78	23.55	47.10
4mm	2.83	3.14	6.28	9.42	12.56	15.70	31.40	62.80
5mm	3.53	3.93	7.85	11.78	15.70	19.63	39.25	78.50
6mm	4.24	4.71	9.42	14.14	18.84	23.55	47.10	94.20
8mm	5.65	6.28	12.56	18.84	25.12	31.40	62.80	125.60
10mm	7.07	7.86	15.71	23.57	31.40	39.25	78.50	157.00
12mm	8.48	9.43	18.85	28.28	37.68	47.10	94.20	188.40
16mm	11.30	12.57	25.14	37.68	50.24	62.80	125.60	251.20
20mm	14.13	15.71	31.42	47.10	62.80	78.50	157.00	314.00
25mm	17.66	19.64	39.28	58.88	78.50	98.13	196.25	392.50
28mm	19.78	21.98	43.96	65.94	87.92	109.90	219.80	439.60
32mm	22.61	25.12	50.24	75.36	100.48	125.60	251.20	502.40
40mm	28.26	31.40	62.80	94.20	125.60	157.00	314.00	628.00
50mm	35.33	39.28	78.50	117.75	157.00	196.25	392.50	785.00
60mm	42.39	47.10	94.20	141.30	188.40	235.50	471.00	942.00
70mm	49.46	54.95	109.90	164.85	219.80	274.75	549.50	1099.00
80mm	56.52	62.80	125.60	188.40	251.20	314.00	628.00	1256.00
100mm	70.65	78.50	157.00	235.50	314.00	392.50	785.00	1570.00

Note: for mass of chequer plate add 2.1 kg/m² to mass for 1000mm width.

SQUARE/RECTANGULAR HOLLOW SECTIONS

Specifications:

- NZ & Australia AS1163–2009 Grade min C350L0
- USA & Japan ASTM–A500 Grade A/B/C
- Mill Finish: Available uncoated or painted

Square Hollow Sections				Rectangular Hollow Sections			
Size	Mass (kg/m)	Size	Mass (kg/m)	Size	Mass (kg/m)	Size	Mass (kg/m)
20 × 20 × 1.6	0.87	100 × 100 × 4.0	11.60	50 × 25 × 1.6	1.75	150 × 75 × 9.0	27.60
25 × 25 × 1.6	1.12	100 × 100 × 5.0	14.20	50 × 25 × 2.0	2.15	150 × 100 × 4.0	14.80
25 × 25 × 2.0	1.36	100 × 100 × 6.0	16.70	50 × 25 × 2.5	2.62	150 × 100 × 5.0	18.20
25 × 25 × 2.5	1.64	100 × 100 × 8.0	21.40	50 × 25 × 3.0	3.07	150 × 100 × 6.0	21.40
25 × 25 × 3.0	1.89	100 × 100 × 9.0	23.50	65 × 35 × 2.0	2.93	150 × 100 × 8.0	27.70
30 × 30 × 1.6	1.38	100 × 100 × 10.0	25.60	65 × 35 × 2.5	3.60	150 × 100 × 9.0	30.60
30 × 30 × 2.0	1.68	125 × 125 × 4.0	14.80	65 × 35 × 3.0	4.25	150 × 100 × 10.0	33.40
30 × 30 × 2.5	2.03	125 × 125 × 5.0	18.20	65 × 35 × 4.0	5.35	152 × 76 × 5.0	16.40
30 × 30 × 3.0	2.36	125 × 125 × 6.0	21.40	75 × 25 × 1.6	2.38	152 × 76 × 6.0	19.40
35 × 35 × 1.6	1.63	125 × 125 × 8.0	27.70	75 × 25 × 2.0	2.93	200 × 100 × 4.0	17.90
35 × 35 × 2.0	1.99	125 × 125 × 9.0	30.60	75 × 25 × 2.5	3.60	200 × 100 × 5.0	22.10
35 × 35 × 2.5	2.42	125 × 125 × 10.0	33.40	75 × 50 × 2.0	3.72	200 × 100 × 6.0	26.20
35 × 35 × 3.0	2.83	150 × 150 × 5.0	22.10	75 × 50 × 2.5	4.58	200 × 100 × 8.0	33.90
35 × 35 × 4.0	3.46	150 × 150 × 6.0	26.20	75 × 50 × 3.0	5.42	200 × 100 × 9.0	37.70
40 × 40 × 1.6	1.88	150 × 150 × 8.0	33.90	75 × 50 × 4.0	6.92	200 × 100 × 10.0	41.30
40 × 40 × 2.0	2.31	150 × 150 × 9.0	37.70	75 × 50 × 5.0	8.35	250 × 150 × 5.0	29.90
40 × 40 × 2.5	2.82	150 × 150 × 10.0	41.30	75 × 50 × 6.0	9.67	250 × 150 × 6.0	35.60
40 × 40 × 3.0	3.30	200 × 200 × 5.0	29.90	76 × 38 × 2.5	4.15	250 × 150 × 8.0	46.50
40 × 40 × 4.0	4.09	200 × 200 × 6.0	35.60	76 × 38 × 3.0	4.90	250 × 150 × 9.0	51.80
50 × 50 × 1.6	2.38	200 × 200 × 8.0	46.50	76 × 38 × 4.0	6.23	250 × 150 × 10.0	57.00
50 × 50 × 2.0	2.93	200 × 200 × 9.0	51.80	100 × 50 × 2.0	4.50	250 × 150 × 12.5	69.40
50 × 50 × 2.5	3.60	200 × 200 × 10.0	57.00	100 × 50 × 2.5	5.56	250 × 150 × 16.0	85.50
50 × 50 × 3.0	4.25	200 × 200 × 12.5	69.40	100 × 50 × 3.0	6.60	300 × 200 × 6.0	45.00
50 × 50 × 4.0	5.35	200 × 200 × 16.0	85.50	100 × 50 × 3.5	7.53	300 × 200 × 8.0	59.10
50 × 50 × 5.0	6.39	250 × 250 × 6.0	45.00	100 × 50 × 4.0	8.49	300 × 200 × 10.0	72.70
50 × 50 × 6.0	7.32	250 × 250 × 8.0	59.10	100 × 50 × 5.0	10.30	300 × 200 × 12.5	89.00
65 × 65 × 2.0	3.88	250 × 250 × 9.0	65.90	100 × 50 × 6.0	12.00	300 × 200 × 16.0	111.00
65 × 65 × 2.5	4.78	250 × 250 × 10.0	72.70	102 × 76 × 3.5	9.07	350 × 250 × 6.0	54.40
65 × 65 × 3.0	5.66	250 × 250 × 12.5	89.00	102 × 76 × 5.0	12.50	350 × 250 × 8.0	71.60
65 × 65 × 4.0	7.23	250 × 250 × 16.0	111.00	102 × 76 × 6.0	14.70	350 × 250 × 10.0	88.40
65 × 65 × 5.0	8.75	300 × 300 × 8.0	71.60	125 × 75 × 3.0	8.96	350 × 250 × 12.5	109.00
65 × 65 × 6.0	10.10	300 × 300 × 10.0	88.40	125 × 75 × 4.0	11.60	350 × 250 × 16.0	136.00
75 × 75 × 2.5	5.56	300 × 300 × 12.5	109.00	125 × 75 × 5.0	14.20	400 × 200 × 8.0	71.60
75 × 75 × 3.0	6.60	300 × 300 × 16.0	136.00	125 × 75 × 6.0	16.70	400 × 200 × 10.0	88.40
75 × 75 × 3.5	7.53	350 × 350 × 8.0	84.20	127 × 51 × 3.5	9.07	400 × 200 × 12.5	109.00
75 × 75 × 4.0	8.49	350 × 350 × 10.0	104.00	127 × 51 × 5.0	12.50	400 × 200 × 16.0	136.00
75 × 75 × 5.0	10.30	350 × 350 × 12.5	128.00	127 × 51 × 6.0	14.70	400 × 300 × 8.0	84.20
75 × 75 × 6.0	12.00	350 × 350 × 16.0	161.00	150 × 50 × 3.0	8.96	400 × 300 × 10.0	104.00
89 × 89 × 3.5	9.07	400 × 400 × 10.0	120.00	150 × 50 × 4.0	11.60	400 × 300 × 12.5	128.00
89 × 89 × 5.0	12.50	400 × 400 × 12.5	148.00	150 × 50 × 5.0	14.20	400 × 300 × 16.0	161.00
89 × 89 × 6.0	14.70	400 × 400 × 16.0	186.00				
100 × 100 × 3.0	8.96						

MILD STEEL SQUARES & ROUNDS

Mild Steel Squares

Size	Mass per Metre (kg/m)
10 × 10	0.79
12 × 12	1.13
16 × 16	2.01
20 × 20	3.14
25 × 25	4.91
32 × 32	8.04
40 × 40	12.57
45 × 45	15.91
65 × 65	33.19
75 × 75	44.18

Mild Steel Rounds

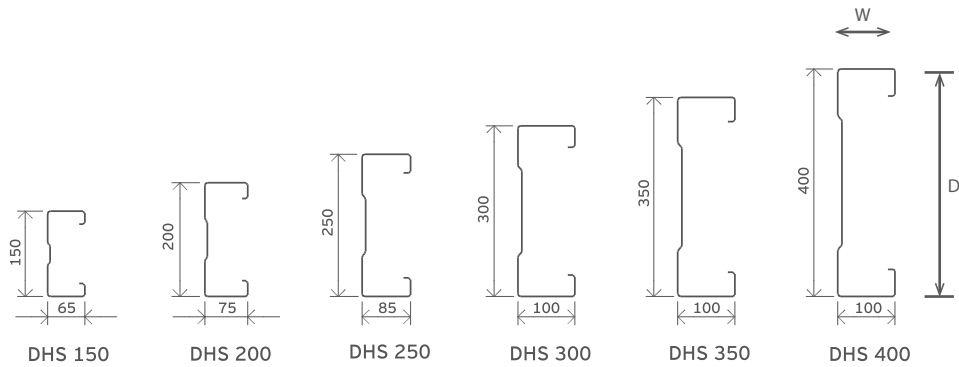
Size	Mass per Metre (kg/m)
6	0.222
8	0.395
10	0.617
12	0.888
16	1.578
20	2.466
24	3.551
25	3.853
28	4.834
33	6.714
36	7.990
39	9.380
45	12.480
50	15.410
56	19.330
60	22.190
65	26.050
70	30.210
75	34.680
80	39.460
90	49.940
100	61.650
110	74.600
120	88.780
130	104.200
140	120.800
150	138.700
160	157.800
200	246.600

CIRCULAR HOLLOW SECTIONS

Size mm	Mass kg/m
26.9 × 2.6	1.56
26.9 × 3.2	1.87
33.7 × 3.2	2.41
33.7 × 4.0	2.93
42.4 × 3.2	3.09
42.4 × 4.0	3.79
48.3 × 3.2	3.56
48.3 × 4.0	4.37
60.3 × 3.6	5.03
60.3 × 4.5	6.19
76.1 × 3.6	6.44
76.1 × 4.5	7.95
88.9 × 4.0	8.38
88.9 × 5.0	10.30
114.3 × 4.5	12.20
114.3 × 5.4	14.50
139.7 × 5.0	16.60
139.7 × 5.4	17.90
165.1 × 5.0	19.70
165.1 × 5.4	21.30

DHS PURLINS

DHS Purlins - Nominal Dimensions



DHS Section Properties

DHS Section	Depth D	Width W	Thickness t	Mass
	(mm)	(mm)	(mm)	kg/m
DHS 150/12	150	65	1.15	2.99
DHS 150/15	150	65	1.45	3.74
DHS 200/12	200	75	1.15	3.71
DHS 200/15	200	75	1.45	4.65
DHS 200/18	200	75	1.75	5.59
DHS 250/13	250	85	1.25	4.87
DHS 250/15	250	85	1.45	5.63
DHS 250/18	250	85	1.75	6.76
DHS 300/15	300	100	1.45	6.66
DHS 300/18	300	100	1.75	8.01
DHS 350/18	350	100	1.75	8.83
DHS 400/20	400	100	1.95	10.74

PASSIVE FIRE PROTECTION OF STEELWORK

There are many insulating products on the market that will provide passive protection to steel for a given FRR requirement ranging from ½ to 4 hours (except for intumescent paint).

When choosing a product consider:

- final appearance (decorative, exposed or concealed)
- impact protection
- resistance to humidity or water during application
- need to clean and prime steel for intumescent paint
- impact on the rest of the project
- final installed cost.

An appropriate installed cost comparison between the various groups of products is expressed below as a percentage of the cost of concrete encasement. The comparison applies to structures over 5 storeys high.

	%
Concrete encasement (placed insitu on erected steelwork)	100
Concrete encasement (precast prior to erection)	50
Sprayed systems	10–25
Intumescent paint ½ hour	50
Intumescent paint 1 hour	65–100
Plaster encasement	70
Boarded systems	50
Preformed systems	65
Flexible blankets	75

Hp/A Concept

The heating rate of a steel section in a fire depends upon:

Hp = the perimeter of steel exposed to flames

A = the cross-sectional area of the section

High Hp and Low A give Fast Heating

Low Hp and High A give Slow Heating

The rectangular 'box protection' provided by boards gives a lower Hp than the 'profile protection' of products applied directly to the surface of a steel UB.

The required thickness of fire protection is obtained from the manufacturer's published data which relates the thickness to both the fire resistance period and the Hp/A value of the steel section size.

Sprayed Systems

Mandolite, Cafco etc, thickness range 8 - 80mm or more, usually applied direct to profile of clean steel section. The need for reinforcement, multiple coats for 3-4 hr FRR can make sprayed systems dearer than boards.

Intumescent Paint

Applied to primed steelwork as a thin coating comprising a basecoat and topseal (in neutral or decorative colours), the basecoat expands in a fire at temperatures above 200°C. The basecoat loading rate (g/m²) must be obtained from manufacturer's data. If the steel section is not favourable, intumescent paints can be very expensive at 1 hr FRR. High film build thickness limits use of intumescent paints at 1½ hr FRR.

Board	Thickness (mm)	Board Size (mm)
Vermiculux	20, 25, 30	1220 × 1204
Supalux	6, 9, 12	2400 × 1200
Promatect – H	10, 12, 15, 20, 25	1250 × 2500 or 3000
Promatect – L	20, 25	1200 × 2500 or 3000
Vicuclad	16, 18, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75	1000 × 610

OTHER COMMON FIRE PROTECTIVE PRODUCTS

Door and Smoke Seals

Intumescent seals placed on door edges will expand with heat to increase the effectiveness of the fire doors; also available with smoke seals.

Pipe Collars

PVC pipes penetrating fire resisting walls or floors are crushed by the fire collar in the event of a fire.

Fire Pillows

Openings through floors and walls for services ducts can be sealed around the pipes, cables, etc. with fire resistant pillows.

Floor Penetration Panels

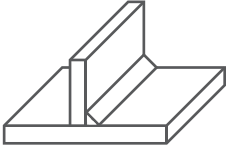
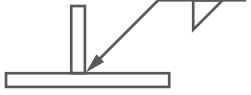
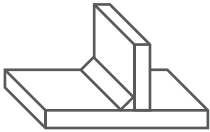
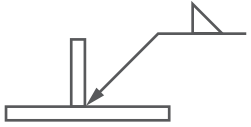
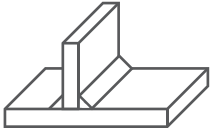
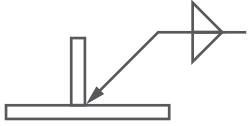

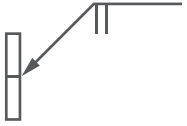

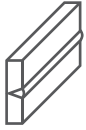
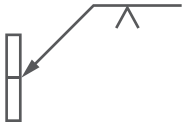
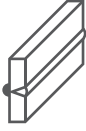
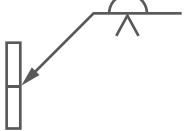
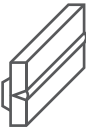
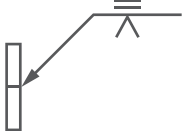

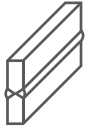


Flush or surface mounted panels in a steel frame and with fire sealant to edges and penetrations.

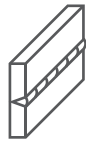
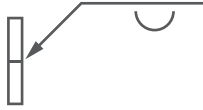

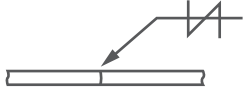
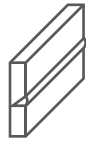
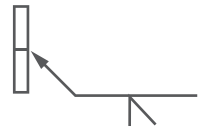
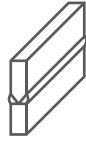
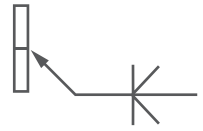

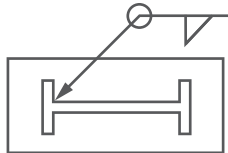
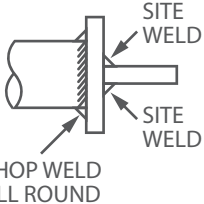
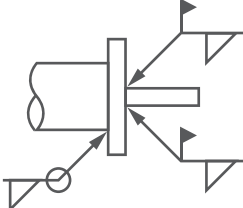
Fire Rated Sealant

To seal joints in tilt-up panels, control joints, perimeter of frames and around metal pipes.

WELDING SYMBOLS

NZS 5902











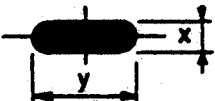
Form of weld	Notes	Sketch of weld	Symbolic representation
Fillet	When the symbol is below the reference line, it refers to a weld on the "arrow side" of the joint.		
Fillet	When the symbol is above the reference line, it refers to a weld on the "other side" of the joint.		
Double fillet	When the symbol is both sides of the reference line, it refers to welds on "both sides" of the joint.		
Square butt	When this type of weld is used, covering notes will be given.		
Single V butt			
Single V butt with sealing run			
Single V butt with backing strip			
Double V butt			
Full strength butt weld	This symbol may be used when a particular type of butt weld is not critical.		

Form of weld	Notes	Sketch of weld	Symbolic representation
Seal (or bead)	Weld used to make a fluid tight joint. Symbol also used to denote a backing run on the root side of a butt weld.		
Flash butt	For reinforcing bar.		
Single level butt	Where only one plate is prepared, the arrow should point towards that plate.		
Double bevel butt			
Weld all round	A circle at the joint in the reference line indicates a continuous weld all around the joint.		
Shop and site weld	Site weld indicated by a filled flag.		

Form of weld	Notes	Sketch of weld	Symbolic representation
Flush finish	Line above or below symbol indicated a flush finish. If one side only required flush, flush finish line will be on "arrow side" or "other side". For approximate flush finish omit "G".		
Size and length of fillet welds	Size of welds (mm) before symbol, length of weld (mm) after symbol.		
Filletts with unequal leg length	Vertical leg length (mm) given first, horizontal leg length (mm) follows.		
Intermittent welds: lengths and spacings	Welded length given by unbracketed number (mm), space between weld (mm) given by bracketed number, e.g. 50(75).		
Stud	Refers to weld on "arrow side" of joint.		
Stud	Refers to weld on "other side" of joint.		

SYMBOLS FOR BOLT AND HOLES

Note: To be used on large-scale details only.

		Countersunk Near Side	Countersunk Far Side
HOLES	PLAN		
	SECTION		
BOLTS	PLAN		
	SECTION		
SHOP HSFG BOLTS	PLAN		
SITE HSFG BOLTS	PLAN		
SLOTTED HOLES	PLAN		Always state x & y dimensions, e.g. 18 × 38 slotted hole. $y = 2x+2$

LABOUR CONSTANTS - STRUCTURAL STEELWORK

Excludes on-site costs of craneage, cartage, etc.

Framing and Bracing

These labour constants refer to traditional estimating methods

		Unit	Tradesman Hours	Labourer Hours
Heavy sections , including connections—UB, UC, RSJ and RSC	Fabrication	tonne	23.00	
	Erection	tonne	7.00	
Light sections —angles etc.	Fabrication	tonne	40.00	
	Erection	tonne	20.00	
Hollow sections , including connections	Large sections, fabrication	tonne	30.00	
	Large sections, erection	tonne	10.00	
	Small sections, fabrication	tonne	35.00	
	Small sections, erection	tonne	15.00	
Trusses , including connections	Up to 10m span, fabrication	tonne	50.00	
	Up to 10m span, erection	tonne	10.00	
	Over 10m span, fabrication	tonne	35.00	
	Over 10m span, erection	tonne	6.00	
Proprietary purlins and girts	Up to 150mm high	m	0.09	
	Over 150mm high	m	0.12	
Surface Treatment				
Sand blast and paint	Light sections	tonne	8.00	
	Heavy sections	tonne	5.00	

WORKSHOP FABRICATION

Explanation of Fabrication Labour

- The following labour constants use modern estimating methods, whereby it is the work content in detailing, fabricating, and erecting individual pieces of steel that determine costs, and not weight.
- Fabrication labour is determined by the quantity of labour tasks in each steel assembly, for example, each column, beam, brace, assembly, or bracket. Much of the labour is contained in the connections and other “labours” such as assemblies, transitions, precambering, stiffener plates, and penetrations.
- These “labours” are similar to those given in ANZSMM 2018 (and the NZ Guidelines for AMZSMM) as well as in NZS4202, which also explain fabrication work content.
- The SCNZ Estimating Guide and SteelEst programme uses the labour in connections and other work in a similar way to the labour tasks below.
- Structural steel fabricators often use hours per tonne as an estimating shortcut. This can be reasonably accurate, but only when used across a complete project so that the variances in fabricating different pieces is averaged in the overall estimate.
- The fabrication of different steelwork pieces often varies from 5 to over 200 hours per tonne, despite overall weighted averages of 15 to 30 hours per tonne for an entire project. This makes pricing of light weight secondary steel items, often encountered in variations, difficult without quantifying the labours.
- See below for further information on individual and workshop productivity factors.

Plates, brackets, and fly braces		Average	Range (Min–Max)
Prepare plate connections , cleats and stiffeners, rectangular shape ex flat bar, not exceeding 300mm wide or 16mm thickness ; guillotine to size and punch holes, using hydraulic ram punch and shear machine.	piece	4.5 min	3 - 6 min
Same as last but irregular shape ex plate. Or exceeding 300mm wide or 16mm thickness; cut to size and form holes – punch and shear, flame cut, or drill equipment	piece	9 min	6 - 30 min
Prepare angle brackets or fly braces not exceeding 1.5m long; guillotine to length and punch holes–using punch and shear.	piece	9 min	6 - 12 min
Slotted holes in maximum 20mm plate or angle–punched and flame slotted	slot	7.5 min	6 - 10 min
Mark and tack plate connections, cleats and stiffeners in position on beams, columns etc, square and not exceeding 400mm length	No	6.5 min	5.5 - 7.5 min
Same as last but bracing cleats, plates 400mm to 1000mm length, or hip rafter plates etc.	No	12 min	8 - 15 min
Cutting sections		Average	Range (Min–Max)
Cut secondary sections. up to 150mm–angles, PFCs. HS	piece	15 min	12 - 20 min
Extra Value for each end mitre cut, or notch cut	end	6 min	
Extra Value straight join including prepare and vee butt weld	join	1 hr	
Cut sections to length, up to 310 UB/UC/PFC/HS	piece	28 min	26 - 30 min
Extra Value for each end mitre cut, or notch cut	end	12 min	
Extra Value cut and form taper end, approx 300mm long	end	45 min	
Extra Value straight join including prepare and vee butt weld	join	2.5 hr	1.5 - 3 hr
Cut sections, over 310 UB/UC/PFC/RHS	piece	40 min	35 - 55 min
Extra Value for each end mitre cut, or notch cut	end	15 min	
Extra Value cut and form taper end. approx 500mm long	end	72 min	60 - 80 min
Extra Value straight join including prepare and vee butt weld	join	4.5 hr	3.5 - 5.5 hr

Labours to all sections		Average	Range (Min-Max)
Drill bolt holes in structural sections Form slotted bolt holes in structural sections	hole slot	6.5 min 15 min	4.5-7.5 min
Gas cut and grind edges for cut outs, penetrations. straight	metre	20 min	
Same as last, circular	metre	30 min	
Assemble and tack portal frame knee, apex, or k-brace join	join	1.25 hr	1-1.5 hr
Assemble secondary section frame joins	join	30 min	20-45 min
Precambering; up to 310 UB or UC	No	2.5 hr	1-3 hr
Precambering; over 310 UB or UC	No	3.5 hr	3-6 hr
Cut, prepare and assemble corbels, tapers, haunchings etc. max. 1m long	No	1 hr	0.75-2 hr
Assemble composite members, e.g. crane beam channel onto UB	metre	30 min	
Truss cutting and assembly			
Cut truss diagonals and struts	piece	12 min	10-15 min
Extra Value mitre cut or notch ends	end	7.5 min	6-9 min
Cut, prepare, join and weld chord, maximum 250 PFC or UB x 12m long	chord	1.5 hr	1.25-2 hr
Mark out and set up jig for truss assembly x 12m long	No	4 hr	3-6 hr
Assemble truss top and bottom chords with diagonals and struts x 12m long, in jig	truss	4 hr	3-6 hr
Extra Value to precamber truss, x 12m long	No	2 hr	1-3 hr
Diagonal bracing			
Diagonal bracing rod cut, join, assemble turnbuckles, threaded ends	No	40 min	20-60 min
Diagonal bracing angle cut, join, drill bolted ends	No	50 min	30-75 min
Welding-80% downhand, 20% vertical			
5 and 6mm fillet weld	m	18 min	15-22 min
8mm fillet weld-2 runs	m	32 min	
10mm fillet weld-3 runs	m	46 min	
12mm fillet weld-4-5 runs	m	72 min	
Vee prepare end of UB, UC, PFC, HS for butt weld, < 300mm depth	end	8 min	
Same as last, over 300mm depth	end	12 min	
Vee butt weld up to 12mm	m	90 min	
Vee butt weld over 12mm, up to 16mm	m	150 min	
Extra Value for backing strip to joins in SHS	join	7.5 min	
Extra Value for backing strip to joins in CHS	join	30 min	
Hit and miss stitch 6mm fillet weld	m	10 min	
Miscellaneous			
H.D. bolt assembly into pairs	pairs	6 min	
Unload and stack inwards steel and load out fabricated steel onto trucks	tonne	1.5 hr	1.25-2 hr

Productivity factors - against the constants above	Average
General: Market, complexity or regional	0.85 - 1.33
Site fabrication and welding	2.00 - 4.00

Notes

- The average constants are for high repetition portal frame and high rise type work. The ranges are for differences in piece size, detail, repetition, and fabrication methods.
- These constants are based on conventional fabrication methods used by most fabricators, i.e. manual gas cutting and magnetic broach drilling, and semi-automatic "mig" or "flux core" welding.
- With semi-automated saw and drill lines output is much higher but machine costs are higher, and generally the market does not differentiate costs because semi-automation affects only part of overall fabrication.
- The constants include for reading fabrication drawings, stacking and sorting materials, marking out, turning, grinding edges and welds, operator setting up, servicing gear such as welders and grinders, and QA including average rework.
- These constants are "whole of job", and hence will differ from spot check times which will not be representative of a complete job due to the tendency not to include downtime and variances in productivity.
- Repetition affects productivity in different ways, and for some labour operations can have a significant impact on output while other labours produce only slight improvements. A high degree of difficulty can also have a large impact on output, for example, very detailed drawings, angled assembly, low repetition of detail, complex set out
- Welding output varies according to the length of welds and the amount of shifts to different pieces being welded, and handling. Repetition alone has little impact on welding output, unless it is practical to use a different welding method. Structural steel usually involves small runs, with greater attention to weld ends around plate edges, and corners. Thus, where long runs of continuous welding are involved output is generally higher, particularly if a different welding method can be used.

BRICKWORK

CLAY BRICKS

Monier	Length × Height × Width	No./m ²	Mass/1000
90 series (Standard Metric)	230 × 76 × 90 mm	48	2350–2600 kg
70 Series	230 × 76 × 70 mm	48	1750–2200 kg

Notes:

1. 10 mm should be added for mortar joint thickness.
2. Clay bricks are manufactured in a wide variety of different styles, textures and colours.
3. Special shape bricks (cants, bullnose, squints, skews etc.) may be requested from Monier.
4. Mass varies depending on type of product.

CONCRETE BRICKS

Firth

Settler	230 × 76 × 90	48	4000
Pioneer	230 × 76 × 90	48	4000

Winstone

Balmoral (Plain, rumbled, or rough hewn)	210 × 70 × 100	57	3250
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MORTAR REQUIRED FOR BRICKWORK

Half-brick wall	(100 nominal)	0.02 m ³ /m ²
One-brick wall	(230 nominal)	0.05 m ³ /m ²

LABOUR CONSTANTS – BRICKWORK

	Unit	Tradesman Hours	Labourer Hours
Brickwork			
Brickwork, stretcher bond			
Veneer walls, standard	1000 bks	16.00	8.00
Facing, pointing and cleaning down	m ²	0.20	0.06

BLOCKWORK (CONCRETE MASONRY)

FILLING OF "VIBRAPAC" CONCRETE MASONRY

a) To fill 10 lineal metres of vertical core

Style of Block	VOLUME OF CONCRETE (in m ³)		
	10 Series	15 Series	20 Series
.01 Standard (with 2 cores)	0.05	0.10	0.16
.02 Half	0.04	0.09	0.13
.03 Corner, large core		0.16	0.19
.03 Corner, small core			0.17
.05 Open end reinforcing, open end	0.05	0.11	0.22
.05 Open end reinforcing, core	0.05	0.12	0.19
.19 Threequarters		0.22	0.32
.30 Pier Unit	0.15	0.16	0.46
.36 Column Series (pair of blocks)			0.88

b) To fill 10 lineal metres of lintel or bondbeam

Style of Block	10 Series	15 Series	20 Series	25 Series	30 Series
.11 or .12 Lintel	0.07	0.12	0.15	0.20	
.13 Deep Lintel		0.23	0.35		
.14 Bondbeam	0.06				
.14 Knock in Bondbeam,					
2 K.O. in Place		0.11	0.17	0.23	0.30
1 K.O. in Place		0.12	0.18	0.26	0.34
K.O.'s removed		0.13	0.20	0.29	0.38

c) To solid fill 10 m² of blockwork

Style of Block	10 Series	15 Series	20 Series	25 Series	30 Series
(No allowance has been made for bondbeams which should be considered separately)	0.25	0.60	1.00	1.25	
Percentage by which filling a bondbeam exceeds filling of a typical course	20%	8%	0%	16%	

Note: Volumes shown are net and no deductions have been made for reinforcement bars. If pumped grout is to be used, a slightly larger volume should be allowed as liquid grout will fill more interstices and re-entrant spaces within a wall than standard concrete.

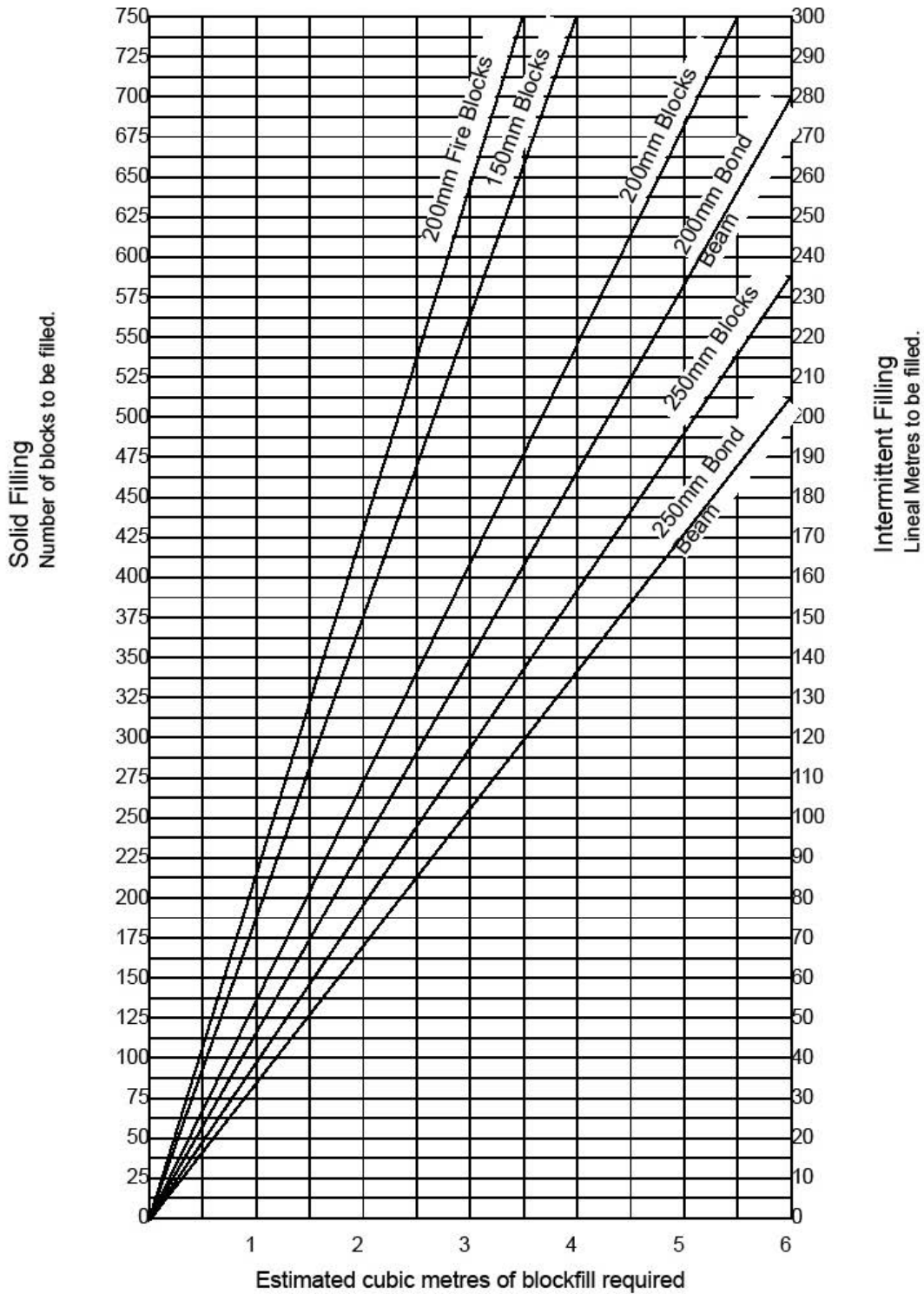
GENERAL ESTIMATING DATA

When estimating quantities allow 12.5 (200 mm high) blocks per m².

LABOUR CONSTANTS - BLOCKWORK (CONCRETE MASONRY)

	Unit	Tradesman Hours	Labourer Hours
Blockwork in walls, of hollow blocks			
400mm × 200mm × 100mm	m ²	0.43	0.22
400mm × 200mm × 150mm	m ²	0.50	0.25
400mm × 200mm × 200mm	m ²	0.56	0.28
400mm × 200mm × 200mm hollow block threaded over bar reinforcement	m ²	0.96	0.28
Pointing and cleaning down	m ²	0.10	0.10
Labours and Filling			
Fair raking cutting			
100mm hollow block	m	0.18	0.18
200mm hollow block	m	0.28	0.28
Concrete filling to cores of hollow blocks			
150mm hollow block	m ²	0.45	
200mm hollow block	m ²	0.55	
Lintel block , including filling			
200mm wide × 200mm high × 200mm long	m	0.40	0.14
200mm wide × 400mm high × 200mm long	m	0.54	0.18

BLOCKFILL VOLUME



METALWORK

GAUGE CONVERSION

Aluminium, Copper, Stainless Steel

Gauge	mm	Gauge	mm
34	0.2	18	1.2
32	0.25	17	1.4
30	0.3	16	1.6
28	0.4	15	1.8
26	0.45	14	2.0
25	0.5	12	2.5
24	0.6	10	3.0
22	0.7	8	4.0
20	0.9	6	5.0
19	1.0		

Brass, Phosphor Bronze

Gauge	mm	Gauge	mm
34	0.2	18	1.2
32	0.25	17	1.4
30	0.3	16	1.6
28	0.4	15	1.8
26	0.5	14	2.0
24	0.6	12	2.5
22	0.7	10	3.0
20	1.0	8	4.0
		6	5.0

Note: Thickness of sheet, strip and tube shall be expressed in mm and reference to gauges shall be avoided.

ALUMINIUM ALLOY DESIGNATIONS

Mass (kg/m²) = thickness (mm) × relative density

Alloy	Relative Density	Uses
1050	2.700	Mirror finish sheet
1200	2.697	Sheet
3003	2.730	Coil
5005	2.697	Sheet, plate
5083	2.656	Sheet, plate
5251	2.683	Sheet, plate
5454	2.683	Sheet, plate
6063	2.700	Bar, tube, flat, angle, etc
6261	2.700	Bar, tube, flat, angle, etc
6351	2.700	Bar, tube, flat, angle, etc

Standard Thicknesses

Sheet: 0.45, 0.55, 0.7, 0.9, 1.2, 1.6, 2, 2.5, 3

Plate: 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50, 80, 100

Flat: 3, 4.5, 6, 9, 10, 12, 25

For treadplate pattern add 0.7 kg/m²

TEMPERS

Extrusions and Sheet

F	As fabricated
O	Annealed

Rolled Product

H12	Strain hardened – ¼ hard
H14	As for H12 but to a greater degree – ½ hard
H24	Strain hardened then partially annealed

Extrusions

T4	Solution heat treated then naturally aged
T5	Cooled from elevated temperature then artificially aged
T6	Solution heat treated then artificially aged
T8	Solution heat treated, cold worked and then artificially aged (usually drawn tube)

ALUMINIUM

Equal Angles	kg/m
12 × 12 × 1.5	0.091
12 × 12 × 3	0.170
15 × 15 × 1.6	0.123
20 × 20 × 1.6	0.165
20 × 20 × 3	0.297
25 × 25 × 1.5	0.196
25 × 25 × 3	0.381
25 × 25 × 4.5	0.555
30 × 30 × 3	0.463
32 × 32 × 3	0.494
40 × 40 × 1.6	0.338
40 × 40 × 3	0.624
40 × 40 × 4.5	0.915
40 × 40 × 6	1.199
50 × 50 × 1.5	0.399
50 × 50 × 3	0.786
50 × 50 × 6	1.523
75 × 75 × 6	2.330
100 × 100 × 6	3.140
100 × 100 × 10	5.180

Channels (base × leg × thickness)	kg/m
9.5 × 9.5 × 1.6	0.102
12.7 × 12.7 × 2.54	0.226
17.5 × 12 × 3	0.288
20 × 20 × 3	0.437
22 × 22 × 3	0.486
25 × 20 × 2.5	0.405
25 × 25 × 3	0.559
30 × 25 × 3	0.640
32 × 25 × 3	0.618
40 × 20 × 3	0.599
45 × 25 × 3	0.718
50 × 25 × 1.6	0.468
50 × 25 × 3	0.761
50 × 35 × 3	0.926
75 × 40 × 4.5	1.840
75 × 40 × 6	2.750
100 × 25 × 3	1.160
100 × 50 × 3	1.577
100 × 50 × 5	2.560
100 × 50 × 6	3.046
150 × 75 × 6	5.940

Unequal Angles	kg/m
20 × 12 × 1.5	0.124
20 × 12 × 3	0.235
25 × 12 × 1.6	0.154
25 × 19 × 2.5	0.281
32 × 19 × 3	0.388
32 × 25 × 3	0.437
40 × 20 × 1.6	0.252
38 × 25 × 3	0.486
50 × 25 × 3	0.583
75 × 25 × 3	0.788
75 × 50 × 4.5	1.470
75 × 50 × 6	1.930
100 × 50 × 2	0.802
150 × 75 × 6	3.550

SHS	kg/m
19 × 19 × 1.5	0.283
20 × 20 × 3	0.551
25 × 25 × 1.8	0.443
25 × 25 × 3	0.713
25 × 25 × 5	1.070
40 × 40 × 2	0.797
40 × 40 × 3	1.199
40 × 40 × 5	1.870
50 × 50 × 3	1.523
75 × 75 × 3	2.341
75 × 75 × 4.5	3.420
100 × 100 × 3	3.140

RHS	kg/m
50 × 25 × 2	0.767
50 × 40 × 3	1.361
65 × 50 × 3	1.790
75 × 25 × 2.2	1.130
75 × 40 × 5	2.830
80 × 50 × 3	2.009
100 × 25 × 2.5	1.620
100 × 50 × 3	2.333
100 × 50 × 6	4.460
120 × 40 × 3	2.490

Consult suppliers for details of tubes, flat or square bars, round or hexagon rods, angles, l-beams, channels, zed, tee or top hat sections, etc. Some are manufactured to imperial sizes but referred to in metric dimensions.

BRASS FLAT BAR, ANGLE, SHEETS AND TUBES

Brass Flat Bar

Mass in kg/m

Widths mm	Thickness, mm							
	1.59	3.18	4.76	6.35	9.53	12.7	19.05	22.23
12.7		0.341	0.512	0.681	1.02			
15.88		0.427	0.640					
19.05	0.256	0.512	0.768	1.02	1.53	2.04		
25.4	0.341	0.683	1.02	1.36	2.05	2.73	4.09	4.77
31.8	0.427	0.854	1.28	1.70				
38.1		1.02	1.54	2.04	3.07	4.10		
50.8		1.37	2.05	2.72	4.10	5.46		
63.5		1.71	2.56	3.40				
76.2		2.05	3.07	4.09	6.15	8.19		
101.6		2.73	4.10	5.45				

Brass Angle

Mass in kg/m

Dimensions mm	Thickness, mm			
	1.59	3.18	4.76	6.35
12.7 × 12.7	0.320	0.598		
19.05 × 19.05	0.492	0.938		
25.4 × 25.4		1.302		
31.8 × 31.8		1.451	2.118	
38.1 × 38.1	1.001	1.964	2.887	3.75
50.8 × 50.8		2.649	3.914	5.119

Consult suppliers for details of round or hexagon rods, channels, tee sections etc. These are mostly manufactured in imperial sizes but referred to in metric dimensions.

Brass – Sheet

Mass Per Unit Area

Calculated on the mean density of rolled 70/30 Brass taken as 8524 kg/m³. Slight variations correspond to the composition of different alloys.

Table can also be used for 63/37 Brass and other copper alloys if the values listed are multiplied by the factors appearing in the footnote.

Thickness mm	Mass kg/m ²	Thickness mm	Mass kg/m ²
0.05	0.426	0.7	5.97
0.08	0.682	0.8	6.82
0.10	0.852	0.9	7.67
0.12	1.02	1.0	8.52
0.16	1.36	1.2	10.23
0.20	1.71	1.6	13.64
0.25	2.13	2.0	17.05
0.30	2.56	2.5	21.31
0.40	3.41	3.0	25.57
0.45	3.84	5.0	42.62
0.50	4.26	6.0	51.14
0.55	4.69	9.5	80.98
0.60	5.11	12.5	106.6

To Obtain Value for

90/10 & 85/15 Gilding Metals

12% Nickel Silvers

18% Nickel Silvers

Engraving Brass

5% Phosphor Bronze

63/37 Brass

Multiply Listed Value By Factor

1.026

1.008

1.020

0.993

1.039

0.990

Brass Tubes

Alloy 70/30 (Copper/Zinc)

Mass in kg/m

Outside Diameter mm	Wall Thickness, mm						
	0.71	0.91	1.22	1.63	2.03	3.25	4.06
4.76	0.077	0.095					
6.35	0.107	0.134	0.168	0.206			
7.94	0.138	0.173	0.220	0.275			
9.53	0.168	0.211	0.272	0.345	0.402		
12.70	0.229	0.290	0.372	0.476	0.580		
15.88		0.372	0.476	0.625			
19.05		0.446	0.580	0.759		1.384	
22.23		0.521	0.685	0.893			
25.40		0.595	0.789	1.042			
26.99						1.935	
28.58			0.893	1.176			
31.80		0.759	0.997	1.310	1.622	2.485	
38.10	0.699	0.908	1.205	1.592		3.036	
50.80		1.220	1.622	2.143		4.152	
53.93				2.292			
63.50				2.694		5.268	
76.20				3.260	4.048	6.369	
101.60				4.360		8.587	10.640

STAINLESS STEEL TYPES AND GRADES

Type 304 Stainless Steel (this type used in benches)

Type 304 is a low carbon austenitic chrome nickel stainless steel. Its heat and corrosion resistance is superior to Type 302. Because of its low carbon content, carbide precipitation as a result of welding will be minimised, resulting in less susceptibility to inter-granular corrosion. It has found widespread use in chemical, textile dyeing and food handling equipment; evaporators, cooling coils and dairy machines. This alloy can be formed into most shapes. In many cases more than one forming operation may be conducted before a re-anneal is necessary. Non-magnetic in the annealed state, it becomes slightly magnetic after cold-working.

Type 316 Stainless Steel

Type 316 is particularly suitable for applications involving severe corrosive conditions, high strength and creep resistance at elevated temperatures and welding without subsequent heat treatment. It will work-harden and the material should be in the annealed condition before each severe cold-forming operation. It is also recommended that after severe cold-forming operations, material be stress-relieved as a final step. This alloy has found wide acceptance in the paper, chemical, food and textile industries, in soap and photographic handling equipment, in oil refining equipment and in the preparation of pharmaceuticals.

Type 430 Stainless Steel

The addition of aluminium to this 13% chromium steel lessens the self-hardening properties. This steel does not harden when subjected to rapid cooling from high temperatures and has excellent weldability. Ductile welds can be made without the need of subsequent annealing and the alloy is magnetic.

Type 303 Stainless Steel Bar

An austenitic chrome nickel alloy, free machining, 303 is widely used in automatic screw machines. The addition of sulphur, while improving machinability up to 70% of standard screw stock, lowers its corrosion resistance slightly compared to non-free machining 18-8 stainless. It is non-seizing and non-galling. Specified in work that requires heavy feed or deep cuts, it is used for shafts, aircraft fittings, nuts, bolts, valve stems and valves. It becomes slightly magnetic when cold-worked.

Other Types or Grades

Various other stainless steel alloys are obtainable, the details of which are available from the suppliers.

STAINLESS STEEL FINISHES

Common finishes held in stock are No. 1, 2B, BA and No. 4. Other finishes can be sourced from overseas suppliers.

Unpolished Finishes

No. 1	Hot Rolled, annealed and pickled. Generally used where smoothness of finish is not of particular importance.
2D	A dull cold rolled finish obtained from a final annealing and pickling, or a final light cold roll pass on dull rollers, after sheet has been cold rolled annealed and pickled. This finish is generally used in forming deep drawn articles which may be polished after fabrication.
2B	A semi-bright satin finish obtained from temper rolling after the sheet has been cold rolled, annealed and pickled. This is a general purpose finish that polishes better than 2D and is commonly used except in exceptionally difficult deep drawing applications.
BA	A slightly reflective surface obtained from bright annealing after cold rolling used for quality deep drawing such as sinks, tubs etc.

Polished Finishes

Sheets can be produced with 1 or 2 sides polished. When polished on only one side, the other side may be rough ground in order to obtain the necessary flatness.

No. 3	A polished finish obtained by mechanical polishing on 2D or 2B finish with approx. 100 grit abrasive.
No. 4	A 'Brush' finish obtained from mechanical polishing with 120–150 grit. A general purpose finish widely used for kitchen and dairy equipment.
No. 6	A dull satin finish which has lower reflectivity than No. 4 finish. It is used for architectural applications where high lustre is undesirable; it is also used effectively to contrast with brighter finishes.
No. 7	Buff polished to a high reflection ratio. Chiefly used for architectural and ornamental purposes.
No. 8	Mirror finished for high reflection. This finish is most widely used for press plates as well as small mirrors and reflectors.
HL	Hairline finish obtained by mechanical polishing with 120–320 grit. Used mostly for finishing on flat bar for architectural purposes.

STAINLESS STEEL SHEETS, ANGLES, SQUARES AND TUBES

Calculated on a mean density of 7930 kg/m³ for Alloys 304 or 321
(for Alloy 316 use 7980 kg/m³; for Alloy 430 use 7770 kg/m³).

Sheet, mm	kg/m ²
3.0	23.79
2.5	19.83
2.0	15.86
1.5	11.90
1.2	9.52
0.9	7.14
0.7	5.55
0.6	4.76
0.55	4.36
0.45	3.57

Angles, mm	kg/m
20 × 20 × 3	0.91
25 × 25 × 3	1.15
30 × 30 × 3	1.39
40 × 40 × 3	1.88
50 × 50 × 3	2.41
25 × 25 × 5	1.81
30 × 30 × 5	2.21
40 × 40 × 5	3.03
50 × 50 × 5	3.87
20 × 20 × 6	1.41
30 × 30 × 6	2.58
40 × 40 × 6	3.56
50 × 50 × 6	4.55
65 × 65 × 6	6.07
75 × 75 × 6	7.03
100 × 100 × 6	9.50

Square Tubes	kg/m
12.7 × 12.7 × 1.2	0.450
19.05 × 19.05 × 1.2	0.691
19.05 × 19.05 × 1.5	0.852
25.4 × 25.4 × 1.2	0.933
25.4 × 25.4 × 1.5	1.151
31.8 × 31.8 × 1.2	1.185
31.8 × 31.8 × 1.5	1.470
38.1 × 38.1 × 1.2	1.425
38.1 × 38.1 × 1.5	1.780
50.8 × 50.8 × 1.2	1.898
50.8 × 50.8 × 1.5	2.356
50.8 × 50.8 × 2	3.115
76.2 × 76.2 × 2	5.003
76.2 × 76.2 × 3	7.430
101.6 × 101.6 × 3	9.343

Tubes OD × Wall	kg/m
6.35 × 0.9	0.120
7.94 × 0.9	0.156
9.52 × 0.9	0.191
9.52 × 1.2	0.257
12.7 × 0.9	0.261
12.7 × 1.2	0.344
12.7 × 1.5	0.418
15.9 × 0.9	0.331
15.9 × 1.2	0.439
15.9 × 1.5	0.538
19.0 × 0.9	0.414
19.0 × 1.2	0.539
19.0 × 1.5	0.661
22.2 × 1.2	0.628
22.2 × 1.5	0.773
25.4 × 0.9	0.522
25.4 × 1.2	0.731
25.4 × 1.5	0.903
31.8 × 0.9	0.704
31.8 × 1.2	0.925
31.8 × 1.5	1.145
38.1 × 0.9	0.849
38.1 × 1.2	1.110
38.1 × 1.5	1.437
44.5 × 1.5	1.625
44.5 × 2.0	2.142
50.8 × 0.9	1.233
50.8 × 1.2	1.499
50.8 × 1.5	1.863
50.8 × 2.0	2.459
63.5 × 1.2	1.883
63.5 × 1.5	2.343
76.2 × 1.5	2.819
101.6 × 1.5	3.783
101.6 × 2.0	5.019
152.4 × 1.5	6.050
152.4 × 2.0	7.543

Consult suppliers for details of plates, flat or square bars, round or hexagon rods, angles, tubes, etc. Some are manufactured to imperial sizes but referred to in metric dimensions.

LABOUR CONSTANTS – METALWORK

		Unit	Tradesman Hours	Labourer Hours
Metalwork				
Stairs, Balustrades and Ladders				
Ladder , 450mm wide, fully welded steel and shop primed		tonne	100.00	
Staircase , steel framed, including treads and shop treatment		tonne	60.00	
Balustrade , steel, 900mm high, balusters at 150mm centres		tonne	140.00	
Framing and Cladding				
Angle trim , aluminium, screwed to backing surface				
	12mm × 12mm angle	m	0.08	
	32mm × 20mm angle	m	0.10	
	45mm × 20mm angle	m	0.11	
Bench supports , tubular framing with welded joints				
	Steel	tonne	200–300	
	Stainless steel	tonne	250–375	
	Brackets, small section steel angle or flat	tonne	200–250	
Cladding , sheet material fixed to framing				
	Aluminium, 1.6mm	m ²	1.60	
	Galvanised or zincalume steel, 1mm	m ²	1.25	
	Stainless steel	m ²	1.50	
Gratings and Covers				
Manhole covers , including concrete filling				
Light duty	450mm × 450mm	No	0.70	0.70
	600mm × 600mm	No	0.85	0.85
	900mm × 900mm	No	1.05	1.05
Medium duty	450mm × 450mm	No	0.75	0.75
	600mm × 600mm	No	0.95	0.95
	900mm × 900mm	No	1.15	1.15
Heavy duty	450mm × 450mm	No	0.80	0.80
	600mm × 600mm	No	1.00	1.00
	900mm × 900mm	No	1.20	1.20
Trench grating , take delivery, build in frame and place in position				
Light duty	225mm wide	No	0.40	0.40
	450mm wide	No	0.65	0.65
Heavy duty	225mm wide	No	0.50	0.50
	450mm wide	No	0.80	0.80

CARPENTRY

BOLTS, NAILS AND SCREWS

Bolts and Nuts

Nominal Size (diameter) mm	Bolt length allowance to be added to grip for 1 Nut, 1 washer and Sufficient bolt protrusion	Nominal height of head, mm	Nominal thickness of nut, mm
M6	12	4	5
M8	15	5	6
M10	18	7	8
M12	22	8	10
M16	26	10	13
M20	30	13	16
M24	36	15	19
M30	42	19	24
M36	48	23	29

Nominal Length of Bolts

Up to and including 125 mm

Over 125 mm up to and including 150 mm

Length of Thread

2d + 6 mm

2d + 12 mm

Stock Sizes Bolts and Set Screws

Note: Bolts that are too short for minimum thread lengths are threaded to head and designated as set screws.

Size	16	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100	110	120	130	140	150
M6	⊗	⊗	*	*	*	*	*	*	×	×	×	×	×	×	×	×	×	-	-	-	-
M8	⊗	⊗	⊗	*	*	*	*	*	×	×	×	×	×	×	×	×	×	×	-	-	-
M10	-	⊗	⊗	⊗	*	*	*	*	×	×	×	×	×	×	×	×	×	×	×	×	-
M12	-	-	⊗	⊗	⊗	*	*	*	×	×	×	×	×	×	×	×	×	×	×	×	×
M16	-	-	-	-	⊗	⊗	*	*	×	×	×	×	×	×	×	×	×	×	×	×	×
M20	-	-	-	-	-	⊗	⊗	⊗	×	×	×	×	×	×	×	×	×	×	×	×	×

⊗ Set Screws Only, * Bolts and Set Screws, × Bolts Only

Bolts Lengths Above Stock Sizes

160, 180, 200, 220, 240, 260, 280, 300, 325, 350, 375, 400 mm

Nails	Length × Dia mm	Approx No./kg	
		Jolthead	Flathead
Steel Nails	125 × 5.3	45	42
	100 × 4.5	77	73
	100 × 4.0	98	93
	75 × 3.15	210	205
	50 × 2.5	498	475
	40 × 2.0	970	930

		Approx No./kg
Plain Spring Head	60 × 3.55	158
	75 × 3.55	138
Square Twisted Spring Head	60 × 3.15	202
	75 × 3.15	170

Wood Screws

No physical change. Will continue to be ordered by their gauge, but in mm lengths.

Wood Screw Gauge	Shank Diameter	
	Imperial (in)	Metric (mm)
4	0.108	2.74
5	0.122	3.10
6	0.136	3.45
7	0.150	3.81
8	0.164	4.17
9	0.178	4.52
10	0.192	4.88
12	0.220	5.59
14	0.248	6.30
16	0.276	7.01
18	0.304	7.72

Nails staples and screw: [NZ Nails](#)

Timber connectors and structural brackets:

MiTek Structural Fixings On-site Guide for Building Code Compliance Guide;

[MiTek Fixings Guide App](#)

[MiTek Structural Fixings On-Site Guide for Building Code Compliance Guide](#)

TIMBER SIZE, LENGTHS, VOLUME AND MASS

NZS : 3601 Timber

Preferred Range of Call Sizes (mm)										Finished Dimensions (mm)			
Call Dimensions	Call Dimensions – Width									Call Dimension	Finished Dimension		
											Green Gauged Timber	Dry Dressed Timber	
												Radiata	Rimu
Thickness	50	75	100	125	150	200	225	250	300	25	–	19	18
25	x	x	x	x	x	x	x	x	x	30	–	25	22
30			x		x					40	37	35	30
40	x	x	x	x	x	x	x	x	x	50	47	45	40
50	x	x	x	x	x	x	x	x	x	75	69	65	60
75			x	x	x	x	x	x	x	100	94	90	85
100			x	x	x	x	x	x	x	125	119	115	110
	Preferred Lengths (in metres)									150	144	140	135
	1.8	3.3	4.8							200	194	180	180
	2.1	3.6	5.1							225	219	205	200
	2.4	3.9	5.4							250	244	230	225
	2.7	4.2	5.7							300	294	280	270
	3.0	4.5	6.0										

The size used in descriptions will continue to be the nominal size, or if necessary, the finished size identified by the abbreviation “(fin)”

eg: 100 × 50 stud
40 × 10 (fin) architrave

The importance of using the correct mm size.

Nominal Size	Green Gauged	Dry Dressed
100 × 50 mm	94 × 47 mm	90 × 45 mm

A finished size of 96 mm is uneconomic because not obtainable from 100 timber.

TIMBER : METRES PER CUBIC METRE

Thickness	Widths								
	50	75	100	125	150	200	225	250	300
25	800	533	400	320	267	200	178	160	133
30	-	-	333	-	222	-	-	-	-
40	500	333	250	200	167	125	111	100	83
50	400	267	200	160	133	100	89	80	67
63	-	-	-	-	106	79	-	-	-
75	-	178	133	107	89	67	59	53	44
100	-	-	100	80	67	50	44	40	33

Species	Mass (kg/m ³)	
	Green	Dry (12% m.c.)
Pinus Radiata	931	506
Rimu	963	594
Douglas Fir	753	480
Western Red Cedar (imported)	466	359

TIMBER TREATMENT

Where timber treatments might be used (from NZS 3604:2003 Chemical Preservation of Round and Sawn Timber)

Hazard Class	Exposure	Service Conditions	Biological Hazard	Typical Uses
H1.1	Protected from the weather, above ground	Protected from the weather, always dry	Borer	Interior finishing timber – see NZS 3602
H1.2	Protected from the weather, above ground, but with a possibility of exposure to moisture	Protected from weather, but with a risk of moisture content conducive to decay	Borer, fungal and decay	Wall framing – see NZS 3602
H3	Exposed to the weather, above ground	Periodic wetting, not in contact with the ground	Decay, fungi and borer	Plywood exterior wall bracing – see NZS 3602
H3.1	Exposed to the weather, above ground	Periodic wetting, not in contact with the ground	Decay fungi and borer	Cladding, fascia, joinery – see NZS 3602
H3.2	Exposed to the weather, above ground or protected from the weather but with a risk of moisture entrapment	Periodic wetting, not in contact with the ground, more critical end uses	Decay, fungi and borer	Decks, pergolas, external beams, posts not in ground
H4	Exposed to the weather, in ground or in fresh water	Ground contact, or conditions of severe or continuous wetting	Decay, fungi and borer	Fence posts, landscaping timbers not requiring a building consent
H5	Exposed to the weather, in ground or in fresh water	Ground contact, or conditions of severe or continuous wetting, where uses are critical and where a higher level of protection than H4 is required	Decay, fungi and borer	House piles and poles; crib walling; posts in ground for decks, verandahs, pergolas

The above table applies particularly to Radiata Pine.

NZS 3602 describes what level of timber treatment is required, according to where it is used.

FLAT SHEET

Width, mm		900				1200					
Length, m		1.8	2.4	2.7	3.6	1.8	2.1	2.4	2.7	3.0	3.6
Hardboard & Insulating Board	Thickness, mm										
Hardboard	4.75					×		×	×	×	
Hardboard	3, 6							×	×	×	
Tempered Hardboard	4.75, 6							×	×	×	
Pegboard	4.75							×			
Seratone, Riotone	4.75		×					×			
Chalkboard	4.75							×			
Triple S Sheathing	10.5								×		
“Flameguard” Insulating Board	12					×	×	×	×	×	
Panelweave	14							×			
Plywood											
Construction/Formwork Plywood	7.5, 9, 12.5							×			
(veneers 2.5 or 3 mm thick)	15, 17.5, 21							×			
Interior and Exterior Plywood	4, 5.5							×			
Laminates											
Formica Laminate	1.0				×			×			×
Formica Colorcore	1.3										×
Aquapanel (Formica Wallboard)	4.75		×					×			
Formica Whiteboard/Chalkboard	3							×			×
Hardies Products											
Hardiflex	4.5, 6, 7.5	×	×			×		×	×	×	
Harditex	7.5		×	×		×		×	×	×	
Hardiglaze	4.5		×					×			
Hardiglaze Industrial	6							×			
Villaboard	6		×					×		×	×
	9							×		×	
Compressed Sheeting	9					×		×		×	
	18					×		×			
Hardisoffit	4.5 × 2400	450, 600, 750									
Hardisoffit 2000 prepainted	4.5 × 2400	435, 585, 735, 1200									

Notes:

The sizes marked are those shown on manufacturers price lists.

Some sheets are supplied oversize e.g. 2440 × 1220.

Non-standard sizes are available on special order and cut sizes are available from some suppliers.

Width, mm		900	1200			1800		
Length, m		2.4	1.8	2.1	2.4	3.6	2.4	3.6
Particle Board, Fibreboard	Thickness, mm							
Bisonboard	3, 8		×	×	×			
Bisonboard	4, 4.75, 6	×	×	×	×			
Superflake Medium Density	9, 12, 15, 18		×		×		×	×
Superfine Medium Density	9, 12, 15, 16, 18				×		×	
Superfloor	20							×
Pynefloor	20		×		×		×	×
Lakepine MD Fibreboard	9, 12, 16, 18, 25, 30		×		×	×		
Panafill LD Fibreboard	9, 12, 15, 18, 20				×			
Customwood MD Fibreboard	9, 12, 16, 18		×		×	×		
Customwood MD Fibreboard	25				×	×		
Thinline MD Fibreboard	3, 4, 4.75, 6	×			×			
ColorBoard on MDF	16, 18				×			
Melteca	6, 9, 12, 18, 25, 30				×			
Melamine Single Sided	4.75				×			
Melamine	6, 9, 12, 15, 16, 18, 25, 30				×			

Width, mm		900					1200			
Length, m		1.5	1.1	2.1	2.4	2.7	1.8	2.1	2.4	2.7
	Thickness, mm									
Wood Veneered Thinline	4, 5, 6, 7			×	×	×	×	×	×	×
Wood Veneered Particle Board	10, 13, 16, 17, 19, 26, 31	×	×	×	×	×	×	×	×	×
Wood Veneered MDF	10, 12, 16, 17, 19, 26, 31	×	×	×	×	×	×	×	×	×

Notes: As previous page

Construction Plywood Grading And Uses

Grades are defined by the face veneer grading of both faces. For example grade B-D has veneer grade B on one face and veneer grade D on the other.

Veneers are rotary cut Radiata pine of the following grades:

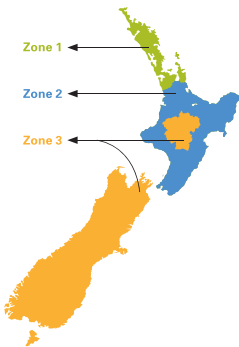
- A Suitable for high quality paint finish.
- B Solid face, suitable for paint finish or formwork.
- Cp Reasonably solid face with minor defects plugged, suitable for paint finish, formwork or flooring.
- D This grade permits combinations of open defects, suitable for sarking, sheathing, crates.

Mass of Sheet Materials

		Thickness mm	Mass kg/m²
Durioid Building Paper	Light	–	0.21
	Heavy	–	0.26
Malthoid	2 ply	–	1.82
	3 ply	–	2.30
Pinex Insulating Board		12	3.6
Pinex Hardboard		3	3.1
		4.75	4.3
		6	5.4
Pinex Tempered Hardboard		4.75	4.7
		6	5.8
Construction Plywood		7.5	3.8
		9	5.0
		12.5	6.7
		15	8.3
		17.5	10.0
Particleboard	Low Density	21	11.7
		18	18.6
		25	11.3
		30	12.6
	Medium Density	35	14.7
		9	6.1
		12	7.9
	High Density	18	11.9
		20	13.8
Hardiflex		4.5	7
		6	9.5
		7.5	11.5
Woodtex		15	10
		25	15
		38	21
		50	26
		75	40
Fibreboard	Medium Density	9	6.75
		12	8.88
		16	11.84
		18	13.32
		25	18.0
		30	21.0

BUILDING CODE REQUIREMENTS – HOUSE INSULATION

Map of Climate Zones



ZONES 1 AND 2	R Value	ZONE 3	R Value
Roof	R 2.9	Roof	R 3.3
Walls	R 1.9	Walls	R 2.0
Floor	R 1.3	Floor	R 1.3
Heated floors	R 1.9	Heated floors	R 1.9
Windows	R 0.26	Windows	R 0.26
Skylights	R 0.26	Skylights	R 0.31

Additional requirements

- The total window area must be $\leq 30\%$ of the total exterior wall area.
- The combined window area of the east, south and west walls must be, 30% of the combined area of these walls.
- The total skylight area must be $\leq 1.2\text{m}^2$.
- The total area of leadlight glass must be $\leq 2.6\text{m}^2$.
- If you have downlights that are not CA-Rated, they will reduce the thermal resistance of the ceiling and you will need to increase the insulation R-value to compensate.
- The R-value of carpets or floor coverings must not be included in calculation of floor R-value for heated floors.
- For heated walls or ceilings, higher R-values are required (walls R 2.6, Ceilings R 3.5).

Calculating R-values

The insulation R-values specified in Zones 1–3 R-value table above are for the complete building element (eg, roof or wall), not just the insulation product. The R-value of the complete building element is different to the insulation R-value. The extent of that difference depends on the construction details.

R-values for building elements can be determined using:

- The BRANZ house insulation guide, 3rd Edition, 2007
- NZS 4214: 2006
- The free online tool at www.designnavigator.co.nz

[DBH 12 page PDF Quick Guide download "Building Code Requirements: House Insulation"](#)

<http://www.building.govt.nz/building-code-compliance/h-energy-efficiency/h1-energy-efficiency/>

INSULATION

Fibreglass Building Insulation

Product	Pieces Per Bale	Size, mm	Nominal Thickness, mm	m2 Per Bale
BATTS				
a) Ceiling Insulation				
Batts R1.8	26	1220 × 432	75	13.7
Batts R2.4	19	1220 × 432	100	10.0
Super Batts R3.4	13	1220 × 432	150	6.9
b) Wall Insulation				
Wall Batts R1.8	26	1140 × 580	75	17.2
Wall Batts R2.2	21	1140 × 580	94	13.9
Building Insulation Blanket				
unfaced	3	8000 × 1200	50	28.8
unfaced	2	8000 × 1200	75	19.2
Flamestop 524 faced	1	12000 × 1200	50	14.4
Sisalation faced	1	12000 × 1200	50	14.4
Sisalation faced	1	12000 × 1200	75	14.4
Noise Control Board	20	1200 × 900	11	21.6
Noise Control Panel	20	1200 × 900	50	21.6
Noise Control Blanket	3	8000 × 1200	50	28.8
	2	8000 × 1200	75	19.2
Noise Control Block	20	1140 × 580	100	13.2

SEALANT ESTIMATING TABLES

JOINT SEALING COMPOUNDS PACKED BY VOLUME

378 ml CARTRIDGE	1.5 litre PACK	2 litre PACK	3 litre PACK	4 litre PACK	50 kg PACK
Seelastick/Secomastic	Thioflex 600	Exposeal	Uraflex F	Exposeal	Arealastic
Asbestumen	Uraflex 2		Uraflex P	Plastijoint	Pliastic
Uraflex One	Uraflex F			Asbestumen	
Silaflex	Uraflex P				

JOINT SIZE mm	m/378 ml	m/1.5 litre	m/2 litre	m/3 litre	m/4 litre	m/50 kg
3 × 5	25.20	100.00	130.00	200.00	260.00	
10	12.60	50.00	67.00	100.00	134.00	
5 × 5	15.00	60.00	80.00	120.00	160.00	
10	7.50	30.00	40.00	60.00	80.00	
15	5.00	20.00	27.00	40.00	54.00	
20	3.75	15.00	20.00	30.00	40.00	490.00
25	3.00	12.00	16.00	24.00	32.00	392.00
10 × 5	7.50	30.00	40.00	60.00	80.00	
10	3.75	15.00	20.00	30.00	40.00	490.00
15	2.50	10.00	13.00	20.00	26.00	326.00
20	1.90	7.50	10.00	15.00	20.00	245.00
25	1.50	6.00	8.00	12.00	16.00	196.00
30	1.26	5.00	6.70	10.00	13.40	163.00
40	0.94	3.80	5.00	7.60	10.00	122.00
15 × 10	2.50	10.00	13.00	20.00	26.00	326.00
15	1.68	6.70	8.90	13.40	17.80	217.00
20	1.26	5.00	6.70	10.00	13.40	163.00
25	1.00	4.00	5.30	8.00	10.60	130.00
30	0.84	3.30	4.40	6.60	8.80	108.00
40	0.63	2.50	3.30	5.00	6.60	81.00
50	0.50	2.00	2.70	4.00	5.40	65.00
20 × 10	1.90	7.50	10.00	15.00	20.00	245.00
15	1.26	5.00	6.70	10.00	13.40	163.00
20	0.94	3.80	5.00	7.60	10.00	122.00
25	0.76	3.00	4.00	6.00	8.00	98.00
30	0.63	2.50	3.30	5.00	6.60	81.00
40	0.47	1.90	2.50	3.80	5.00	61.00
50	0.38	1.50	2.00	3.00	4.00	49.00
25 × 15	1.00	4.00	5.30	8.00	10.60	130.00
20	0.76	3.00	4.00	6.00	8.00	98.00
25	0.60	2.40	3.20	4.80	6.40	78.00
30	0.50	2.00	2.70	4.00	5.40	65.00
40	0.38	1.50	2.00	3.00	4.00	49.00
50	0.30	1.20	1.60	2.40	3.20	39.00
60	0.25	1.00	1.30	2.00	2.60	32.00
65	0.23	0.90	1.20	1.80	2.40	30.00
30 × 25	0.50	2.00	2.70	4.00	5.40	65.00
30	0.42	1.60	2.20	3.20	4.40	54.00
40	0.32	1.30	1.70	2.60	3.40	40.00
50	0.25	1.00	1.30	2.00	2.60	32.00
60	0.21	0.83	1.10	1.66	2.20	27.00
65	0.19	0.75	1.00	1.50	2.00	25.00
35 × 25	0.43	1.70	2.30	3.40	4.60	56.00
30	0.36	1.40	1.90	2.80	3.80	46.50
40	0.27	1.10	1.40	2.20	2.80	35.00
50	0.22	0.83	1.10	1.66	2.20	28.00
60	0.18	0.71	0.95	1.42	1.90	23.00
65	0.16	0.66	0.88	1.20	1.76	21.50
40 × 25	0.38	1.50	2.00	3.00	4.00	49.00
30	0.32	1.30	1.70	2.60	3.40	40.50
40	0.24	1.00	1.30	2.00	2.60	30.50
50	0.19	0.75	1.00	1.50	2.00	24.50
60	0.16	0.63	0.83	1.26	1.86	20.00
65	0.14	0.58	0.77	1.16	1.54	18.50
50 × 25	0.30	1.20	1.60	2.40	3.20	39.00
30	0.25	1.00	1.30	2.00	2.60	32.00
40	0.19	0.75	1.00	1.50	2.00	24.50
50	0.15	0.60	0.80	1.20	1.60	19.00
60	0.13	0.50	0.67	1.00	1.34	16.00
65	0.12	0.46	0.62	0.92	1.24	15.00

Sealant Estimating Tables

PRODUCT	TYPE	PACK SIZE	COVERAGE
Adhesives	Packed in 378 cartridges	378 cm ³	Gun application 5 mm dia BEAD × 19.25 m per cartridge
	Contact type	250 ml	0.83/1.0 m ²
	(Packed in tins)	500 ml	1.75/2.0 m ²
		1 litre	3.5/4.0 m ²
		2 litre	7.0/8.0 m ²
		4 litre	14.0/16.0 m ²
		20 litre	70/80 m ²
		(Coverage is dependant on surface profile & porosity)	
Mulseal	PACK SIZE		COVERAGE SINGLE COAT
	4 litre	8 m ² per coat	} (Coverage based on average singlecoat of 2m ² per litre)
	20 litre	40 m ² per coat	
	PRIMING COAT	1 litre/3.7 m ²	
Galvafroid	GRADE		COVERAGE SINGLE COAT
	AVERAGE DRY COAT THICKNESS		
	GW7	6.6 m ² /kg	23 microns
	GWB4/GWS4	6.6 m ² /kg	23 microns
	EVB/EVS	4.5 m ² /kg	40 microns
Micanox Ekv	EKV	4 m ² /litre	120 microns
			} (Coating thickness measured on smooth steel)
Primers for Sealants	GRADE		COVERAGE
	Thioflex		
	Std & No.1	1 litre per 30 litres of Thioflex	
	No.6	1 litre per 200 litres of Thioflex	
	Uraflex		
	Porus	1 litre per 30 litres of Uraflex	
	Non Porous	1 litre per 200 litres of Uraflex	
	Plastijoint		
No.3	1 litre per 20 litres of Plastijoint		
Pliastic			
No.3	1.5 litres per 50kg of Pliastic		
Epoxy Compounds	GRADE		COVERAGE
	(Spreadable)		
	A	1m ² /litre	
	AC	2m ² /litre	
	C	2m ² /litre	
	Other grade calculated from volume		
e.g.	1 litre of EXPOCRETE UA	1000 cm ³	
	1 litre of EXPOCRETE S	4000 cm ³	

WOOD MOULDINGS

Standard Metric Finished Sizes for Ex-stock Delivery

(Profiles issued by TRADA December 1974 for Moulding Manufacturers)
(Incorporated in NZS 3610:1979)

Quadrants*	12 mm; 18 mm
Bungalow Moulds*	18 mm; 28 mm
Scotias*	28 mm; 35 mm
Bevelled Cornices	30 × 18 mm; 40 × 18 mm
External Angle	23 × 23 mm
Gibraltar Board Mould	19 × 19 mm
Half Rounds	18 × 6 mm; 30 × 7 mm
Scriber	43 × 10 mm
Coving*	28 mm; 44 mm
Button Mould	25 × 12 mm
Pelmet	135 × 10 mm
Architrave, Double Bevelled	40 × 10 mm
Architrave, Single Bevelled	40 × 10 mm; 60 × 10 mm
Architrave, Bullnosed	40 × 10 mm; 60 × 10 mm
Dressed Four Sides	12 × 12 mm; 18 × 18 mm; 24 × 24 mm 30 × 10 mm; 40 × 10 mm; 40 × 18 mm 65 × 10 mm; 90 × 10 mm; 135 × 10 mm

* Size given is the cover dimension, for example the amount covered each way from the room internal angle.

Wood Dowels

Diameter 4, 6, 8, 10, 12, 15 mm increasing by 5 mm up to 50 mm.

LABOUR CONSTANTS – CARPENTRY

		Unit	Tradesman Hours	Labourer Hours
Carpentry				
• Constants based on using No. 1 framing				
• For small additions to buildings or for partitioning in commercial contracts, add up to 50% to given rate				
Damp Proof Course				
DPC–damp proof course–all widths		m	0.025	
Sub Floor Framing				
Jack stud	100mm × 100mm	m	0.22	
Bearer	100mm × 75mm	m	0.22	
	125mm × 100mm	m	0.24	
Joist	150mm × 50mm	m	0.20	
	200mm × 50mm	m	0.21	
	250mm × 50mm	m	0.22	
	300mm × 50mm	m	0.22	
Solid blocking	100mm × 50mm	m	0.17	
	150mm × 50mm	m	0.23	
	200mm × 50mm	m	0.25	
	300mm × 50mm	m	0.32	
Beam	200mm × 50mm	m	0.23	
	250mm × 50mm	m	0.28	
	200mm × 100mm	m	0.29	
	300mm × 100mm	m	0.36	
Wall Framing				
Plate	75mm × 50mm	m	0.12	
	100mm × 50mm	m	0.13	
	150mm × 50mm	m	0.15	
Stud	75mm × 50mm	m	0.12	
	100mm × 50mm	m	0.13	
	150mm × 50mm	m	0.15	
Jack stud	75mm × 50mm	m	0.13	
	100mm × 50mm	m	0.13	
	150mm × 50mm	m	0.24	
Dwang	75mm × 50mm	m	0.13	
	100mm × 50mm	m	0.17	
	150mm × 50mm	m	0.24	
Lintel	100mm × 100mm	m	0.26	
	150mm × 100mm	m	0.36	
	200mm × 100mm	m	0.46	
	250mm × 100mm	m	0.50	
Metal studs 64mm		m	0.12	
Bracing				
Metal angle diagonal bracing		m	0.12	
Plywood sheet bracing checked in flush		m ²	0.90	
Plywood sheet bracing fixed over framing		m ²	0.40	

		Unit	Tradesman Hours	Labourer Hours
Roof and Ceiling Framing				
Ceiling joist	100mm × 50mm	m	0.20	
	150mm × 50mm	m	0.20	
Ceiling dwang	100mm × 50mm	m	0.21	
Ceiling strapping	50mm × 25mm	m	0.08	
	100mm × 25mm	m	0.10	
Rafter	100mm × 50mm	m	0.18	
	150mm × 50mm	m	0.20	
	200mm × 50mm	m	0.22	
Collar tie	150mm × 25mm	m	0.17	
Strut and brace	100mm × 50mm	m	0.12	
	100mm × 75mm	m	0.22	
Purlin	75mm × 50mm	m	0.12	
	100mm × 50mm	m	0.15	
	150mm × 50mm	m	0.17	
	200mm × 50mm	m	0.20	
Eaves framing	75mm × 50mm	m	0.18	
	100mm × 50mm	m	0.20	
Fascia	100mm × 50mm	m	0.17	
	150mm × 50mm	m	0.20	
Ridge board	150mm × 25mm	m	0.20	
	200mm × 25mm	m	0.22	
	100mm × 50mm	m	0.17	
Valley board	150mm × 25mm	m	0.18	
	200mm × 25mm	m	0.20	
	150mm × 50mm	m	0.16	
	200mm × 50mm	m	0.21	
Beams and Lintels	200mm × 50mm	m	0.27	
	300mm × 75mm	m	0.34	
	200mm × 100mm	m	0.34	
Posts	300mm × 100mm	m	0.45	
	100mm × 100mm	m	0.28	
Prefabricated roof trusses, erection only				
	6m span	No	1.50	
	9m span	No	2.00	
	12m span	No	3.00	
Exterior Linings and Trim				
Weatherboards				
Bevel back	150mm × 25mm	m ²	1.00	
	200mm × 25mm	m ²	0.85	
Vertical shiplap	150mm × 25mm	m ²	1.05	
	200mm × 25mm	m ²	0.85	
Rusticated	150mm × 25mm	m ²	0.65	
	200mm × 25mm	m ²	0.50	
PVC		m ²	1.00	

	Unit	Tradesman Hours	Labourer Hours
Fibre cement sheathing, including PVC jointers			
4.5mm flat sheets	m ²	0.35	
6mm flat sheets	m ²	0.35	
7.5mm flat sheets	m ²	0.45	
7.5mm weatherboards	m ²	0.90	
Building paper and insulation			
Building paper	m ²	0.08	
Sisalation	m ²	0.15	
Batts between wall framing	m ²	0.06	
Batts in ceiling	m ²	0.09	
Eaves soffit lining			
4.5mm and 6mm fibre cement	m ²	0.52	
Deck sheathing			
100mm × 25mm timber sheathing	m ²	0.90	
100mm × 25mm hardwood	m ²	1.20	
12mm fibre cement (screw fixed)	m ²	1.00	
Exterior finishings			
150mm × 25mm, 200mm × 25mm fascia	m	0.26	
200mm × 40mm fascia	m	0.33	
50mm × 25mm, 75mm × 25mm, 100mm × 25mm fascia	m	0.17	
25mm × 25mm, 40mm × 25mm, 50mm × 25mm beads, etc.	m	0.15	
Interior Linings			
Wall linings			
10mm Gib ® standard plasterboard (fix only)	m ²	0.20	
10mm Gib ® Braceline (fix only)	m ²	0.22	
13mm Gib ® standard plasterboard (fix only)	m ²	0.22	
16mm Gib ® standard plasterboard (fix only)	m ²	0.26	
19mm Gib ® standard plasterboard (fix only)	m ²	0.30	
Stopping of standard plasterboard	m ²	0.25	
4.75mm, 6mm hardboard	m ²	0.30	
12mm Pinex softboard	m ²	0.18	
4.5mm Hardiflex	m ²	0.38	
4.75mm plastic covered wallboard	m ²	0.60	
7.5mm, 9mm plywood	m ²	0.50	
13mm Pinex panels	m ²	0.22	
13mm Pinex acoustic tiles	m ²	0.32	
Extra values on linings, for			
Screw fixing	m ²	0.45	
Glue fixing	m ²	0.25	
PVC Jointers	m ²	0.16	

	Unit	Tradesman Hours	Labourer Hours
Wall strapping			
50mm × 25mm at 300mm centres	m	0.08	
75mm × 25mm at 300mm centres	m	0.08	
50mm × 25mm at 600mm centres	m	0.11	
75mm × 25mm at 600mm centres	m	0.11	
50mm × 25mm at 600mm centres on concrete	m	0.20	
Ceiling linings			
10mm Gib ® standard plasterboard (fix only)	m ²	0.22	
Stopping of standard plasterboard	m ²	0.28	
12mm Pinex softboard	m ²	0.20	
4.75mm, 6mm hardboard	m ²	0.40	
4.5mm fibre cement	m ²	0.50	
13mm Pinex panels	m ²	0.30	
13mm Pinex acoustic tiles	m ²	0.35	
4.75m Seratone	m ²	0.38	
Ceiling strapping			
50mm × 25mm at 300mm centres	m	0.08	
75mm × 25mm at 300mm centres	m	0.08	
Flooring			
Tongued and grooved flooring			
100mm × 25mm	m ²	1.00-1.25	
100mm × 25mm end matched	m ²	0.75-1.00	
Particle board			
2400mm × 1200mm × 20mm sheet	m ²	0.40	
3600mm × 1200mm × 20mm sheet	m ²	0.38	
3600mm × 1800mm × 20mm sheet	m ²	0.36	
Plywood flooring			
2400mm × 1200mm × 17.5mm sheet	m ²	0.38	
2400mm × 1200mm × 21mm sheet	m ²	0.40	
Interior Finishings			
Skirtings	m	0.16	
Architraves	m	0.18	
Cornices	m	0.15	
Sill boards	m	0.25	
Facings	m	0.18	
Doors and Frames, Fix Only			
Timber frame to suit door size			
1980mm × 760mm, in stud wall	No	1.50	
Hollow core flush door, size			
1980mm × 760mm on two hinges	No	1.80	
1980mm × 760mm on three hinges	No	2.00	
Solid core flush door, size			
1980mm × 760mm on three hinges	No	2.00	
1980mm × 760mm on four hinges	No	2.40	

	Unit	Tradesman Hours	Labourer Hours
Panelled, framed and glazed door, size			
1980mm × 760mm on two hinges	No	2.00	
1980mm × 760mm on three hinges	No	2.40	
Roller shutters			
Domestic shutter, 2100mm × 2400mm wide	No	4.00	
Industrial shutter, 3000mm × 3000mm wide	No	6.00	
Hardware, Fix Only			
Lockset and furniture	Set	0.80	
Surface mounted closer	No	1.20	
Concealed closer	No	1.60	
Fixings			
Drill brick wall for 12mm dia. masonry anchor	No	0.10	
Drill concrete wall for 12mm dia. masonry anchor	No	0.13	
Drill timber for 6/12mm dia. bolt	No	0.05	
Drill steel angle for 6/12mm dia. bolt	No	0.13	

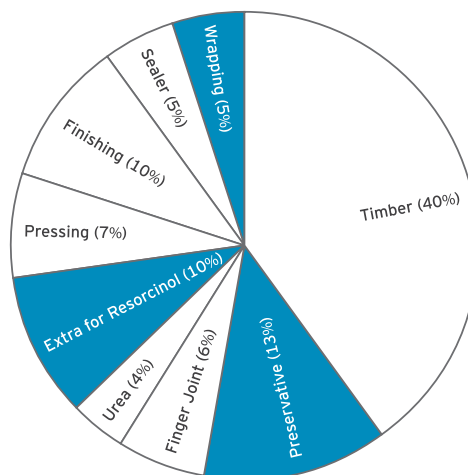
LAMINATED TIMBER

Specification Outline for Glulam

Timber	Radiata or NZ Douglas Fir Kiln Dried graded to the Engineers Design Spec or to achieve F8 Strength Beam All timber must be kiln dried to 12–15%
Built in Camber	As specified or 1/400
Treatment of Timber H4	a) Pre treated Radiata : Interior H1, Exterior H3. In ground H4 b) Treated after fabrication with saturation coating
Glue	a) Interior or protected use – melamine urea b) Exterior or wet use – phenol or resorcinol
End Joints in Laminations	Finger jointed to NZS 3616
Surface Finish	a) Utility for industrial or not seen positions – planer dressed with some low spots, no filling b) Standard sanded with filling or plugging as required for exposed to view positions.
Protection	a) Water repellent sealer/stain – one coat before despatch from factory. Next coat applied after 8–10 weeks if in weather. b) Wrapping may be applied as protection from dirt etc during transport and handling. c) Lifting and handling of heavy beams by nylon slings.
General	All manufacture to be carried out to the requirements of NZS 3606 McIntosh Licence No. 2061 and NZS 3616 McIntosh Licence No. 2354.

Pie chart showing typical cost structure of glulam production. Shaded segments represent significant cost savings possible in certain applications.

It is strongly recommended that manufacturers be contacted directly for price estimates of all glulam structures. Published price lists reflect a retail value for one-off items which should not be applied to material in specifically designed structures.



JOINERY

DOORS	Width, mm	Mass (kg)	
		Solid Core	Hollow Core
Height : 1980 mm	460	–	8.2
	610	25.2	9.6
Nominal Thickness (mm)	660	26.8	10.5
Solid Core 36	710	29.0	11.6
Hollow Core:	760	30.5	11.8
Veneer 35	810	31.5	12.3
Hardboard 34	860	33.8	13.6
MDF 36	910	34.5	14.3

Construction

Plyco Flush doors are made with timber stiles and rails, solid (Superflake LD particleboard) core or hollow (cellular) core and selected facings.

Open Top Doors

Standard Opening 600 high × door width less 225 (112 from top of door).

Natural Wood Veneer Facings

Rimu : Heart, Figured, Select Pale or Economy Sapele, Sapele Rotary, Tawa, Kauri, Utility Veneer

Paint Quality Facings

Hardboard.

MDF Thinline. Clashed or unclashed.

Premium (4.75 hardboard) skins : for high gloss paint or sprayed lacquer. Unclashed.

Entrance Doors (not exposed to direct weather) : tempered hardboard.

Exterior Doors : tempered hardboard skins, waterproof resorcinol adhesive, solid core, tanalised timber frame, unclashed.

Clashing Strips

Except as noted above, solid core doors are clashed two edges, hollow core doors are clashed generally one edge but two edges in the case of Tawa, Rimu Heart or Figured, Sapele and Entrance doors. All hollow core doors can be clashed on two edges on request at extra cost.

Note: The manufacturer will quote special prices for non-standard sizes, and for matched pairs of Rimu faced doors.

LABOUR CONSTANTS – JOINERY

	Unit	Tradesman Hours	Labourer Hours
Joinery			
Staircases			
Timber staircase , comprising strings, treads, landing supports and balustrades	m/rise	8.00	
Handrail , 150mm × 50mm fixed to steel, including ramps and wreaths	m	0.45	
Cupboards, Shelving			
Cupboards , fabricate and fix			
Standard kitchen cupboard, 450mm wide × 900mm high	m	6.00	
Shelving, 225mm × 25mm, fixed to framing	m	0.17	

ROOF COVERINGS

Roofing	Overall Sheet Width mm	Cover	Pitch of Crests	Galv Steel BMT mm	Aluminium Thickness mm
Floclad Brownbuilt 900	960	900	150	0.40, 0.55, 0.75	0.70, 0.90
Dimond LT7	933	889	127	0.40, 0.55, 0.75	0.70, 0.90
Dimond V-Rib	966	915	101.6	0.40, 0.55, 0.75	0.70, 0.90
Spandek	754	700	87.5	0.40, 0.55, 0.75	
Trimdek	810	755	189	0.40, 0.55	
Windek	793	750	250	0.40, 0.55	
Dimond Metric	1043	1000	250	0.40, 0.55	
Styleline	810	750	250	0.40, 0.55	
Corrugated (10.5 × 76.2)	851	762	76.2	0.40, 0.55	
Corrugated (8 × 76.2)	661	572	76.2	0.40, 0.55	
Ditto with 2 corr side lap	661	534	76.2	0.40, 0.55	
Dimondek 300	–	305	152.5	0.40, 0.55, 0.75	
Dimondek 400	–	406	203	0.40, 0.55, 0.75	
Twin-Rib	870	762	323.8	0.40, 0.55	
Fineline Cladding	947	915	66	0.55, 0.75	
Steelspan 900	970	888	230	0.40, 0.55, 0.75, 0.95	
Hardies Super Six	1080	1000	150	Fibre cement 6.45mm thick	

LONG RUN ROOFING

Lengths up to 18 m are available custom-cut and supplied to any location in New Zealand. Some rail routes and alternative transport facilities can accommodate longer lengths. Only in exceptional circumstances will the Ministry of Transport give a permit to transport longer lengths than 25 m. Site handling is also a limiting factor.

Roofing Stock Lengths

Corrugated Galvanised Steel	1500 to 3600 (in 300 multiples)
Corrugated Aluminium	1500 to 5400 (in 300 multiples)
Super Six	1800, 2400, 2700, 3000

THERMAL MOVEMENT

With long run metal roofings, allowances must be made for thermal movement. The amount of movement sheet metal roofing will undergo depends upon:

1. The range of temperature – the actual high and low temperature of the material – which varies with colour.
2. The coefficient of thermal expansion of the material.
3. The length of the roofing sheet.

The following table indicates the expected movement for various situations. For design purposes the temperature range for light coloured roofs is 40°C and for dark coloured roofs is 65°C.

Sheet Length		15 m	20 m	25 m	30 m
Galv Steel	Light Colour	7 mm	10 mm	12 mm	14 mm
	Dark Colour	12 mm	16 mm	19 mm	23 mm
Aluminium		14 mm	19 mm	24 mm	29 mm

MASS

Material	Mass in kg/m ²				
	Thickness mm	Dimondek		Circular Corrugated	
		300	400	8 corr	10½ corr
Galvanised Steel	0.40	6.10	5.49	4.98	4.15
	0.55	8.35	7.51	7.20	6.12
	0.75	10.50	9.45		
Aluminium	0.55				1.84
	0.70	3.22	2.90		2.34
	0.80	3.67	3.31		
	0.90	4.13	3.72		

Mass in kg/m²

Butyl rubber sheet	1.0 mm	1.26
	1.5 mm	1.89
	2.0 mm	2.52
Decramastic (protected metal) tiles		7.85
Hardies (fibre cement) shingles		22.00
Monier (concrete) tiles		46.50

VARIATIONS OF ROOF AREA WITH SLOPE

Incline		Percentage Increase in area over flat roof
per metre horizontal	Angle with Horizontal	
mm	Degree Minute	%
Flat Roofs		
10	0 34	0.005
20	1 10	0.020
30	1 43	0.045
40	2 18	0.08
50	2 52	0.125
75	4 17	0.28
100	5 43	0.50
125	7 07	0.78
150	8 32	1.12
175	9 56	1.52
Pitched Roofs		
200	11 20	1.99
250	14 02	3.08
300	16 42	4.40
350	19 17	5.95
400	21 48	7.70
500	26 34	11.80
600	30 58	16.62
700	35 00	22.07
800	38 40	28.06
900	42 00	34.54
1000	45 00	41.42
1500	56 20	80.28
2000	63 26	123.61

Labour content varies significantly between the following:

- Low pitch 0° – 25°
- Medium pitch 25° – 45°
- High pitch 45° – 80°
- Vertical 80° – 90°

(depending on the amount of safety precautions roofers need to take)

INSULATING PANEL SYSTEMS

(Bondor New Zealand)

Expanded Polystyrene (EPS)

Sheet size 4800 × 1200 (North Island), 3600 × 1200 (South Island)

Thickness from 10 to 480 mm, cut by hot wire.

Standard Thickness 5, 10, 12.5, 15 to 75 (in increments of 5),

100, 125, 150, 175, 200, 250, 300

The four classes of EPS manufactured to AS 1366 are SL, S, H, VH – in order of increasing strength.

EPS Exterior Insulation and Render Finish System

When applied on site the system comprises:

1. EPS insulation board
2. Render coat of acrylic and Portland cement mix
3. Fibreglass reinforcing mesh
4. Acrylic based top coat

The above system may be applied prefabricated on a substrate screwed to a light steel frame, ready to bolt in place on the face of the building. Sculptured effects are obtained by profile cutting of the EPS block.

The manufacturer usually supplies EPS for applicators to fix and render, but for large commercial work will contract for the whole system.

Equibond Insulated Panel

Equibond is a composite panel comprising two Colorsteel lightly ribbed outer skins laminated under tension onto an EPS core. Panels are jointed with folded “slip joint”, without a joint strip.

Panel width 1200 mm

Length to order – limited only by handling and transportation

Thickness: 45, 50, 75, 100, 125, 150, 175, 200, 225, 250

Mass of 100 thick panel: 11.5 kg/m²

Equiroof Insulated Roof Panel

Equiroof is a structural sandwich panel for long spans between purlins or girts. It combines a Colorsteel profiled roof exterior facing, rigid urethane foam insulation and a Colorsteel lightly ribbed interior lining, has a proven lap type joint and screw fixings similar to conventional roofing.

Panel widths are 1060 (3 rib), 1000 (5 rib), 900 (7 rib)

Length up to 11 m

Core Thickness: 50, 75, 100, 125, 150

Roof rib height: 32

PLUMBING

ALUMINIUM ALLOY SHEET

Thickness mm	kg/m ²
0.16	0.434
0.18	0.488
0.20	0.542
0.22	0.596
0.25	0.678
0.28	0.759
0.30	0.813
0.35	0.949
0.40	1.084
0.45*	1.220
0.50	1.355
0.55*	1.491
0.60	1.626
0.70*	1.897
0.80	2.168
0.90*	2.439
1.00	2.710
1.10	2.981
1.20*	3.252
1.40	3.794
1.60*	4.336
1.80	4.878
2.00*	5.420
2.20	5.962
2.50*	6.775
2.80	7.588
3.00*	8.130
3.50	9.485
4.00*	10.840
4.50	12.195
5.00*	13.550
5.50	14.905
6.00*	16.260

*Thickness normally available

COPPER – SHEET AND STRIP

Thickness, mm	kg/m ²	Thickness, mm	kg/m ²
0.08	0.72	0.70	6.26
0.12	1.07	0.90	8.05
0.15	1.34	1.2	10.73
0.20	1.79	1.5	13.41
0.25	2.24	2.0	17.88
0.30	2.68	2.5	22.35
0.40	3.57	3.0	26.82
0.50	4.47		

Stock Sizes

Sheet: 2400 × 1000

Coil: 1000 wide

Shim: 300 wide

Strip: 245 and 273 wide

Finishes

Natural Copper – oxidation changes the appearance from pale brown to dark brown after a few years, eventually developing a green patina.

Nordic Green & Nordic Copper – have a pre-painted appearance.

Nordic Décor Copper – has a light or heavy rolled textured surface on one side and is available in natural copper and in Nordic Brown.

ZINC SHEET

Thickness mm	Mass kg/m ²
0.5	3.60
0.6	4.32
0.7	5.04
0.9	6.48

COPPER TUBES

Nominal Bore	Approx Outside Diameter	Light Wall Tubes	Domestic Copper Tubes NZS 3501		Mass
			For Water and Gas	For Sanitation	
mm	mm	Wall Thickness, mm			kg/m
10	11		0.91		0.267
15	15	0.70			0.275
15	15		1.02		0.387
20	21	0.90			0.509
20	21		1.02		0.566
25	27		1.02	1.02	0.744
32	34	0.91			0.835
32	34		1.22	1.22	1.124
40	40	0.91			0.998
40	41		1.22	1.22	1.346
50	53		1.22	1.22	1.778
65	66		1.22	1.22	2.200
80	79			1.42	3.110
80	80		1.63		3.560
100	105			1.63	4.690
100	105		2.03		5.719
125	130			1.63	5.870
150	156			1.83	7.860

100, 125 and 150 NB are imported sizes.

NZS 3501 NZ Domestic Copper Tubes (replaced NZS 1755)

Available in 5 metre lengths. Jointing can be with capillary or compression fittings, silver bronzing or by suitable method of welding.

STEEL TUBES

Nominal Bore	Approx Outside Diameter mm	Grade	Wall Thickness mm	Metres Per Tonne		Girth for Painting mm
				Black P.E.	Galv. P.E.	
15	21.2	Light	2.00	1,049	998	67
15	21.4	Medium	2.65	819	785	
15	21.4	Heavy	3.25	690	669	
20	26.6	Light	2.35	709	682	85
20	26.9	Medium	2.65	633	609	
20	26.9	Heavy	3.25	529	512	
25	33.5	Light	2.65	497	479	106
25	33.8	Medium	3.25	409	397	
25	33.8	Heavy	4.05	335	327	
32	42.2	Light	2.65	388	374	134
32	42.5	Medium	3.25	318	308	
32	42.5	Heavy	4.05	260	253	
40	48.1	Light	2.90	306	296	152
40	48.4	Medium	3.25	276	268	
40	48.4	Heavy	4.05	225	219	
50	59.9	Light	2.90	243	235	189
50	60.3	Medium	3.65	196	191	
50	60.3	Heavy	4.50	162	158	
65	75.6	Light	3.25	172	167	239
65	76.0	Medium	3.65	153	149	
65	76.0	Heavy	4.50	126	123	
80	88.3	Light	3.25	146	142	279
80	88.8	Medium	4.05	118	115	
80	88.8	Heavy	4.85	99	97	
100	113.4	Light	3.65	101	98	358
100	114.1	Medium	4.50	82	80	
100	114.1	Heavy	5.40	69	68	
125	139.7	Medium	4.88	62	61	439
125	139.7	Heavy	5.40	56	55	
150	165.1	Medium	4.88	52	51	519
150	165.1	Heavy	5.40	47	46	

125 NB and 150 NB are imported sizes, as are also the small sizes 6 NB, 8 NB, 10 NB.

NB	OD	Medium Grade		Heavy Grade	
		Wall	kg/m	Wall	kg/m
6	10.2	2.0	0.407	2.6	0.493
8	13.5	2.3	0.65	2.9	0.77
10	17.2	2.3	0.852	2.9	1.02

GALVANISED STEEL SHEETS

Changes in the specifications of galvanised steel products used in the manufacture of building materials such as roofing, cladding, etc are the result of the revised Standards NZS 3441:1978 Hot-dipped Zinc-coated Steel Coil and Cut Lengths.

1. Thickness

Prior to the Standard's introduction, the thickness of galvanised steel building products was specified to include the two layers of the galvanising process – i.e. the TOTAL COATED THICKNESS or TCT of the steel base plus the zinc coating.

Under the revised Standard this method of specification has been replaced entirely by a system which concentrates solely on the BASE METAL THICKNESS or BMT of the product i.e. the thickness of the steel only. The new specification however, DOES NOT ALTER THE OVERALL THICKNESS of galvanised steel products.

Approximate Birmingham Gauge	TCT mm	BMT mm
14	2.00 (nominal)	1.85
16	1.60	1.55
18	1.20	1.15
20	1.00	0.95
22	0.80	0.75
24	0.60	0.55
26	0.50	0.45
26 cml	0.45	0.40

2. Metallurgical Grade

Ductile: For products where NO structural properties are required (e.g. flashing or ridging), a ductile grade known as GC may be specified.

Structural: Where galvanised steel products are manufactured for structural purposes (e.g. roofing, purlins, concrete formwork etc.) they must be specified to conform with one of the revised Standard's structural grades. Under the revised Standard, structural grades are directly related to a **guaranteed minimum yield stress** of the steel base, which is indicated numerically in each case eg G250 has a minimum yield stress of 250 MPa.

Former Terminology	New Terminology
Drawing Quality Medium Strength	G250 G300
High Strength	G350 (new Grade) G450 (1.5 mm & greater) G500 (1.0 mm to less than 1.5 mm) G550 (less than 1.0 mm)

3. Zinc Coating

Old Coating Weights		New Coating Masses	Recommended For
oz/sq ft	g/m ²	g/m ²	
0.25	75	100	Steel studs; ventilation ducting
0.50	150	200	
1.25	275	300	Colorcoat pre-painting all external applications culverts
1.75	425	400	
2.00	505	500	

Theoretical coating thickness per 100 g/m² = 0.014 mm

Zinc Coating Types

As well as manufacturing a range of zinc coating masses, New Zealand Steel produces a number of surface finishes.

The majority of galvanised steel used in the building industry has a “Regular Spangle” surface finish and under the revised Standard this is designated **type Z**. A special “Minimised Spangle” surface may also be specified where surface appearance is paramount, e.g. suspended ceiling systems. Under the revised Standard this coating type becomes **ZM**. The Zinc coating type and coating mass are then combined to give the required **coating class** eg Z400.

COLORSTEEL Product Type	Recommended Environment	Prohibited Environment
Colorsteel G2	Mild or moderate environments including moderate marine, geothermal or industrial	Severe marine, geothermal or industrial, condensation above 30 Deg C
Colorsteel VP (Not generally available ex-stock)	Severe marine or industrial	Continuous temperature above 65 Deg C or high internal humidity
Colorsteel FL (Not generally available ex-stock or for contracts less than 1000 m ²)	Severe marine, geothermal or industrial. High aesthetic and good hygienic requirements	Where underside environments are severe

URINALS

No. of Stalls	Maximum Length of Slab	NB of Waste Pipe	NB of Vent Pipe	NB of Flush Pipe	Capacity of Cistern
	m	mm	mm	mm	Litres
1	0.6	50	50	20	5
2	1.2	50	50	25	9 or 10
3	1.8	65	50	32	14 or 15
4	2.4	65	50	32	18 or 20
5	3.0	80	50	32	23 or 25
6	3.6	80	50	32	28 or 30

Capacities of Zip Water Heaters and Hot Water Cylinders

Litres	Litres
6.5	155
9	180
13	200
18	225
22	270
27	320
40	360
45	450
54	700
65	900
90	1100
110	1300
135	

CORROSION OF METALS

Group Number	Corroded End Anode Positive	Symbol
(1)	Magnesium Aluminium	Mg Al
(2)	Zinc Cadmium	Zn Cd
(3)	Iron Chromium–Iron (active) Chromium–Nickel–Iron (active)	Fe
(4)	Soft Solder Tin Lead	Sn Pb
(5)	Nickel Brasses Bronzes Nickel–Copper Alloys Copper	Ni Cu
(6)	Chromium–Iron (passive) Chromium–Nickel–Iron (passive) Silver Solder Silver Gold Platinum Negative Cathode Protected End	Ag Au Pt

This series is built upon actual experience with corrosion and laboratory measurement.

Metals shown grouped together have little tendency to produce galvanic corrosion on one another.

In general, the greater the distance between any two metals on the list, the greater will be the tendency towards corrosion if these metals are connected.

When galvanic corrosion takes place between two metals on the list, in general it will be the one higher on the list that will be corroded.

The Chromium–Iron and Chromium–Nickel–Iron alloys (stainless steels) may change position as indicated. The factors governing this phenomenon are too complex to permit prediction of probable results within the scope of this list.

The series as it stands is correct for many dilute water solutions such as sea water, weak acids and alkalies.

RIGID PVC PRESSURE PIPE

Sizes, Classes and Pressure Ratings at 20°C.

Nom Pipe Size	Mean Outside Diameter	Class B			Class C		
		Pressure Rating 60 metre head/0.6 MPa			Pressure Rating 90 metre head/0.9 MPa		
		ID	Mean Wall Thickness	Mass	ID	Mean Wall Thickness	Mass
	mm	mm	mm	kg/m	mm	mm	kg/m
15	21.4						
20	26.8						
25	33.5						
32	42.2						
40	48.3						
50	60.4				55	2.7	0.73
65	75.2				69	3.2	1.07
80	88.9	83	3.1	1.25	82	3.7	1.49
100	114.3	107	3.6	1.87	105	4.8	2.46
125	140.2	132	4.0	2.57	129	5.8	3.71
150	168.3	159	4.8	3.63	154	7.0	5.32
200	219.1	208	5.6	5.60	203	8.2	8.00

Nom Pipe Size	Mean Outside Diameter	Class D			Class E		
		Pressure Rating 120 metre head/1.2 MPa			Pressure Rating 150 metre head/1.5 MPa		
		ID	Mean Wall Thickness	Mass	ID	Mean Wall Thickness	Mass
	mm	mm	mm	kg/m	mm	mm	kg/m
15	21.4				18	1.8	0.16
20	26.8				23	2.0	0.23
25	33.5				29	2.3	0.34
32	42.2	38	2.3	0.44	36	2.9	0.53
40	48.3	43	2.7	0.57	42	3.3	0.69
50	60.4	54	3.3	0.89	52	4.1	1.08
65	75.2	67	4.1	1.38	65	5.1	1.68
80	88.9	79	4.9	1.92	77	6.0	2.33
100	114.3	102	6.3	3.17	99	7.7	3.86
125	140.2	125	7.7	4.77	121	9.5	5.81
150	168.3	150	9.3	6.94	146	11.4	8.37
200	219.1	198	10.8	10.60			

LABOUR CONSTANTS – PLUMBING

	Unit	Tradesman Hours	Labourer Hours
Sanitary Fixtures			
• Fix only including brackets, fixings, etc.			
Vanity basin	No	1.70	
Wall basin	No	1.75	
Bath , pressed steel	No	1.40	
Bidet – excluding heater	No	2.00	
W.C. suite	No	2.35	
W.C. pan			
	Floor mounted	No	1.00
	Wall mounted	No	4.00
Cistern , wall type	No	1.00	
Cleaner’s sink	No	1.80	
Kitchen sink	No	1.50	
Laundry trough	No	1.00	
Slop hopper	No	5.00	
Urinal			
	single stall	No	3.50
	1800mm long	No	5.00
	3000mm long	No	6.50
Hot Water Units			
• Fix only, including connections to piping			
Hot water cylinder			
	Instantaneous multi-point	No	1.50
	180 litre mains pressure, glass lined	No	3.00
	Add for low pressure unit	No	3.00
Cocks, Taps and Traps			
• Fix only including connections, diameter			
Stop cock	15mm to 25mm	No	0.25
	32mm	No	0.35
	40mm	No	0.50
	50mm	No	0.75
Tap or faucet			
	Basin combination set	Set	0.50
	Laundry combination set	Set	0.75
	Pillar tap	Set	0.35
	Shower combination set	Set	3.00
	Sink combination set	Set	1.25
‘S’ or ‘P’ trap , copper or brass			
	40mm diameter	No	0.25
	50mm diameter	No	0.30
‘S’ or ‘P’ trap , PVC			
	32mm diameter	No	0.50
	40mm diameter	No	0.55
	50mm diameter	No	0.60

		Unit	Tradesman Hours	Labourer Hours
Soil, Waste and Vent Pipes				
• Constants include fixing to walls and testing.				
• Pipe constants exclude bends, junctions, etc. To include these in 'per metre' constant, allow one fitting for every 2 to 3 metres of pipe				
Copper pipe, diameter	32mm	m	0.35	
	40mm	m	0.40	
	50mm	m	0.47	
	65mm	m	0.53	
	80mm	m	0.60	
	100mm	m	0.68	
	150mm	m	0.78	
Bend, diameter	32mm	No	0.15	
	40mm	No	0.18	
	50mm	No	0.25	
	65mm	No	0.30	
	80mm	No	0.35	
	100mm	No	0.45	
Junction, diameter	150mm	No	0.65	
	32mm	No	0.22	
	40mm	No	0.26	
	50mm	No	0.30	
	65mm	No	0.35	
PVC pipe, diameter	80mm	No	0.40	
	100mm	No	0.50	
	150mm	No	0.80	
	32mm	m	0.25	
	40mm	m	0.28	
	50mm	m	0.30	
Bend, diameter	65mm	m	0.33	
	80mm	m	0.38	
	100mm	m	0.40	
	32mm	No	0.16	
	40mm	No	0.18	
	50mm	No	0.22	
Junction, diameter	65mm	No	0.27	
	80mm	No	0.33	
	100mm	No	0.42	
	32mm	No	0.18	
	40mm	No	0.20	
Junction, diameter	50mm	No	0.24	
	65mm	No	0.30	
	80mm	No	0.35	
	100mm	No	0.45	

		Unit	Tradesman Hours	Labourer Hours
Water Pipes				
• Constants include fixing to walls and testing.				
• Pipe constants exclude bends, tees, etc. To include these in 'per metre' constant, allow one fitting for every 2 to 3 metres of pipe				
Copper pipe, diameter	15mm	m	0.22	
	20mm	m	0.24	
	25mm	m	0.26	
	32mm	m	0.30	
	40mm	m	0.35	
	50mm	m	0.40	
	65mm	m	0.47	
	80mm	m	0.55	
	100mm	m	0.65	
Bends, tees				
PVC pipe, diameter	15mm	m	0.13	
	20mm	m	0.13	
	25mm	m	0.16	
	32mm	m	0.18	
	40mm	m	0.20	
	50mm	m	0.23	
	65mm	m	0.26	
	80mm	m	0.30	
	100mm	m	0.35	
Bend, diameter	15mm	No	0.10	
	20mm	No	0.10	
	25mm	No	0.10	
	32mm	No	0.13	
	40mm	No	0.15	
	50mm	No	0.18	
	65mm	No	0.20	
	80mm	No	0.25	
	100mm	No	0.33	
Tee, diameter	15mm	No	0.14	
	20mm	No	0.14	
	25mm	No	0.14	
	32mm	No	0.15	
	40mm	No	0.18	
	50mm	No	0.22	
	65mm	No	0.24	
	80mm	No	0.29	
	100mm	No	0.38	

DRAINAGE

Ceramic Pipes (Earthenware)

Nominal bore : 100 and 150 mm

Spun Concrete Pipes

Class S, X, Y or Z

Nominal effective lengths available are 1.22 m, 1.25 m, 1.83 m and 2.44 m depending on factory location.

- a) **Rubber Ring Jointed**
Nominal bore : 150, 225, 300, 375, 450, 525, 600, 750, 825, 900, 975, 1050, 1200, 1350, 1600, 1800 mm
- b) **Flush Jointed**
Nominal bore : 600, 675, 750, 825, 900, 1050, 1200, 1350, 1500, 1650, 1800, 1950, 2300 mm
- c) **Skid Ring Jointed**
Nominal bore : 1950, 2100, 2550 mm

uPVC Pipes for Sewer

Nominal outside diameter : 110 and 160 mm

uPVC Pipes for Stormwater

Nominal bore : 90 mm

uPVC Pipes for Plumbing And Draining

Nominal Bore	Outside Dia	Wall Thickness	Mass kg/100 m
Waste Pipe NZS 7641			
32	36.3	2.0	32.0
40	43.0	2.1	39.5
50	55.9	2.3	56.5
Soil Pipe NZS 7642			
80	82.6	3.3	121
100	110.2	3.3	162
Sewer Pipe NZS 7649			
100	110.2	3.6	170
150	160.3	4.3	300

LABOUR CONSTANTS – DRAINAGE

		Unit	Tradesman Hours	Labourer Hours
Sewer and Stormwater Drains				
• Constants include laying, jointing and testing, but exclude excavation and backfilling				
Earthenware pipe , with rubber ring joints, diameter				
Sewer	100mm	m	0.50	
	150mm	m	0.70	
	225mm	m	1.00	
Stormwater	100mm	m	0.20	
	150mm	m	0.37	
	225mm	m	0.50	
Bends, junctions	100mm	No	0.25	
	150mm	No	0.25	
	225mm	No	0.50	
PVC pipe , with solvent welded joints, diameter				
Sewer	100mm	m	0.25	
	150mm	m	0.60	
Stormwater	100mm	m	0.20	
	150mm	m	0.35	
Bends, junctions	100mm	No	0.25	
	150mm	No	0.30	
Concrete pipe, with rubber ring joints, diameter				
	100mm	m	0.35	
	150mm	m	0.43	
	225mm	m	0.50	
	300mm	m	0.65	

MECHANICAL SERVICES

PIPE INSULATION

Fibreglass Rigid Pipe Sections

Standard grade is for temperature applications up to 230°C

Special grade is for temperature applications up to 350°C

Each section is a one piece unit, 900 mm long, with a longitudinal hinge which opens for application to the pipe. Sections may be supplied plain, or with various factory applied facings e.g. calico, sisalation etc.

Pipe Material	Nominal Bore of Pipe (mm)	Nominal Insulation Thickness (mm)					
		19	25	38	50	63	75
Copper	10, 15	*	x				
Copper	20, 25, 32, 40, 50, 65	*	x	x	x		
Copper	80, 100, 125, 150		x	x	x	*	
Steel	10	*	x				
Steel	15, 20, 25, 32, 40, 50, 65, 80		x	x	x	*	
Steel	25, 32, 40, 50, 65, 80, 100	*	x	x	x		
Steel	65, 80, 100, 125, 150, 200, 250, 300		x	x	x	*	*

* = special manufacture

Centurylon Elastomeric Closed Cell Insulation

Continuous Service Temperature -40°C to +105°C

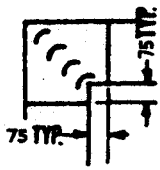
13 mm and 19 mm thickness, 2 m lengths.

Centurylon Inside Diameter 10, 12, 15, 20, 22, 27, 28, 35, 42, 48, 51, 54, 60, 67, 76, 80, 89

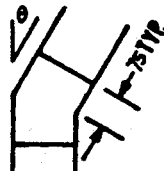
Centurylon "closed cell" PVC nitrile rubber insulation is supplied in tubes, tapes and rolls.

DUCTING TERMS

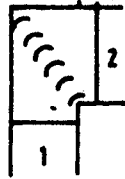
ELBOW



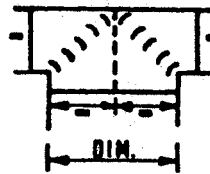
300 ELBOW



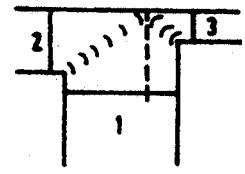
UNEQUAL ELBOW



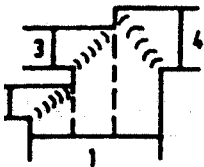
TWIN ELBOW



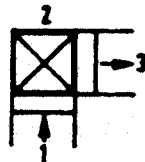
DOUBLE ELBOW



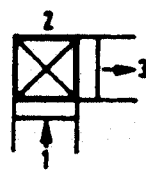
MULTIPLE ELBOW



TWO WAY ELBOW



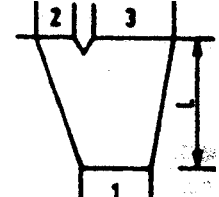
TRANSITION



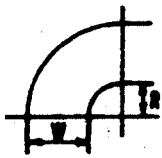
TRANSITION



BIFURCATED TRANSITION



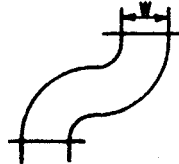
BEND



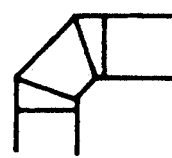
300 BEND



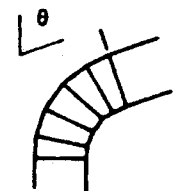
DOUBLE BEND



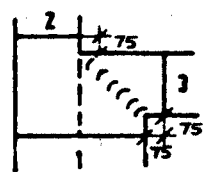
3 PIECE BEND



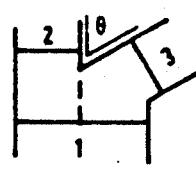
5 PIECE BEND



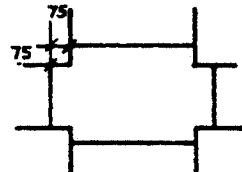
SQUARE TAKE - OFF



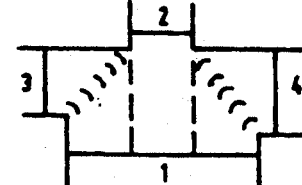
450 TAKE - OFF



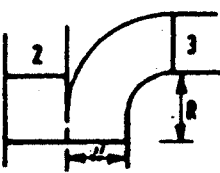
CROSS



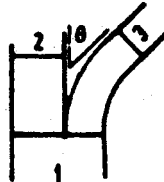
MULTIPLE SQUARE TAKE - OFF



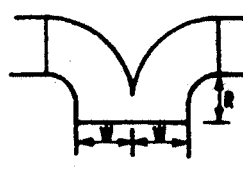
RADIUS TAKE - OFF



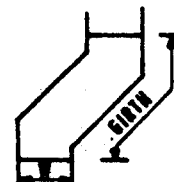
450 RADIUS TAKE - OFF



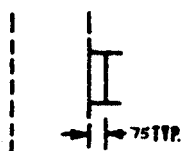
RADIUS TEE



OFFSET



BRANCH



300 BRANCH



600 RADIUS BRANCH



FLEXIBLE CORD COMPARISON CHART)

Metric Cord Conductors (NZS 6402)				Imperial Cord Conductors (NZS 1908)			
Nominal c.s.a. mm ²	Formation Wires/dia mm	Calculated Actual Areas		Formation Wires/dia in	Nominal c.s.a. in		
		mm ²	mm ²				
			0.3				
0.05	16/0.20	0.50	→	← 0.41	14/.0076	0.0006	
			0.6				
0.75	24/0.20	0.75	→	← 0.67	23/.0076	0.001	
			0.8				
1.0	32/0.20	1.0	→	← 1.2	40/.0076	0.0017	
1.5	30/0.25	1.5	→				
			2				
2.5	50/0.25	2.5	→	← 2.0	70/.0076	0.003	
				← 3.2	110/.0076	0.0048	
4	56/0.30	4.0	→	← 4.7	162/.0076	0.007	
			6				
			8				
			10				

In describing electrical cables in imperial sizes, the normal method was to state the conductor stranding for the smaller cables (e.g. 3/.036) and the conductor cross-sectional area for larger cables (e.g. 0.15”).

In metric description the nominal cross-sectional area of the conductors is to be used for all sizes (e.g. 2.5 mm²).

ELECTRICAL TERMS

Ohm's Law enables electrical pressure, current flowing, or resistance, to be calculated. The unit of electrical pressure is the volt (V) and is the difference in electric potential across a circuit. The unit of current flowing is the ampere (amp or A). The unit of resistance is the ohm (Ω).

When any two of these factors are known, the third may be found as follows:

Volts	=	amperes \times ohms
Amperes	=	volts \div ohms
Resistance in Ohms	=	volts \div amperes

"I" is very generally used to denote current and R is used to denote resistance. The three foregoing calculations may then be expressed as follows:

$$V = I \times R, I = V \div R \text{ and } R = V \div I.$$

The watt is the unit of power and equals amperes \times volts.

The wattage dissipated may also be found from:

$$\text{ohms} \times (\text{amperes})^2 \quad \text{or} \quad (\text{volts})^2 \div \text{ohms}$$

It will thus be seen that current or voltage may be found by:

$$\text{amperes} = \text{watts} \div \text{volts} \quad \text{and} \quad \text{volts} = \text{watts} \div \text{amperes}$$

VOLTAGE DEFINITIONS

Extra low voltage means any voltage normally not exceeding 32 volts alternating current or 50 volts direct current.

Low voltage means any voltage normally exceeding 32 volts alternating current or 50 volts direct current, but not exceeding 250 volts in either case.

Medium voltage means any voltage normally exceeding 250 volts but not exceeding 650 volts.

High voltage means any voltage exceeding 650 volts but not exceeding 6600 volts.

Extra high voltage means any voltage exceeding 6600 volts.

In New Zealand the normal three phase 400/230 volt multiple-earthed-neutral system of supply is considered to be a "low voltage" system.

LIGHT FITTINGS

Fluorescent lamp sizes available in New Zealand

Lamp dimensions are nominal only, in mm.

38 Diameter

Watts	Length
4	150
6	225
8	300
13	525
14	375
15	450
20	600
30	900
40	600
40	1200
65	1500
75	1800
85	1500
85	1800
110	2400
125	2400

26 Diameter

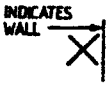












Watts	Length
15	450
18	600
30	900
36	1200
58	1500

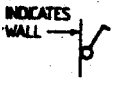






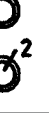




Circular Fluorescent Lamps

Watts	Nominal Lamp Circle Diameter
22	200
32	300
40	400
60	400

ELECTRICAL LOCATION SYMBOLS

NZs 5902 Part 4: 1976
















Description	Symbol
LIGHTING POINTS OR LAMPS	
Lighting point or lamp: general symbol	
Lamp or lighting point: wall mounted	
Emergency (safety) lighting point	
Lighting point with built in switch	
Lamp fed from variable voltage supply	
Projector or lamp with reflector	
Spotlight	
Floodlight	
Fluorescent lighting point	
Auxiliary apparatus for discharge lamp NOTE – only used when the auxiliary apparatus is separated from the lamp fixture	
Illuminated sign (annotation as required) Note: The annotation may include an arrow to indicate direction	
Illuminated emergency or safety sign	
Signal lamp	







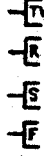







Switches And Outlets	
Single-pole, one-way switch Note: Number of switches at one point may be indicated	
Two-pole, one-way switch	
Three-pole, one-way switch	
Cord-operated single-pole one-way switch	
Two-way switch	
Intermediate switch	
Switch pole lamp	
Push button, e.g., 2 push buttons	
Regulating switch e.g., Dimmer	
Period limiting switch	
Time switch	
Luminous push button	

SOCKET OUTLETS (OTHER THAN TELECOMMUNICATIONS)	
Socket outlet (mains): general symbol. Note: This symbol normally implies an outlet to NZS 1980. Exceptions should be indicated, e.g. Shaver outlet, multi-phase outlet.	INDICATES WALL
Switched socket outlet	
Socket outlet with interlocking switch	
Socket outlet with pilot lamp	
Switched socket outlet with pilot lamp	
Multiple socket outlet Example: for 2 plugs	

CONTROL AND DISTRIBUTION	
Main switchboard	
Main control point (where remote from distribution board).	
Meter panel (where remote from main switchboard).	
Point of supply, overhead	O/H
Point of supply, underground	U/G
Distribution board or point. Note: The circuits controlled by the distribution board may be shown by the appropriate qualifying symbol or reference. EXAMPLES: General distribution Heating Lighting Ventilation	
Transformer	
Surge diverter	

FIXED APPARATUS AND EQUIPMENT	
Electrical appliance: general symbol Note: If necessary use designations to specify type, See fig. 4.1 for examples.	
Heater	
Fan	
Motor: general symbol	
Generator: general symbol	
Thermostat: block symbol	
Humidistat; block symbol	

FIRE ALARM AND SECURITY DEVICES	
Restricted access push button	
Restricted access push button for fire alarm call point–FACP	
Automatic fire detector H. Heat sensitive S. Smoke sensitive	
Watchman system device or key–operated switch	
Bell (warning device)–FAWD	
Buzzer	
Siren	
Horn	
Indicator or control panel	
Lighting arrestor	
Clock and slave clock: (general symbol)	
Master clock	
Synchronous clock	
Impulse clock	
Clock with electrical rewind	

TELECOMMUNICATIONS APARATUS INCLUDING RADIO AND TELEVISION	
Telephone call point Note: Special services may be indicated by appropriate references	
Manual switchboard: general symbol	
Automatic telephone exchange equipment	
Telecommunication cable terminal: General symbol	
EXAMPLES Telephone circuit/terminal/ Telegraph or data circuit/terminal Video circuit/terminal Sound circuit/terminal	
Socket outlet for communications: General symbol	
EXAMPLES Socket outlet for television Socket outlet for radio Socket outlet for sound Socket outlet for telephone	
Teleprinter	
Aerial	
Earth	
Radio or television receiver service to be specified	
Amplifier	
Microphone	
Loudspeaker	

LABOUR CONSTANTS - ELECTRICAL SERVICES

	Unit	Tradesman Hours	Labourer Hours
Electrical Services			
Conduit			
• Constants include installing a nominal quantity of bends and conduit fittings and saddling, to comply with wiring regulations where required			
UPVC Conduit			
Fixed to masonry maximum 4m above floor			
20mm diameter	m	0.15	
32mm diameter	m	0.18	
50mm diameter	m	0.22	
Cast into suspended concrete slab			
20mm diameter	m	0.05	
32mm diameter	m	0.06	
50mm diameter	m	0.08	
Fixed within suspended ceiling space			
20mm diameter	m	0.11	
32mm diameter	m	0.12	
50mm diameter	m	0.15	
Cable			
• Constants include drawing cabling in sets of four cables plus approved size earth cable into adequately sized conduits, With minimal long sweep bends, and for fixing cabling to top of horizontal single side supported trays.			
TPI cable in conduit			
2.5mm ²	m	0.03	
6mm ²	m	0.04	
25mm ²	m	0.05	
35mm ²	m	0.06	
95mm ²	m	0.09	
Four core and earth PVC/PVC circular cable on tray			
2.5mm ²	m	0.08	
6mm ²	m	0.11	
16mm ²	m	0.17	
35mm ²	m	0.23	
95mm ²	m	0.42	
150mm ²	m	0.59	

	Unit	Tradesman Hours	Labourer Hours
MIMS/PVC cable on tray, single core			
6mm ²	m	0.11	
10mm ²	m	0.13	
25mm ²	m	0.17	
50mm ²	m	0.23	
70mm ²	m	0.25	
120mm ²	m	0.32	
MIMS/PVC cable on tray, four core			
4mm ²	m	0.11	
6mm ²	m	0.13	
10mm ²	m	0.17	
16mm ²	m	0.23	
25mm ²	m	0.25	

FIRE PROTECTION

Wet or Dry Riser Systems

General:

These systems provide valves and unlet breechings for Fire Services use on all floors in multi-storey buildings

Dry Riser:

This system is required in buildings from 5 to 45 meters in height. In the normal condition its pipes are dry. An attending Fire Service Pumper will connect to the dry system and pump water to the various landing valves.

Wet Riser:

This system applies to all buildings over 45m in height. It is connected directly to the water main and continually provides water pressure at the landing valve on each floor. The system can also be used to supply standard hose reels.

Coverage:

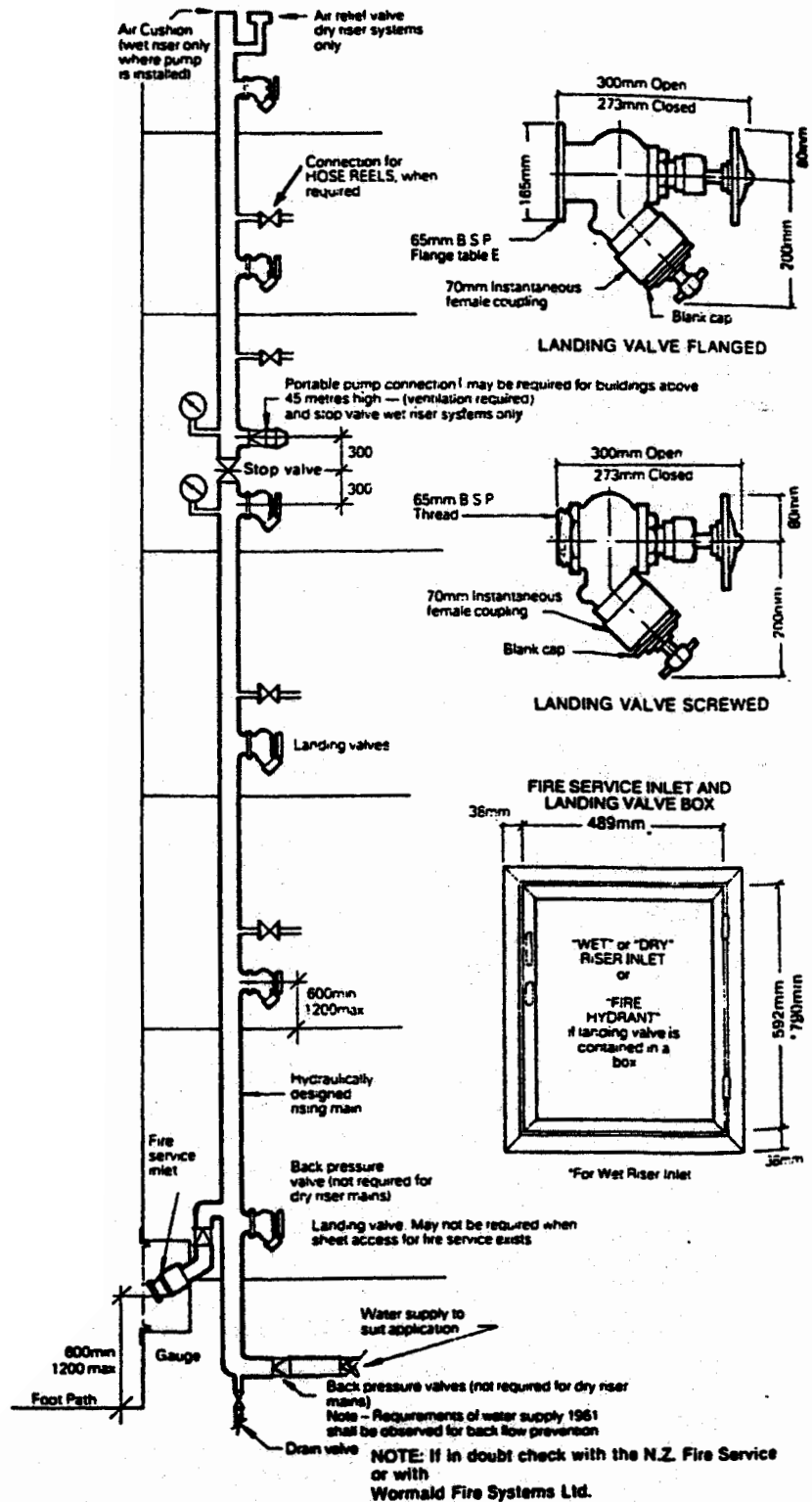
Each landing valve provides coverage to 1000 sq meters of accessible floor area from two 22.5 meter standard Fire Service delivery hoses. For larger floor areas or where subdivisions prevent access, additional riser mains may be required

Specifications:

The following New Zealand Standards provide information on the application of Wet and Dry Riser systems –N.Z.S 4505 (equipment design), N.Z.S 4521 (inlet and landing valve cabinets). N.Z.S 4503 (hose reels), N.Z.S 4510 (system design).

Design:

Wormald Fire Systems will provide a complete hydraulic design for its Riser systems including pumping facilities and will install the system and provide annual maintenance contracts.



SOLID PLASTER

Table 1 : Thickness of Plaster (mm)

Background	Base Coats	Finish Coats	Total
Dense Concrete Walls	15 max	3 max	18 max
Dense Concrete Ceilings	9 max	3 max	12 max
Unit Masonry	12 min	3 max	15 min
Lightweight Concrete and Blocks	12 min	3 max	15 min
Woodwool	18 min	3 min	21 min
Metal Lath	18 min*	3 max	21 min*

(* measured from the face of the metal lath)

Base coats : bond coat and flanking coat

Bond coat : a slurry thrown on to give an open textured layer up to 6mm thick

Table 2 : Recommended mixes for plastering as set down in NZS 4251 "Code of Practice for Solid Plastering"

Background	Finish	Bond Coat	Flanking Coat	Finish Coat
Dense Concrete	Dado	1 : 1.5 CS	1 : 1 : 6 CLS	1 : 2 : 2 CLS
	Sponge	1 : 1.5 CS	1 : 1 : 6 CLS	1 : 1 : 6 CLS
	Tyrolean	1 : 1.5 CS	1 : 1 : 6 CLS	1 : 3 CS
Concrete Masonry	Dado	1 : 1.5-2 CS	1 : 1 : 6 CLS	1 : 2 : 2 CLS
	Sponge	1 : 1.5-2 CS	1 : 1 : 6 CLS	1 : 1 : 6 CLS
	Tyrolean	1 : 1.5-2 CS	1 : 1 : 6 CLS	1 : 3 CS
Metal Lath	Dado	1 : 1 : 6 CLS	1 : 1 : 6 CLS	1 : 2 : 2 CLS
	Sponge	1 : 1 : 6 CLS	1 : 1 : 6 CLS	1 : 2 : 9 CLS
	Tyrolean	1 : 1 : 6 CLS	1 : 1 : 6 CLS	1 : 3 CS
Lightweight concrete and blocks and woodwool slabs	Dado	1 : 2 CS	1 : 1 : 6 CLS	1 : 1 : 1 CLS
	Sponge	1 : 2 CS	1 : 1 : 6 or 1 : 2 : 9 CLS	1 : 1 : 6 or 1 : 2 : 9 CLS
	Tyrolean	1 : 2 CS	1 : 1 : 6 CLS	1 : 3 CS

Note: Key C = Portland cement, L = Lime putty, S = Sand

Dado : trowelled smooth

Sponge : wood floated and lightly textured with a sponge

Tyrolean : final coat thrown or spattered on by machine

Lime Putty : at least 16 hours puttying (soaking) in water prepares the lime to aid workability and reduce shrinkage stresses in the plaster mix

LABOUR CONSTANTS - SOLID PLASTER

	Unit	Tradesman Hours	Labourer Hours
Solid Plaster			
Render for wall tiling , cement and sand in one coat 13mm thick	m ²	0.20	0.10
Cement render , one coat 13mm thick on			
Walls	m ²	0.25	0.11
Soffits	m ²	0.28	0.11
Columns	m ²	0.42	0.18
Beams	m ²	0.42	0.18
Hardwall plaster , two coats 16mm thick on			
Walls	m ²	0.42	0.18
Soffits	m ²	0.50	0.20
Columns	m ²	0.55	0.25
Beams	m ²	0.55	0.25
Skim coat hardwall plaster on soffits	m ²	0.22	0.08
Plaster cove	m	0.15	
Plaster nosing	m	0.15	

GIBRALTAR BOARD

Standard Width 1200 mm	Thickness mm	Length (m)									Mass Kg/m ²
		2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.8	6.0	
Gib Board	10	x	x	x	x	x	x	x	x		6.6
Gib Board	13	x	x	x	x	x	x	x	x		8.7
Gib Ultraline	10			x		x			x	x	7.0
Gib Aqualine	10	x	x	x		x					7.5
Gib Aqualine	13	x	x	x		x					10.0
Gib Braceline	10	x	x	x							8.8
Gib Noiseline	10	x	x	x					x		8.8
Gib Toughline	10			x		x			x		8.8
Gib Toughline	13	x	x	x							11.1
Gib Fyreline	10	x	x	x	x	x					7.0
Gib Fyreline	13	x	x	x	x	x					9.8
Gib Fyreline	16	x	x	x	x						14.15
GibFyreline	19	x	x	x							16.6
Gib X-Block	13			x							15.3

Non-standard lengths are available on special order

LEVELS OF GIB BOARD FINISH

Level	Stopping Required	Suitable for
0	None	Temporary work or if decoration not decided
1	Embed tape in joint compound to joints and internal angles	Above ceilings, concealed and service areas
2	Also one coat of joint compound over all joints, angles, fixings etc	Garages, warehouses fire rating
3	Also smooth the joint compound	Sealer & heavy textured coverings
4	Also additional coats of joint compound	Sealer & Flat or Low Sheen Paint, lightweight wall coverings
5	Also skim coat over the entire surface	Sealer & Gloss or Semi Gloss Paint or where lighting is critical

(Refer to Winstone Wallboards Ltd brochure for full details)

FIBROUS PLASTER

Material	Thickness mm	Mass kg/m ²
Plasterglass	8	8.7
Plasterglass	12.5	13.4
Plasterglass – Ultra hard	12.5	13.4
Fyrwall	12.5	11.6
Fyrwall	16	14.3
Fyrwall	19	18.8
Acoustic tiles: 600 × 600		
Various patterns	35	19*
Roughcast panels 1200 × 600 or 600 × 600	12.5	13.6*

* nominal including grid system

GRID SUSPENDED CEILINGS

LABOUR CONSTANTS - GRID SUSPENDED CEILINGS

	Unit	Tradesman Hours	Labourer Hours
Grid Suspended Ceilings			
Suspension Systems, suspended 600mm from concrete soffit or steel purlins			
Fully concealed suspension system	m ²	0.20	
Exposed grid system	m ²	0.18	
Linings			
10mm plasterboard fixed to concealed suspension system	m ²	0.25	
Plasterboard tiles set into exposed grid system	m ²	0.14	

TILING

		Size mm	Thickness mm	Joint mm	Coverage per m ²	per m
EXTRUDED TILES						
Unglazed						
Eureka Natural	SE Tiles	250 × 250	10	6–8	16	–
	Bull Nose	250 × 100	10	6–8	–	3.9
	Step Tread	250 × 110	10	6–8	–	3.9
Eureka Unglazed	SE Tiles	200 × 200	15	6–8	24	–
	Bull Nose	200 × 100	15	6–8	–	4.8
	Step Tread	200 × 112	12	6–8	–	4.8
Glazed						
Eureka Versatile	SE Tiles	250 × 250	10	6–8	16	–
	Step Tread	250 × 110	10	6–8	–	3.9
Engobe Finish						
Eureka Stonetek	SE Tiles	250 × 250	10	6–8	16	–
	Coving	250 × 110	10	6–8	–	3.9
	Step Tread	250 × 110	10	6–8	–	3.9
Acid Resistant						
Eureka Acid Res.	SE Tiles	230 × 110	15	6–8	36	–
	Coving	230 × 110	25	6–8	–	4.2
PRESSED TILES						
Various makes and thicknesses						
Glazed						
	SE Tiles	100 × 100	6–8	3–5	95	–
		200 × 100	6–8	3–5	50	–
		200 × 200	6–8	3–5	25	–
		250 × 250	6–8	3–5	16	–
		300 × 300	6–8	3–5	11	–
		400 × 400	6–8	3–5	6	–
Unglazed, Fully-Vitrified						
(Matching coves and steptreads are generally only available on indent)						
	SE Tiles	100 × 100	6–9	3–5	95	–
		200 × 100	6–9	3–5	50	–
		300 × 300	6–9	3–5	11	–

		Size mm	Thickness mm	Joint mm	Coverage per m²	per m
MARBLE & GRANITE TILES						
Typical Size	SE Tiles	305 × 305	10	2-3	11	-
WALL & MOSAIC TILING						
Wall Tiles						
		108 × 108	4-5.5	1	83	
		152 × 152	6	1-2	45	
		200 × 100	6	1-2	50	
		200 × 150	6-8	2-3	34	
		200 × 200	6-8	2-3	25	
		250 × 200	6-8	2-3	19	
Mosaic Mats for Walls & Floors		300 × 300	3-6	2-5	11	

Many different makes of floor and wall tiles are available and their dimensions (particularly their thicknesses) vary considerably.

LABOUR CONSTANTS – TILING

	Unit	Tradesman Hours	Labourer Hours
Tiling			
• Factors include pointing and cleaning			
Wall tiles , ceramic/mosaic fixed with adhesive	m ²	0.90	
Floor tiles , ceramic/mosaic including bedding	m ²	0.90	

RESILIENT FLOOR COVERINGS

Skellerup Flooring Ltd

	Thickness mm	Roll Length m	Roll Width m	Mass kg/m
COMMERCIAL VINYL SHEET				
POLYFLOR				
INTERNATIONAL UK				
Polyflor XL	1.5	27.5	2	2.36
Polyflor XL	2.0	20	2	3.20
Polyflor Finesse	2.0	20	2	2.70
Polyflor Panache	2.0	20	2	2.90
Polyflor Premier	2.0	20	2	3.15
Polyflor Super XL	2.5	15	2	4.2
Polyflor Super XL	3.0	13	2	5.01
Polyflor Prestige	2.0	20	2	3.0
Polysafe	2.0	20	2	2.43
Polysafe Embossed	2.0	20	2	1.95
Polysafe Decor	2.0	20	2	2.43
Polysafe Decor Embossed	2.0	20	2	1.95
Polyflor Antistatic	2.0	20	2	3.15
Static Conductive	2.0	20	2	3.50
Conductive O.R.	2.0	20	2	3.00
Conductive R.O.F.	2.0	20	2	3.30
Polyflor Finesse Antistatic	2.0	20	2	2.70
Polyclad Wall Covering	1.25	30	1.83	2.22
FORBO HOLLAND VINYL				
Smaragd	2.0	25	2	2.8
Sure Step	2.0	30	2	
Colour Step	2.0	30	2	
Silver Step	2.0	30	2	
Multi Step	2.0	30	2	
Sure Step Studded	2.0	30	2	
FORBO HOLLAND LINOLEUM				
Marmoleum	2.5	32	2	
Desk Top	2.0	32	1.83	
Bulletin Board	6.0	28.5	1.22	
FORBO ANTISTATIC				
Sure Step Data Floor	2.0	30	2	
Colorex 2000 Tiles	2.0	610 × 610		3.2
Colorex 5000 Tiles	2.0	610 × 610		3.2

Mondo Rubber Tiles

	Thickness (mm)	Size
Studded Tiles MR	4	500 × 500, 1000 × 1000
Studded Tiles RG	2.5	500 × 500
Slate Rubber Tiles	3.5	500 × 500, 1000 × 1000
Futura Studded Tiles	3.5	500 × 500

Mondo Sports Surfaces

Mondosports 1000	2.5, 3.5, 6.5	manufactured
Mondoflex	3.0, 4.5, 6.0	to
Indoorflex	3.5, 5.0	size
Indoorflex	5.0 Double Decker	requested

Residential Vinyl Sheet

	Thickness	Roll Length	Width
Forbo Novilon (Holland)	1.8 to 2.7	25 to 30 m	2 to 4 m

**Vinyl Skirtings
– Skellerup Flooring**

		Length	
Cove C8	100 mm	3 m or 30 m	Black or Fawn
Cove C11	150 mm	3 m	Black, Grey, Fawn
Carpet Skirting	100 mm	50 m	Black, Grey, Fawn
Carpet Skirting	150 mm	50 m	Black, Grey, Fawn
Bevel Strip 25 × 2 mm		30 m	Black
Door Edging Strip		Length	
Flat, Round or Rebated		2.15 m	Black, Grey

Robert Malcolm Ltd

Commercial Vinyl Sheet

	Thickness mm	Roll Length m	Roll Width m
Datwyler Toro 2000	2.5	25	1.5
Datwyler Select Super	2.0	30	1.5
Datwyler Counter Topping	1.2	20	1.5
Datwyler Antistatic	2.0	30	1.25

Nairn Linoleum

Armourflex	2.5, 3.2	25	2.0
Plain	2.5, 3.2	25	1.83

Pirelli Rubber Tiles

	Thickness Overall mm	Thickness Studs mm	Size mm	Mass kg/m²
MT – Medium traffic	4	2	500 x500	4.45
HP – High performance	2.7	0.7	500 x500	3.8
HD – Heavy duty	4	1	1000 × 1000	5.2

Tarkett Products - Jacobsens NZ

	Thickness mm	Roll Length m	Roll Width m
Commercial Vinyl Sheet			
Tarkett Eminent	2.0	25	2
Tarkett Optima	2.0	25	2
Tarkett Multiflor Spezial	2.0	20	1.5
Tarkett Multiflor Granit	2.0	25	2
Tarkett Acoustiflor Granit	3.5	25	2
Tarkett Acoustiflor Optima	3.5	25	2
Tarkett Acoustiflor Eminent	3.5	25	2
Eminent Multisafe – profiled surface	2.0	25	2
Diamondtred – Embossed	3.5	25	1
Conductiflor – semiconductive	2.0	25	2
Antistat – static conductive	2.0	25	2
Gymflor	5.5	21	2

Residential Vinyl Sheet

Tarkett Extra 3000		35	2 & 3
Tarkett Extra 2000		35	2
Tarkett Family		35	2
Tarkett Life		35	3
Tarkett Pegulan		35	3
Tarkett Fashion		25	3
Tarkett Excel		30	3
Tarkett Appeal		35	2 & 4

Vinyl Wall Coverings

Wetwall Aquarie	1.0	50	1
Wetwall Aquarelle	1.0	30	2
Wallgard Murale	1.5	30	1.5

Black Vinyl Skirtings

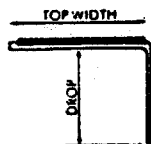
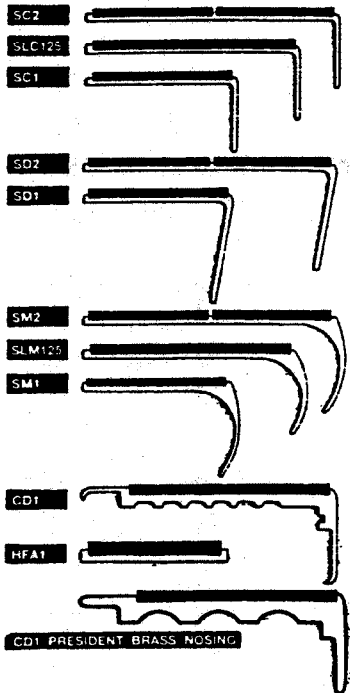
	Size mm	Length
L.T.J. Cove Base Skirting	100, 150	25 m Roll
Ditto with 2 mm Butt Foot	100	25 m Roll
L.T.J. Carpet Skirting	100	25 m Roll

Vinyl Flooring Strips

	Thickness mm	Length
L.T.J. Edge Strip	2, 3.5	25 m Roll
L.T.J. Reducing Strip	0 to 2	25 m Roll
L.T.J. Reducing Strip	0 to 3.5	3m Roll
L.T.J. Floor Wall Finishing Strip		25 m Coil

STAIR NOSINGS

FERODO
STAIR NOSINGS



PROFILE	TOP WIDTH	DROP
SC 1	48 mm	22 mm
SC 2	80 mm	22 mm
SD 1	48 mm	33 mm
SD 2	80 mm	33 mm
SM 1	48 mm	28 mm
SM 2	80 mm	28 mm
SLC 125	66 mm	22 mm
SLM 125	66 mm	25 mm
CD 1	77 mm	24 mm
HFA 1	48 mm	—

ADVANCE
Manufacturing Company

Diamondtred Safety Stairnosings

Old Code	New Code
LS2	AA 201
HB2	AA 202
HR2	AA 203
S2	AA 204
B2	AA 205
R2	AA 206
LSIT	AA 108
LS1	AA 109
LR1	AA 113
S1	AA 114
B1	AA 115
R1	AA 116
UP512	UP 117
BSF1	BR 118
CG1	AA 119
CS1	AA 123
UP911	UP 121
SR2	AA 207
—	AA 122
F1	AA 124

	Dimensions	
	mm	mm
AA201	82	40
AA202	82	35
AA203	82	40
AA204	82	24
AA205	82	24
AA206	82	24
AA207	128	32
AA108	53	40
AA109	48	40
AA113	48	40
AA114	48	24
AA115	48	24
AA116	48	24
UP117	53	32
BR118	48	12
AA119	80	42
UP121	68	25
AA122	38	20
AA123	60	40
AA124	53	

- When Ordering Specify:
- Profile Code
 - Colour of insert
 - Lengths Required
 - Fixing to concrete or wood

Manufactured by
Tredsafe
Pacific Ltd.

LABOUR CONSTANTS - FLOOR COVERINGS

	Unit	Tradesman Hours	Labourer Hours
Floor Coverings			
Carpet laying			
Direct fixed carpet	m ²	0.20	
Carpet and rubber underlay	m ²	0.20	
Cork tiles and clear plastic finish	m ²	0.40	
Linoleum or vinyl fixed with adhesive			
2.5mm thick sheet	m ²	0.30	
Foam backed sheet	m ²	0.40	

PAINTING AND SPECIALIST FINISHES

Paint coverage at recommended dry film build, Dulux Product Specification. Practical spreading rates may be less depending on such factors as application method, application conditions and surface roughness.

	average m² per litre	litres per 100 m²
Lead and Zinc Free Wood Primer	12	8.3
Lead and Zinc Free White U/Coat	12	8.3
Calcium Plumbate Primer	12	8.3
Pigmented Sealer	9	11.1
One-Pack Zinc Rich Paint	9	11.1
Acrylic Lo-Gloss House Paint	13	7.7
Acrylic Full Gloss House Paint	13	7.7
Acrylic Wood Finish	13	7.7
Acrylic Roof Paint	12	8.3
Ferrodor Micaceous Iron Oxide Pigmented Paint	10	10.0
Hi-Gloss Enamel for Exterior	13	7.7
Semi-Gloss Plastic Paint for Interior/Exterior	13	7.7
Flat Plastic Paint for Interior	13	7.7
Matt Enamel for Interior	12	8.3
Semi-Gloss Enamel for Interior	13	7.7
Gloss Enamel for Interior	13	7.7
Polyurethane Clear Finish, Semi-Gloss	10	10.0
Polyurethane Clear Finish, High-Gloss	10	10.0
Paint of Scandatex 6291 Fabric (av for 2 cts)	6	16.7
Can Sizes: 4, 2, 1 litres: 500 ml		
Drum Size: 10 litres		

Painting Actual Surface Areas of Roofing

To find the actual top surface of various profiles multiply the roofing areas by:

1.13	for corrugated steel with 17mm trough
1.16	for corrugated steel with ¾ inch trough
1.22	for Super-Six fibre cement
1.41	for Paneldek 400
1.64	for Diamondek 300
1.50	for Diamondek 400
1.60	for Brownbuilt 300
1.50	for Brownbuilt 400
1.22	for Brownbuilt 450
1.46	for Purlindek Span 20
1.32	for Diamond LT7
1.30	for Diamond V Rib
1.12	for Diamond Twin Rib
1.19	for Diamond Metric
1.15	for Trimdek
1.25	for Spandek
1.27	for Floclad

WALL COVERINGS

Some coverings are hung with butted joints, while others are overlapped, thus affecting the coverage.

Wallpaper	Roll Sizes (mm)
New Zealand Wallpaper	10 050 × 520
English	10 530 × 530
Canadian & French	(check type selected)
Sensations (Jacobsen)	20 100 × 530
Pergamena (Swinsons)	50 000 × 1 040
Antica (Swinsons)	10 000 × 700
Lining Paper	20 100 × 520

The sizes of wallpaper rolls vary according to the manufacturer and country of origin.

New Zealand & English papers will cover approximately 4.68 m² per roll for plain paper and approximately 4.16 m² per roll for patterned paper (however the pattern can affect this greatly). Allowance should also be made for door and large window openings when calculating the number of rolls.

Other Coverings

Tasso (Jacobsen)	50 000 × 1 000
Scandatex (Nylex)	30 000 × 1 000
Glasstex (Swinsons)	50 000 × 1 000
Frontrunner (Nylex)	50 000 × 1 400
Novus (Nylex)	50 000 × 1 850
Studio Vinyl (Nylex)	25 000 × 1 270
Flexiclad Vinyl (Nylex)	100 000 × 1 270
Guard Vinyl (Swinsons)	27 430 × 1 370
Forte (Swinsons)	50 000 × 1 300
Koroseal (Contex)	27 430 × 1 370
Muraweave (Nylex)	50 000 × 1 000
Loomstyle Linen (Nylex)	8 000 × 520
Almtex (Nylex)	25 000 × 900
John Eyre (Nylex)	8 000 × 520

LABOUR CONSTANTS - PAINTING AND SPECIALIST FINISHES

	Unit	Tradesman Hours	Labourer Hours
Painting and Paper Hanging			
Acrylic , prepare and apply two coats			
Walls	m ²	0.20	
Ceilings and soffits	m ²	0.25	
General timber/metal surfaces	m ²	0.23	
Enamel , prepare and apply two coats			
Walls	m ²	0.30	
Ceilings and soffits	m ²	0.32	
General timber/metal surfaces	m ²	0.30	
Polyurethane , prepare and apply two coats to general timber surfaces	m ²	0.18	
Stain , prepare and apply two coats to general timber surfaces	m ²	0.20	
Add 50% for painting/staining to joinery and windows			
Paper hanging , prepare and hang on			
Walls	m ²	0.30	
Ceilings	m ²	0.34	

GLAZING

Glass Type	Thicknesses Generally Available (mm)	Maximum Sheet Size Generally Available ⁽¹⁾ (mm)	Maximum Allowable Glazed Areas ⁽²⁾ ⁽⁷⁾ (m ²)		
			0.5 ⁽⁵⁾ kPa	1.0 kPa	1.5 kPa
Clear Float ⁽³⁾	3	3660 × 2440	2.55	1.28	0.87
	4	3660 × 2440	4.40	2.20	1.50
	5	3660 × 2440	6.75	3.40	2.30
	6 ⁽⁴⁾	3660 × 2440	9.40	4.70	3.20
	10 ⁽⁴⁾	3120 × 2550	–	9.50	6.40
Obscure	4	2140 × 1320	–	–	–
	5 – 6	1840 × 1500	–	–	–
Georgian Wired Clear	6	3300 × 1980	4.70	2.35	1.60
Georgian Wired Cast	6	2760 × 1840	4.70	2.35	1.60
			Maximum Recommended Size ⁽⁶⁾		
Clear Mirror Float	3	2440 × 1840	1.5 m ²		
	4	2760 × 2140	3.0 m ²		
	5	2760 × 2140	6.0 m ²		
	6	3300 × 2440	6.0 m ²		
Vinyl-backed Safety Clear Mirror Float	4	2760 × 2140	1.5 m ²		

Float Glass thickness (mm)	3	4	5	6	8	10
Mass (kg/m ²)	7.5	10	12.5	15	20	25

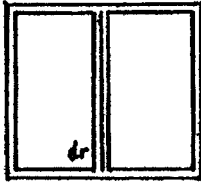
Notes:

- (1) Available sheet sizes vary according to the source of supply.
- (2) For glass supported on four edges. Refer also to NZS 4223:1985 and NZS 42231 Part4: 2000.
- (3) Clear Sheet and Polished Plate glass are no longer available. The quality of float glass for normal glazing is described as Glazing Quality.
- (4) Clear Float glass is also available in 8, 12, 15, 19 & 25 mm thicknesses.
- (5) Design Wind Pressures for each project should be specified by the Architect or Engineer, and will depend on location, aspect, exposure, etc. Three typical pressures are given.
- (6) Maximum recommended areas or sizes for mirrors which are fixed on four edges, glued on back, or mounted top & bottom.
- (7) For glass within 2000 mm of floor refer to Window Panels on the following page.

NZ STANDARDS GUIDE

Safety Glazing Ready Reckoner

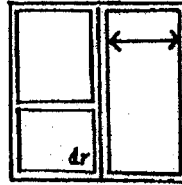
Door & Side Panel:
Full height panels
Clause 304 & 305



5mm laminate up to 2.0m²

6mm laminate up to 3.0m²
4mm toughened up to 2.0m²
5mm toughened up to 3.0m²
6mm toughened up to 4.0m²

Door with Vision Rail & Side panel over 500mm
Clause 304 & 305

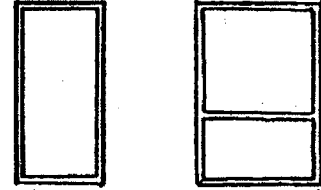


Door Panels

5mm Annealed up to 0.5m²

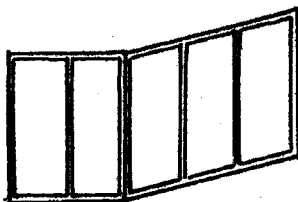
Side Panel
5mm laminate up to 2.0m²
6mm laminate up to 3.0m²
4mm toughened up to 2.0m²
5mm toughened up to 3.0m²
6mm toughened up to 4.0m²

Window Panels
Clause 307.1



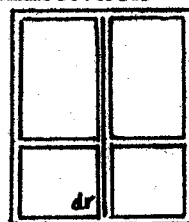
Lower Panels within 200mm of floor.
5mm Annealed minimum up to 1.2m²
6mm Annealed up to 2.1m²
Except where window forms partition where the difference between floor levels from one side of glass to other exceeds 1000mm and the glass exceeds 500mm in width THEN LOWER OR FULL PANELS MUST BE
5mm laminate up to 2.0m²
6mm laminate up to 3.0m²
4mm toughened up to 2.0m²
5mm toughened up to 3.0m²
6mm toughened up to 4.0m²
UPPER PANEL & OTHER PANELS ABOVE 500mm FROM FLOORLEVEL
Annealed to windloading requirements.

Framed Internal Partitions
(not defined as Doors or side panels).
Clause 311.1



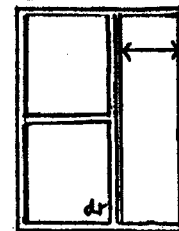
5mm annealed minimum up to 2.2m²
6mm Annealed up to 3.3m²
8mm Annealed up to 4.5m²

Door & Side Panel With Vision Rails
Clause 304 & 305



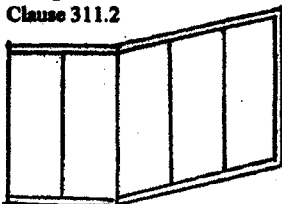
Side Panels
5mm Annealed up to 1.2m²
6mm Annealed up to 2.1m²
Door Panels
5mm Annealed up to 0.5m²
5mm laminate up to 2.0m²
6mm laminate up to 3.0m²
4mm toughened up to 2.0m²
5mm toughened up to 3.0m²
6mm toughened up to 4.0m²

Door with Vision Rail & Side panel under 500mm.



Side Panels
5mm Annealed up to 1.2m²
6mm Annealed up to 2.1m²
Door Panels
5mm laminate up to 2.0m²
6mm laminate up to 3.0m²
4mm toughened up to 2.0m²
5mm toughened up to 3.0m²
6mm toughened up to 4.0m²

Partly Framed Internal Partitions
Clause 311.2

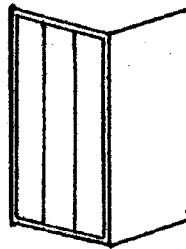
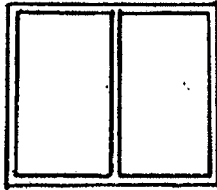


Refer to table 3.4 NZS 4223: Part 3

NZ STANDARDS GUIDE Safety Glazing Ready Reckoner

Windows not within 2000mm of the floor.

Annealed glass selected to windloading Requirements from NZS 4223: Part 4.

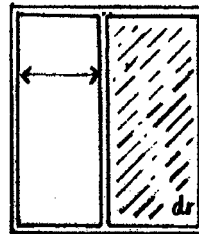
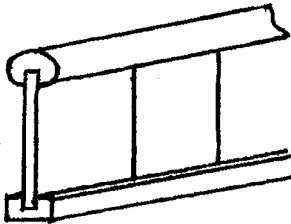


Shower Door & Bath Enclosure.
Clause 308

4mm Toughened up to 2.0m²
5mm Toughened up to 3.0m²
5mm Laminate up to 2.0m²
6mm Laminate up to 3.0m²

Panels or doors with glass edges exposed must be glazed in Toughened minimum 6mm thick.

Balustrades Fully Framed & Partly framed.
Clause 312

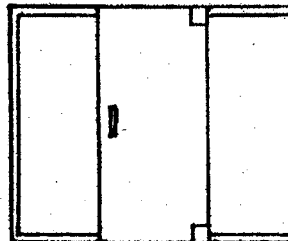


Side panel over 500mm to solid door.
Clause 305

5mm Laminate up to 2.0m²
6mm Laminate up to 3.0m²
4mm Toughened up to 2.0m²
5mm Toughened up to 3.0m²
6mm Toughened up to 4.0m²

4mm Toughened up to 2.0m²
5mm Toughened up to 3.0m²
5mm laminate up to 2.0m²
6mm laminate up to 3.0m²

4mm Annealed up to 0.3m² in fully framed balustrade is approved.

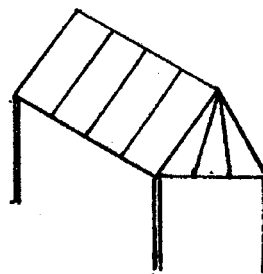


Unframed or Partly framed Glass doors & side panels.
Clause 305.3

10mm Toughened minimum.

Free Standing
Clause 312.3

Toughened glass is mandatory but subject to design, thickness and installation approval by Engineer.



Overhead Glass.
Clause 103.11.1

Glazing over populated areas when there is risk to human safety from falling glass require Grade A safety glass.
Laminated or Toughened – thickness Subject to design load requirements

GRADE A = Toughened or Laminated Glass
GRADE B = Wired Glass (squaremesh).
Safety plastics materials may be used where they comply with AS 2208.

References on this guide relate to New Zealand Standard NZS 4223.
Please consult for full details of all situations

LABOUR CONSTANTS – GLAZING

	Unit	Tradesman Hours	Labourer Hours
Glazing			
Glazing in regular panes approx. 1000mm × 1000mm to			
Timber with putty	m ²	0.90	
Timber with beads	m ²	1.00	
Metal with putty/mastic and/or neoprene strips	m ²	1.20	

SITWORKS

		Nominal Size mm	Thickness mm	Joint mm	Coverage per m ²
Pavers					
Monier Clay Pavers					
Bevelled Edge		230 × 115	60	2-3	38
Firth Concrete Pavers					
Classic Cobblestone		230 × 190	40	2-3	23
(bevelled edge)		230 × 190	60	2-3	23
Cobblestone	(SE)	230 × 190	40	2-3	23
	(Rumbled)	230 × 190	40	2-3	23
	(SE)	230 × 190	60	2-3	23
	(Rumbled)	230 × 190	60	2-3	23
Pathway	(SE)	190 × 190	40	2-3	28
	(Rumbled)	190 × 190	40	2-3	28
Holland		200 × 100	60	2-3	50
		200 × 100	80	2-3	50
		200 × 100	100	2-3	50
Keystone		230 × 140	60	2-3	38
Stockholm		244 × 112	60	2-3	40
		244 × 112	80	2-3	40
Zurich & Munich		210 × 210	60	2-3	31
Gobi Blocks		200 × 200	110	2-3	25
Kerb Unit		360 × 90 (nett)	200 deep	-	-

PART THREE – PRACTICE AND ADMINISTRATION

SAMPLE WAGE CALCULATIONS

The following calculations are an indication only of a build-up of typical wage rates. Due to prevailing economic conditions these may be subject to large fluctuations as actual paid rates will vary between employers, building sites and localities. The local availability of construction work will also affect, to a lesser extent, actual paid hourly wage rates, and to a greater extent, tender rates and daywork rates.

For the purposes of this publication the following terms apply to the different types of hourly rates:

- Hourly paid wage rate (employment contract)
- Labour only paid rates (negotiated contract)
- Tender or contract rates (net)
- Daywork or charge out rates (includes overhead and profit)

These tables are examples of wage rate calculations. Actual rates will vary throughout the country.

HOURLY PAID WAGE RATES

Hourly paid wage rates of pay payable to operatives in accordance with collective agreement.

Note: these are indicative rates only. Rates have moved considerably over the last few years.

- carpenter hourly rate \$25.00
- labourer hourly rate \$19.00

LABOUR ONLY PAID RATES

Labour only paid rate of pay established as a flat rate per hour worked, without any other payments for holidays, sick leave, etc. This means that the worker gets paid for each hour worked and nothing else. Under this heading the employer is responsible for workplace accident and public liability insurance premiums which will add to the rates stated.

- carpenter hourly rate \$35.00
- labourer hourly rate \$25.00

TENDER OR CONTRACT RATE

Tender or contract rate per hour cost to a building contractor. This is used for tender calculations and is calculated separately for each trade. It includes leading hand supervision only. Foreman's and other supervision is normally costed in the Preliminary and General. For tendering purposes a weighted average of carpenters and labourers is used, as calculated below.

Average Contract Rate for tenders or quotations, for gang

	No of staff		Hourly Rate	Total Cost
Carpenter	5	@	\$41.07	\$205.35
Labourer	1	@	\$30.27	\$30.27
Total gang cost per hour, divided by number of staff	÷6			\$235.62
Gives Average Contract Rate (net)			=	\$39.27

Note: Profit and overhead added is added on at the end of the estimate to produce a quotation or tender amount.

PRODUCTIVE HOURS

The **contract rate** is derived from the total weekly cost of employing an operative, divided by the productive hours actually worked. These productive hours are less than the paid worked hours, due to a paid morning and afternoon break, plus starting and stopping, totalling 8 times a day. Wet time is also included as an average allowance.

Productive Hours

Item	Minutes	Times per day	Days per week	Total Minutes		Hours
Standard available hours per week						45.00
Deduct						
Tea break	10 mins ×	2 ×	5	100	=	-1.67
Lost time	5 mins ×	8 ×	5	400	=	-3.33
Wet time allowance (this allows for 4 hours per week wet weather, divided by 2 to allow for 50% of under cover work.)						-2.00
Productive Hours Per Week					=	38.00

DAYWORK OR CHARGE OUT HOURLY RATES

Daywork or charge out hourly rates are used for variations that cannot be measured and rated, and for “charge up” type contracts. An applicable profit and overhead percentage is added.

Because daywork or charge out rates cover the entire working day, the total weekly cost is divided by the paid working hours.

Charge out rate for variations on a daywork basis

		Carpenter	Labourer
Weekly Gross cost		\$1,560.61	\$1,150.41
Divided by hours charged (incl. tea break, lost time and wet time)	÷45 hrs	\$33.68	\$25.56
Profit and Overhead (During the contract period 33%) (Post practical completion 50%) (Jobbing work 60%)	33%	\$11.44	\$8.43
Charge Out Rate		\$45.12	\$33.99

LABOUR RATE BUILD UP

A typical employment contract is incorporated in the calculations below to produce the contract and the daywork rates. If desired, some of the costs can be included separately in the preliminary and general trade. The following calculations are on a weekly basis. Other methods involve calculating on a daily or annual basis.

Labour Rate Build Up–Weekly Basis–Carpenter

Description	Hours	Rate	Amount	Sub-Total
Taxable payments				
Ordinary time	45	\$25.00	\$1,125.00	
Weekly Taxable Pay				\$1,125.00
Kiwisaver Employer Contribution		2.00%	\$22.50	\$22.50
Holiday pay and sick leave etc.		16.00%	\$180.23	\$1,327.73
Public liability insurance, ACC premiums and residual levy, and first week liability		6.35%	\$84.31	\$1,412.04
Redundancy provision (optional)		2.00%	\$28.24	\$1,440.28
Non taxable payments				
Tool, clothing & footwear allowance	45	\$1.00	\$45.00	\$1,485.28
Add costs of supervision by Leading Hand				
Total of carpenters costs as calculated			\$1,485.28	
Plus charge allowance	47.5	\$0.45	\$21.38	
Leading Hand cost: Assume control of 5 operatives for 25% of the time, i.e., 25% divided by 5, gives 5% loading.			\$1,506.66	
Add leading hand cost to Carpenter rate		× 5%	=	\$75.33
Total weekly cost				\$1,560.61
Divide by productive time (38 hrs) gives Nett Contract Rate			÷38 =	\$41.07

Labour Rate Build Up–Weekly Basis–Labourer

Description	Hours	Rate	Amount	Sub-Total
Taxable payments				
Ordinary time	45	\$19.00	\$855.00	
Weekly Taxable Pay				\$855.00
Kiwisaver Employer Contribution		2.00%	\$17.10	\$17.10
Holiday pay and sick leave etc. (see calculation)		16.02%	\$136.97	\$1,009.07
Public liability insurance, ACC premiums and residual levy, and first week liability		6.35%	\$64.08	\$1,073.15
Redundancy provision (optional)		2.00%	\$21.46	\$1,094.61
Add costs of supervision by Leading Hand				
Total of labourers costs as calculated			\$1,094.61	
Plus charge allowance (hours)	47.5	\$0.45	\$21.38	
Leading Hand cost: Assume control of 5 operatives for 25% of the time, i.e., 25% divided by 5, gives 5% loading.			\$1,115.99	
Add leading hand cost to Labourer rate		× 5%		55.80
Total weekly cost				\$1,150.41
Divide by productive time (38 hrs) gives Nett Contract Rate			÷38 =	\$30.27

Holidays and Sick Leave

Holidays, sick leave etc. expressed as percentage—4 weeks annual leave

Working time = total weeks less non working time	Days/days in week	Weeks
Total weeks in year (total days in year, divided by 7) less:	365/7	52.14
Annual holidays (total, divided by 5 working days)	20/5	4.00
Statutory holidays	11/5	2.20
Sick leave	5/5	1.00
Total non-working time	=	7.20 7.20
Time worked in weeks	=	44.94 44.94
Percentage Calculation	$\frac{7.2}{44.94} \times \frac{100}{1} = 16.02$	= 16.02%

INSURANCES AND LEVIES

Public liability premium is usually based on taxable wages paid. 1% is allowed, but the rate will vary according to the risk involved.

Accident compensation premium and residual claims levies. For the purposes of this example, use the percentages given below. Note that the levy percentages used are those for Classification Unit 42420, Carpentry Services, and include the additional 5c per \$100 for the Health and Safety in Employment levy.

Insurances, levies and first week of accident, expressed as percentage
For year 2011/2012, used in example

Type of insurance and/or levy	%	total %
Public liability insurance—say	1.00%	
ACC Residual Claim (RC) Levy	0.68%	
Accident Compensation Levy	2.67%	
1st week (employer)	2.00%	
Percentage addition for insurances & levies etc.		6.35%

ACCIDENT COMPENSATION LEVIES

Accident Compensation Act 2001

The current Act is the Accident Compensation Act 2001, reprinted, incorporating all previous amendments, on 1 July 2010. A search of the government legislation website will bring you **completely up to date with the law in this area – at least for now.** See www.legislation.govt.nz

History

Note in particular that as from 1 July 2010 this Act includes and has superseded other Acts which also formerly dealt with accident related issues e.g. The Injury Prevention, Rehabilitation and Compensation Act 2001, the Accident Insurance Act 1998 and its amendments, the Accident Insurance Act and the Accident Rehabilitation and Compensation Insurance Act 1992. The position in relation to accident compensation has now become more streamlined.

State versus private accident insurance is an area of fundamental policy difference for some political parties therefore this subject area will be subject to frequent and major changes.

Levies

The Accident Compensation Corporation maintains and operates separate accounts for different purposes. There is a Work Account, a Motor Vehicle Account, an Earners Account, a Non Earners Account and a Treatment Injury Account. The Work Account is funded by levies on employers, and the Earners Account levy is deducted from wages via PAYE payments. Sections 168, 168A, 168B and 211 are the relevant sections relating to levies on employers and employees. The regulations for each separate account give more practical details (in particular amounts payable). It is advisable for both employers and employees to consult the new 2010 Accident Compensation (Earners Levy) Regulations and the Accident Compensation (Work Account Levies) Regulations on a regular basis.

Work Account Levies

The 2010 regulations no longer set the residual claims levy, which has now been folded into the Work Account levy, with two components, the current portion and a residual portion. These regulations set separate maximum amounts of earnings for the current portion and the residual portion of the Work Account Levy payable by an employer or private domestic worker.

Earner Levy

All employees must pay an ACC earner levy to cover the cost of non-work injuries, plus an earners' account residual levy—to fund the cost of non-work injuries claimed from 1 April 1992 to 30 June 1999. These levies are incorporated into the PAYE tables, and collected by Inland Revenue on behalf of ACC. They are at a flat rate which can change each year.

- Earner levy—\$1.26 per \$100 of earnings, from 1 April 2015.

Self Employed Persons

From 1 April 2001 ACC has invoiced self-employed persons direct for the earners levy. IRD supply income information to ACC to enable them to do this.

EMPLOYER LEVY RATES

Industrial Activity	Class	2009/10		2010/11		2011/12		2012/13		2013/14		2014/15		2015/16	
		Emp \$	RCL \$	Emp \$	RCL \$	Emp \$	RCL \$	Emp \$	RCL \$	Emp \$	RCL \$	Emp \$	RCL \$	Emp \$	RCL \$
Note: RCL excludes 5c per \$100 HSE levy															
Air Conditioning installation and servicing	42330	0.84	0.47	1.18	0.36	1.35	0.36	1.11	0.28	1.19	0.28	0.96	0.31	0.89	0.31
Alarm systems installation	42341	0.84	0.47	1.18	0.36	1.35	0.36	1.11	0.28	1.19	0.28	0.96	0.31	0.89	0.31
Architectural metal fixtures	27490	2.43	1.66	3.20	1.20	3.03	1.20	2.57	0.99	2.50	0.99	1.83	1.02	1.67	1.02
Architectural services	78210	0.04	0.32	0.06	0.26	0.08	0.26	0.10	0.19	0.14	0.19	0.16	0.22	0.14	0.22
Bituminous Products	25200	1.21	0.91	1.57	0.67	1.51	0.67	1.21	0.54	0.99	0.54	0.57	0.57	0.52	0.57
Boilermaking (installation and repair)	27690	1.30	0.91	2.06	0.67	1.99	0.67	1.57	0.54	1.64	0.54	1.26	0.57	1.16	0.57
Brick (clay) manufacturer	26210	1.18	0.65	1.62	0.48	1.70	0.48	1.45	0.38	1.53	0.38	1.16	0.41	1.06	0.41
Bricklaying/block laying/stonework	42220	2.20	1.14	3.17	0.83	3.64	0.83	3.19	0.68	3.38	0.68	2.66	0.71	2.45	0.71
Bridges/road construction	41210	1.81	0.80	2.37	0.59	2.22	0.59	1.93	0.48	1.74	0.48	1.31	0.51	1.20	0.51
Carpentry Services	42420	2.21	1.14	3.17	0.83	3.33	0.83	2.67	0.68	2.79	0.68	2.18	0.71	1.98	0.71
Commercial property operators	77120	0.37	0.55	0.57	0.42	0.64	0.42	0.61	0.33	0.64	0.33	0.44	0.36	0.40	0.36
Concreting services	42210	2.20	1.14	3.16	0.83	3.34	0.83	2.68	0.68	2.79	0.68	2.18	0.71	1.99	0.71
Construction services not elsewhere classified	42590	2.21	1.14	3.17	0.83	3.34	0.83	2.68	0.68	2.79	0.68	2.18	0.71	1.98	0.71
Consulting engineering services	78230	0.21	0.32	0.33	0.26	0.29	0.26	0.20	0.19	0.22	0.19	0.16	0.22	0.14	0.22
Dams, culverts/jetties construction	41220	1.81	0.80	2.37	0.59	2.55	0.59	1.95	0.48	2.16	0.48	1.65	0.51	1.51	0.51
Demolition of buildings or other structures	42100	1.81	0.80	2.37	0.59	2.46	0.59	2.05	0.48	2.07	0.48	1.52	0.51	1.40	0.51
Drainage or sewer system construction	41220	1.81	0.80	2.37	0.59	2.55	0.59	1.95	0.48	2.16	0.48	1.65	0.51	1.51	0.51
Drilling contracting	42100	1.81	0.80	2.37	0.59	2.46	0.59	2.05	0.48	2.07	0.48	1.52	0.51	1.40	0.51
Earthmoving	42100	1.81	0.80	2.37	0.59	2.46	0.59	2.05	0.48	2.07	0.48	1.52	0.51	1.40	0.51
Electrical wiring installation	42320	0.84	0.47	1.18	0.36	1.25	0.36	1.02	0.28	1.05	0.28	0.78	0.31	0.73	0.31
Elevator installation	28650	0.97	0.41	1.25	0.32	1.25	0.32	1.00	0.54	1.04	0.24	0.71	0.27	0.65	0.27
Fire sprinklers installation	42341	0.84	0.47	1.18	0.36	1.35	0.36	1.11	0.28	1.19	0.28	0.96	0.31	0.89	0.31
Floor coverings, laying/floor sanding/tiling	42430	2.10	1.14	2.98	0.83	3.33	0.83	2.67	0.68	2.79	0.68	2.18	0.71	1.98	0.71
Glazing	42450	2.09	1.14	2.98	0.83	3.34	0.83	2.68	0.68	2.79	0.68	2.18	0.71	1.99	0.71
House construction	41110	2.21	1.14	3.17	0.83	3.29	0.83	2.53	0.68	2.65	0.68	2.09	0.71	1.92	0.71
Joinery work on construction projects	42420	2.21	1.14	2.98	0.83	3.33	0.83	2.67	0.68	2.79	0.68	2.18	0.71	1.98	0.71
Joinery, manufacturing	23230	1.68	0.91	2.32	0.67	2.62	0.67	1.93	0.54	1.87	0.54	1.41	0.57	1.30	0.57
Landscaping services	42510	2.11	0.80	3.06	0.59	3.33	0.59	2.68	0.48	2.79	0.48	2.18	0.51	1.99	0.51
Non-residential building construction	41130	2.20	1.14	3.16	0.83	3.03	0.83	2.52	0.68	2.54	0.68	2.01	0.71	1.84	0.71
Painting and decorating services	42440	2.09	1.14	2.98	0.83	3.08	0.83	2.54	0.68	2.64	0.68	2.00	0.71	1.83	0.71
Pile driving	41220	1.81	0.80	2.37	0.59	2.55	0.59	1.95	0.48	2.16	0.48	1.65	0.51	1.51	0.51
Plaster work on construction projects	42410	2.10	1.14	2.98	0.83	3.34	0.83	2.68	0.68	2.79	0.68	2.18	0.71	1.98	0.71
Plumbing services	42310	1.42	0.80	1.97	0.59	2.06	0.59	1.80	0.48	1.82	0.48	1.42	0.51	1.30	0.51
Quantity surveying	78230	0.21	0.32	0.33	0.26	0.29	0.26	0.20	0.19	0.22	0.19	0.16	0.22	0.14	0.22
Residential building construction, repairs	41120	2.24	1.14	3.17	0.83	3.04	0.83	2.53	0.68	2.55	0.68	2.02	0.71	1.85	0.71
Residential property operators	77110	0.37	0.55	0.57	0.42	0.64	0.42	0.61	0.33	0.64	0.33	0.44	0.36	0.40	0.36
Roofing services	42230	2.21	1.14	3.17	0.83	3.64	0.83	3.20	0.68	3.39	0.68	2.67	0.71	2.46	0.71
Scaffolding construction	42590	2.21	1.14	3.17	0.83	3.34	0.83	2.68	0.68	2.79	0.68	2.18	0.71	1.98	0.71
Structural steel erection	42240	2.20	1.14	3.16	0.83	3.63	0.83	3.18	0.68	3.36	0.68	2.65	0.71	2.44	0.71
Structural steel fabrication	27410	2.43	1.66	3.20	1.20	3.03	1.20	2.57	0.99	2.50	0.99	1.83	1.02	1.67	1.02
Surveying services	78220	0.23	0.55	0.33	0.42	0.29	0.42	0.20	0.33	0.22	0.33	0.16	0.36	0.14	0.36
Welding work on construction projects	42240	2.20	1.14	3.16	0.83	3.63	0.83	3.18	0.68	3.36	0.68	2.65	0.71	2.44	0.71

FEASIBILITY STUDIES

Overview

The purpose of feasibility studies is to calculate the return which will be derived from a particular project.

The return can be expressed as an annual percentage return, or as a terminal percentage return.

An annual percentage return will be used where the project will be generating rent for the owner, while a terminal return is used when the project is to be sold.

The calculated returns are important only for comparisons, i.e., to compare one project with another or to compare one project's return with the return that would be achieved by investing elsewhere.

The following tables represent suggested layouts to assist in calculating the return. Item 3 is shown in alternative forms. The first alternative, 3a, is applicable to an annual return and the second, 3b, to a terminal return.

1-Feasibility Study-Primary Information

Primary Information	Qty/\$ value/ time value	Unit
Physical Factors and Requirements		
• Site Area		m ²
• Frontages		m
• Gross Floor Area		m ²
• Net Rentable Area		m ²
• Parking provision		no (cars)
Cost Factors		
• Land purchase price	\$	
• Building cost	\$	
• Vacant possession costs	\$	
Design and Construction Time Factors		
• Preliminary sketch plans		months
• Development approvals		months
• Developed design stage to calling tenders including working drawings and schedule of quantities		
• Calling tenders and awarding contract		months
• Construction time		months

2-Feasibility Study-Capital Expenditure Calculation

Item	\$	\$ Total
Land Costs		
Purchase price	= \$	
Stamp duty @ _____ % on first \$ _____	= \$	
plus _____ % on remainder	= \$	
Legal costs	= \$	
Vacant possession costs	= \$	
Soil tests	= \$	
Land surveyor's fees	= \$	
Total of Land Costs	=	\$
Building Costs		
Demolitions	= \$	
Contract price	= \$	
Architects, engineers and consultants fees	= \$	
Local council permit and planning authority fees	= \$	
Total of Building Costs	=	\$
Annual Costs	Per Annum	
Rates and taxes	= \$	
Council rates @ _____ in \$	= \$	
Water	= \$	
Total of Annual Costs	=	
Divide by 12 to give \$per month	/12 \$	
Planning and construction time (_____) months × \$ _____ / Month		
Total of Annual Costs-Planning and Construction Time	=	\$
ADD:		
Interest (@ _____ % per month simple)		
on land cost	=	
on rates and charges	=	
on building costs	=	
Total of Interest Costs	=	\$
Sundry Costs		
Owner's moving expenses		
Furnishing		
Market studies		
Advertising and signs		
Premises department's costs		
Owner's overhead expenses		
Letting agent's fees @ _____ %		
Tenant inducements		
Contingency		
Total of Sundry Costs	=	\$
Total Capital Expenditure	=	\$
*no allowance for life cycle costing		

3a-Feasibility Study-Annual income and expenditure

Item	\$	\$ Sub-total	\$ Total
Income			
Carparking _____ cars @ \$_____	= \$		
Ground floor _____m ² @ \$_____	= \$		
Upper floors _____m ² @ \$_____	= \$		
Other _____ @ \$_____	= \$		
Total Annual Income (a)		a	\$
Annual Expenditure			
Council rates	= \$		
Water rates	= \$		
Insurance combined @ ____%	= \$		

3a-Feasibility Study-Annual income and expenditure

Item	\$	\$ Sub-total	\$ Total
Electricity to public areas	= \$		
Garbage removal	= \$		
Caretaker and cleaning @ \$_____ per m ²	= \$		
Window cleaning	= \$		
Security service	= \$		
Fire alarm and sprinkler service	= \$		
Lift maintenance and operation	= \$		
Air Conditioning maintenance and operation	= \$		
Management fees at scale (say 4%) of total letting	= \$		
Total Annual Expenditure (b)	b	\$	
Provisions			
Building maintenance	\$		
Building depreciation ____years @ ____%	\$		
Plant depreciation ____years @ ____%	\$		
Vacancies-say ____%	\$		
Total Provisions (c)	c	\$	
Total Annual Expenditure and Provisions (d = b+c)		d	\$
Net Annual Income (e = a - d)		e	\$
ANNUAL RETURN =	$\frac{\text{Net Annual Income } \$}{\text{Total Capital Expenditure } \$}$	$x 100 = \text{____}\%$	
		1	

3b-Alternative-Terminal Income and Expenditure

Item	\$	\$ Total
Sale Price	=	\$
Selling Expenditure		
Council rates	= \$	
Water rates	= \$	
Insurance	= \$	
Security service	= \$	
Agents fees	= \$	
Interest	= \$	
Total of Selling Expenditure	=	\$
Net Sale Price	=	\$
TERMINAL RETURN =	$\frac{\text{Net Sale Price} - \text{Total Capital Expenditure}}{\text{Total Capital Expenditure}} \times 100 = \text{___}\%$	
	1	

CONTRACTUAL SYSTEMS

A brief commentary on the contractual arrangements commonly available to prospective building owners considering property development or construction. Composite forms or variations of these basic forms may be used.

- traditional tender
- competitive negotiation
- direct negotiation
- cost reimbursement
- design and build
- construction management.

The major determinants in selecting a particular contractual form are:

- Time available to complete the project, this includes the design period.
- Cost
- The extent of information which will be available at the time of selecting a form of contract.

It is often a balance of these constraints which determine which form of contract is best suited to each particular project. As this decision is often critical to the success of a project, it is advisable to seek advice from a professional or principal consultant before choosing the form of contract.

TRADITIONAL TENDER SYSTEM

Tenders may be called for the construction on either:

- a "selected" basis—where tenderers are restricted in number by a process of selection according to their qualification and experience in the type of project in question.
- an "open" or public basis—where no such restriction exists and public accountability and total market exposure is paramount, sometimes at the expense of suitability and selective expertise.

The building owner appoints a project design team comprising an architect, structural engineer, quantity surveyor, mechanical and electrical engineers and other specialist consultants as required, depending on the nature and complexity of the project. The building owner commissions the full design documentation of the project within the cost parameters set by the quantity surveyor's cost plan.

Tenders, usually "lump sum", are then invited from building contractors to ascertain the price of the works, prior to the final decision to proceed. This lump sum can be either a "fixed price" or may make provision for fluctuations in material, plant and labour prices. The fixed price lump sum contract will have no adjustment for price fluctuations.

On awarding the contract to the successful tenderer, the site is handed over to the building contractor and the contract administered by the architect on behalf of the building owner in accordance with the contract documents.

The construction work is carried out by the building contractor generally using sub-contract trades.

The design performance obligations rest with the design team and any risks are invariably underwritten by the individual team members' professional indemnity insurance. The construction (contractual) risks rest with the building contractor.

The building owner is therefore reasonably well protected from risks inherent in design and construction.

Key points

- price is known before building owner is committed to construction—allowing remedial action to be taken if the price exceeds budget expectations.
- price is the “true competitive market” price.
- building owner is insulated, for the most part, from “risks”, or at least has contractual recourse.
- design and tender documentation is complete before proceeding to tender, avoiding the incidence of major cost variations.

COMPETITIVE NEGOTIATION

The building owner appoints a consultant team to prepare schematic design drawings up to preliminary working drawings stage, outline specification including a schedule of construction and finishes, a provisional schedule of quantities and a form of a building contract.

Tenders are called from a selected list of building contractors, for the following elements:

- Preliminaries—i.e. Builders price for site mobilisation, day to day running and final demobilisation, construction plant including cranes, scaffold, etc., builders insurances, temporary and on-site services, water, phones, electricity, periodic and final clean-up, and builder's site administration, including supervision.
- a tendered percentage or lump sum for margins to be based on the value of work when known.
- a tendered percentage or lump sum for off-site overheads.
- a tendered percentage or lump sum for attendance on sub-trades.
- statement of the time required to complete the project accompanied by the builder's bar chart or other programme scheduling.

Tenders, submitted in accordance with the above requirements, are evaluated by the consultant team and a recommendation is made to the building owner. On a recommendation in favour of one of the building contractors being accepted, that builder then joins the project team as a building consultant and their practical building expertise is then used in final design documentation before he proceeds to perform the building works.

The appointed builder prices documentation as it becomes available for final acceptance by the building owner. This is usually done by the builder calling competitive bids from, say, three subcontractors for each trade package.

Key points

- this is essentially an accelerated system of procuring a contract, the main object being to install a selected builder on site and working, before formal design documentation is complete, resulting in an earlier completion and all the advantages stemming therefrom.
- the selected builder becomes a member of the team and is available to add their expertise to the advantage of the project.
- sub-contract prices are tendered just prior to when needed, thereby obtaining current market prices.

DIRECT NEGOTIATION

Directly negotiated contracts are similar to “competitive negotiation” except that instead of calling tenders from a selected list of contracts, one contractor will be chosen and negotiations will take place with this one contractor only.

Care is needed in selecting a particular contractor but it will probably be someone with whom the building owner has worked successfully in the past.

Key points

- As for “competitive negotiations”.
- This method has the effect of further speeding up the start of construction as little time is spent in evaluating tenders.

COST REIMBURSEMENT

The building owner selects a building contractor who contracts to perform the building works in accordance with the contract documents at “cost” plus a fee which is related in various ways to the contract. The documents can be based on any one of the contract conditions mentioned earlier. In this arrangement it is extremely important to define “cost”. The “fee” is then added, to arrive at a total contract price. The “cost” usually includes all on-site activities, whilst the fee covers off-site overheads and profits. The fee can be in the form of:

- percentage of cost (e.g. Cost plus 10%)
- fixed fee (e.g. Cost plus \$20,000)
- fluctuating fee (known also as target estimate)

Another derivative of cost reimbursement contracts is a schedule of rates or unit price contract.

This is based on approximate quantities being priced by the contractor, and these price rates are then applied to actual quantities of work done, to arrive at a total cost of construction.

DESIGN AND BUILD CONTRACT

This usually commences when a client approaches a design and build contractor with a brief for a particular project. Alternatively the client may be approached by a design and build contractor with a development proposal for their site.

The design and build contractor submits a preliminary proposal incorporating outline aspects for the intended design and construction. This proposal would include estimates of time and cost to complete the project. For the investment client the proposal may also incorporate projected return figures for the project.

If the preliminary proposal is accepted by the building owner, the design and build contractor would work up and submit a final development proposal. This would incorporate in many instances, a guarantee of a maximum price for the project and offer the building owner a share in any savings achieved in such maximum price.

The final development proposal would comprise schematic design drawings to a reasonably advanced stage, and an outline specification incorporating a schedule of construction and finishes.

The system may be either with or without a savings participation clause.

CONSTRUCTION MANAGEMENT CONTRACT

When embarking on this form of contractual arrangement, the building owner would usually appoint a project manager and the other members of the construction team. Once the initial schematic design is formulated a construction manager is appointed to the team to assist in design considerations and to provide practical building expertise, procedures, etc., to the project team.

Construction activities are sub-let to firms or companies specialising in the various trade work required. These trades are selected on a fully competitive, delayed letting basis, and enter into direct contract agreements with the client.

A general foreman supervises all on-site activities; a cost clerk and a limited number of carpenters and labourers are also engaged to attend on other trades and execute minor sundry works.

Costs are controlled by the quantity surveyor, with a continuous audit of actual costs incurred. Payments are made to trade contractors, suppliers and “on-site” employees by the client.

DEFINITIONS

Construction Management. The construction manager—an individual, consultancy firm, or a builder—is selected and appointed by the proprietor, or the project manager on the proprietor’s behalf, and carries out the work normally performed by a builder in a traditional system.

S/he organises, manages and co-ordinates the construction of the project on a consultancy basis for a fee. The construction manager does not have any direct commercial interest in the work carried out by sub-contractors, as all sub-contracts are between proprietor and sub-contractor.

Thus s/he neither benefits nor suffers from the contractual risks attendant upon a traditional contract.

Project Management. A project manager is an agent of the proprietor and assumes the role of the proprietor in a construction project where the proprietor lacks the technical and organisational skills for the task. The project manager becomes responsible for preparing a brief, and appointing and co-ordinating the consultants.

The proprietor’s requirements are conveyed to the project manager who ensures that they are acted upon by the consultants and contractor. S/he may, if engaged for a total service, be responsible for such matters as;

- site selection
- feasibility studies
- preparation of consultants briefs
- selection of consultancy team
- negotiation and documentation of conditions of engagement
- evaluation of design profiles
- supervision of documentation
- implementation of programme
- selection of contractual system
- contract financial control
- supervision of letting
- many other services.

It should be noted that the engagement of a project manager is not affected by the contractual arrangement adopted. S/he can serve the client in virtually the same capacity whether it be a traditional “tender” or a “construction management” contract.

CASH FLOW

CLIENT'S VIEW POINT

Cash flow prediction is the forecasting of cash needed to be provided by the building owner at predetermined dates in a building construction programme, for the purpose of making progress payments to the builder for work executed.

An accurate estimate of cash flow for project payments is essential to the organisation that will provide funds for the project. It will give advance notice of the funds needed and the timing of drawdowns.

Such an estimate is usually prepared before the contractor commences work and is obtained by preparing a programme of construction activities for the project, costing these activities and obtaining anticipated expenditure on a month to month basis.

CONTRACTOR'S VIEW POINT

Contractors may operate from a relatively thin capital base and the demise of many firms can be directly related to poor or inadequate cash flow management.

Income and expenditure are combined to arrive at a net inflow or outflow of cash for each period. A time related schedule of receipts and payments is prepared to give a cash flow statement.

A key factor in cash flow control for the contractor is to develop a system which will compare actual with projected cashflow.

EXAMPLE OF CASHFLOW

An example is given of a simplified cashflow prepared for the client, for a two-storey hostel costing \$1,200,000 with a 10 month construction period.

The example assumes a fixed price lump sum contract with no provision for fluctuations and assumes that a bank guarantee will be operating with no retentions being held.

It should also be noted that a delay of 20 days or so elapses between the end of a "construction month" and the actual payment for the work done in that period. This delay should be allowed for in any cash flow.

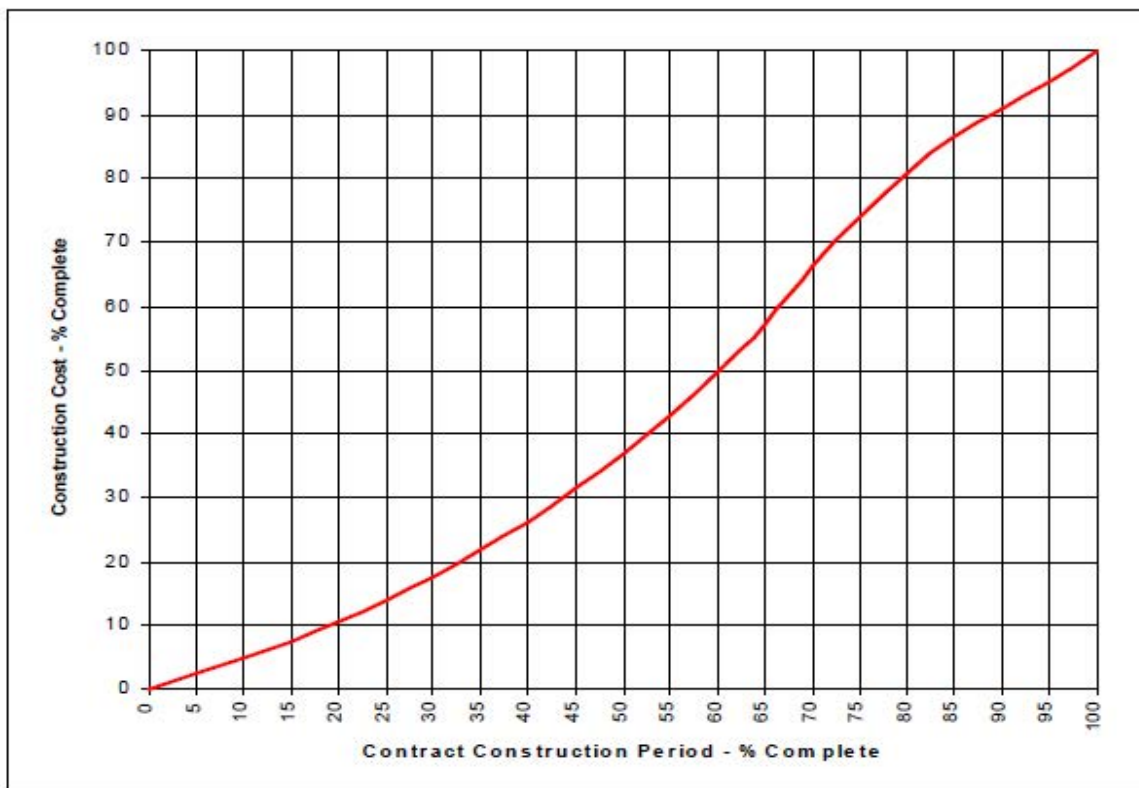
The example is for construction work only and excludes other periodic payments to which the client may be committed, e.g. Consultants fees, land costs, finance costs, etc.

Programme Activity	Construction Period in Months										Total	
	1	2	3	4	5	6	7	8	9	10		
Site establishment, Site clearance, Bulk excavation & fill, Building set-out	9,000											9,000
Excavation & pour footings	20,000	20,000										40,000
Columns:												
Conc. Ground- 1 st		2,000										2,000
Steel. Ground-Roof 1 st -Roof		1,000	4,000	1,000								6,000
Suspended floor slab, Stairs and beams				35,000	40,000							75,000
Roof steelwork:												
Single storey			1,000	3,000	1,000							5,000
Two storey					3,000	1,000						4,000
Roof framing, purlins, roofing, r.w. goods:												
Single storey					30,000	30,000						60,000
Two storey						50,000	20,000					70,000
Services underground slab				4,000								4,000
Ground slab on fill				7,000	27,000							34,000
Lift		3,000				15,000	15,000	14,000				47,000
Mechanical					7,000		1,000	3,000				11,000
Brickwork, windows, door frames: Ground-1st, 1st roof		20,000	40,000	43,000	35,000	49,000						187,000
Services: plumbing							22,000	22,000				44,000
Electrical							35,000	15,000				50,000
Wall plaster/screeds							5,000	5,000				10,000
Glazing							2,000					2,000
Ceilings							23,000	27,000				50,000
Hot water boiler, etc.						6,000	6,000					12,000
Electrical/plumber fit-off							23,000	46,000				69,000
Wall & floor tiles fit-off							16,000	28,000				44,000
Carpentry & joinery fit-off							6,000	23,000	33,000			62,000
Cupboards, fitments, white goods								3,000	3,000	1,000		7,000
Kitchen/laundry equipment									20,000	30,000		50,000
Painting									7,000	18,000		25,000
Carpet / vinyl									3,000	31,000		34,000
Clean-up/commission										5,000		5,000
External works:												
bitumen car parks, roads and kerbs									4,000	1,000		5,000
brick paving									18,000	8,000		26,000
fencing/crossovers									4,000	2,000		6,000
planting/pergolas, etc.									11,000	11,000		22,000
External services:												
stormwater drains	5,000	5,000	5,000		5,000	5,000						25,000
sewer drains	2,000	2,000	2,000		2,000	1,000						9,000
water/fire/gas	3,000	3,000	3,000		3,000	4,000						16,000
electrical										4,000		4,000
Clean-up externally										1,000		1,000
Preliminaries	14,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	68,000
Totals for monthly payment	53,000	62,000	61,000	99,000	159,000	167,000	180,000	192,000	109,000	118,000		1,200,000
Cumulative totals	53,000	115,000	176,000	275,000	434,000	601,000	781,000	973,000	1,082,000	1,200,000		

Programme Activity	Construction Period in Months									
	1	2	3	4	5	6	7	8	9	10
Retentions (Step 1) 10% first \$200,000 (Max \$20,000)	5,300	11,500	17,600	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Retentions (Step 2) 5% next \$800,000 (Max \$40,000)				3,750	11,700	20,050	29,050	38,650	40,000	40,000
Retentions (Step 3) 1.75% above \$1,000,000 (Max \$140,000)									1,435	3,500
Retentions (Max value \$200,000)	5,300	11,500	17,600	23,750	31,700	40,050	49,050	58,650	61,435	63,500
Net after retentions	47,700	103,500	158,400	251,250	402,300	560,950	731,950	914,350	1,020,565	1,136,500
Previous Payment Schedules (cumulative)	0	47,700	103,500	158,400	251,250	402,300	560,950	731,950	914,350	1,020,565
This Payment Amount (Excluding GST)	47,700	55,800	54,900	92,850	151,050	158,650	171,000	182,400	106,215	115,935
Goods and Services Tax @ 15%	7,155	8,370	8,235	13,928	22,658	23,798	25,650	27,360	15,932	17,390
This Payment Amount (Including GST)	54,855	64,170	63,135	106,778	173,708	182,448	196,650	209,760	122,147	133,325

S-Curve

As an alternative, analysis has consistently shown that cash flows follow the “lazy S” curve for construction purposes. This method is intended as a guide only and variations will apply according to the total cost of the work and whether or not lifts, sprinklers, air conditioning and other specialist services are involved. After reading off the theoretical amount expended against the time scale, additions or adjustments should be made to accommodate unusual or extraordinary items such as: interest, professional fees, pre-ordering, and retentions. From the graph it can be seen that 50% of the contract value is expended at 60% of the contract period.



“Lazy S” Curve—an alternative cash flow method

“Lazy S” Curve—an alternative cash flow method

CONTRACT INSURANCES

CONTRACT WORKS INSURANCE

This type of policy provides cover to the works during the construction and maintenance period, for loss or damage, whether in part or in whole. It can be taken out by the contractor, or by the principal. An earlier term for this type of policy was ‘Contractors All Risks Insurance’. The extent of the policy should be checked and additional cover arranged to suit each particular contract as necessary for items such as: plant, tools and equipment, vibration and removal of support, piling work, temporary buildings and structures, plate glass fixing and removal, demolition and clearance of site, indemnity to the principal, damage to underground installations

Blanket Cover—This is substantial annual cover which is pre-arranged and based on projected turnover. It is adjusted retrospectively when actual turnover is calculated for the year. Cover can be set at the anticipated maximum level or alternatively at a lower or average level and special extensions applied for only when required.

Separate Cover—A separate cover for each contract is negotiated making allotment of costs per project easier to establish.

PREMIUM RATES

These vary considerably depending on the type of construction, duration of cover, builder’s track record, amount of self-insurance, etc. Since the Canterbury earthquake events, the insurance premiums have increased throughout the country, and insurances for projects in Canterbury can be significantly higher than elsewhere in the country. Rates have increased from a range of 0.5% to 1.0%, up to a range of 1% to 2%, with some instances of insurance quotations for Christchurch projects ranging up to 5% of the contract value.

OTHER TYPES OF INSURANCE

Advance Loss of Profits, Delay in Start Up: covers financial losses that may arise as a result of a delay caused by an insured event.

Public Liability, or General Liability: concerned with accidents or other events or occurrences causing death of, or bodily injury to, or damage to the property of members of the public. Most policies are underwritten on an “occurrence” basis, so that the event which gives rise to a claim must have occurred during the period of the insurance.

Professional Indemnity: A special type of liability insurance covering loss caused by a legal liability to pay compensation to a client or other third party arising from a breach of professional duty. Usually underwritten on a “claims made & notified” basis.

Contractors’ Plant and Equipment: a separate material damage insurance to be arranged by the Contractor

Force Majeure: Unforeseeable circumstances that prevent someone from fulfilling a contract; Force Majeure insurance provides coverage for financial losses arising out of the inability to bring a project to completion.

PROPERTY INSURANCE

A property may be insured in one of two ways—either for “indemnity value” or for “replacement value”.

INDEMNITY VALUE

Provides the lesser cover—a building so insured provides cover for the value of the building as it stands, i.e. likely depreciated, outdated and not conforming to design regulations. If total loss occurs, the insurer would pay the actual value of the property destroyed. If the loss is a partial one, the insured may be required to contribute to the cost of repairs if remaining old construction is replaced with new. The policy will only place the insured in the position he was in, prior to the loss—no better, no worse.

REPLACEMENT VALUE

An old building may have an indemnity value of \$200,000 and a replacement value of \$1,000,000. Replacement involves the construction of a building having the same functional use and of the same usable area as the old building, but complying with modern technology, and conforming to regulations and by-laws which may have been adopted since the original building was constructed.

An existing building, of whatever age, adequately insured in this category, would absolve the owner from undue expense in the event of building loss. An existing building constructed of, say, pipe columns and metal cladding, if destroyed, could well be required to be replaced with a building of reinforced concrete and block construction. If the insurance premiums covered this “extra cost” element, in other words the building was adequately insured, then the owner would be subjected to no expense if loss occurred.

At present in New Zealand the insurance industry recommends that properties of consequence have reinstatement insurance. The average business or individual does not have the ready capital to bridge the gap between indemnity value and full replacement cost.

LIFE CYCLE COSTING

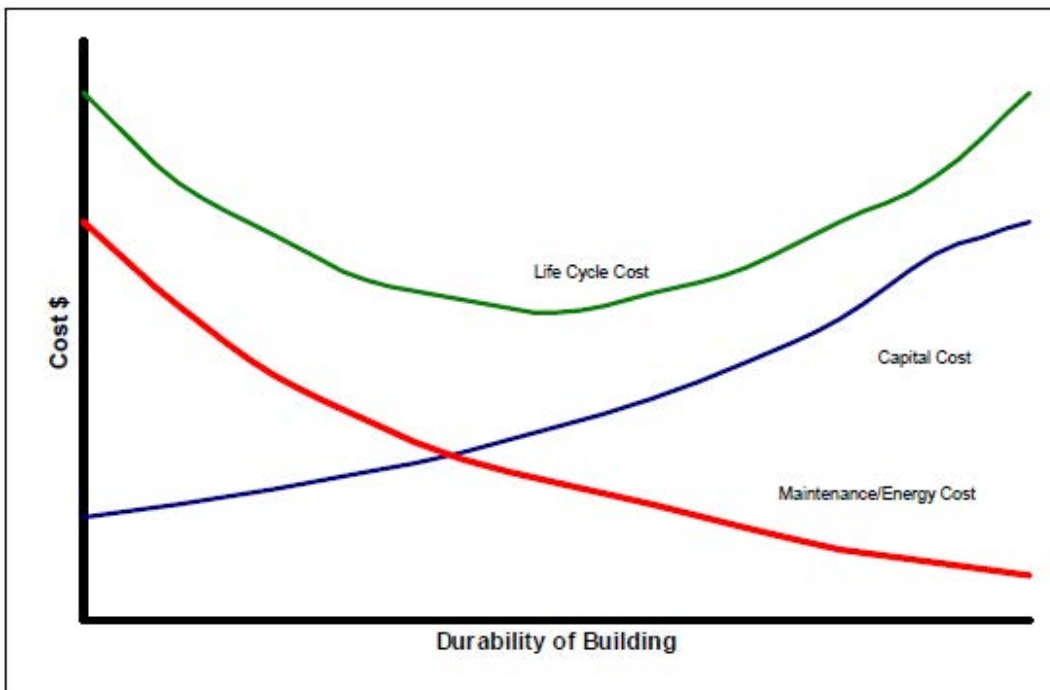
SUMMARY

Life Cycle Costing (LCC) analysis is a method of evaluating all the relevant costs associated with a project throughout its life.

In a building project it is normal practice to group these costs and benefits into four categories, viz:

- Construction
- Maintenance
- Operating
- Demolition or salvage

The basic concept of LCC is to identify the optimum distribution of resources between the above categories. The relationships between the categories are often illustrated in the following manner:



All past, present and future cash flows identified in an LCC analysis have to be converted to present value dollars. The normal method of dealing with these cash flows is to use a technique called discounted cash flow (DCF).

DISCOUNTED CASH FLOW–DCF

Discounted cash flow is derived from the compound interest formula. It is based on the assumption that if the right to receive money, or the obligation to pay out money, is deferred into the future, then the present value of this future sum of money is reduced. The amount of this reduction on the interest selected is calculated at a compound rate.

Example: What is the single present worth or value of the obligation to pay a bill with a present value of \$2,000 in 10 years' time? Assume 7% interest.

The answer can be calculated by using the reciprocal of the compound interest formula as follows:

$$P = F \frac{1}{(1 + i)^N}$$

Where **P** = a present sum of money, **F** = a future sum of money (equivalent to **P** at the end of **N** periods of time at an interest rate of **i**), **i** = interest rate, **N** = number of interest periods.

$$P = 2000 \times \frac{1}{(1 + 0.07)}$$

$$P = 2000 \times \frac{1}{1.9671514}$$

$$P = 2000 \times 0.5083492 \quad \text{Thus, present worth} = \$1,016.70$$

Spreadsheet solutions for the present worth formula are available for a range of values of parameters **i** and **N**. Spreadsheet solutions are also available for other discounting formulae such as Uniform Present Worth, Present Worth of Periodic Payments, Annual Equivalent of Initial Payments and Annual Equivalent of Periodic Payments.

EXAMPLE OF LCC ANALYSIS

LCC analysis is primarily suited for the economic comparison of alternatives. LCC is used to select the design solution which will give the most appropriate in-use characteristics throughout the life of the building.

The following data refers to two air-conditioning systems **X** and **Y**, each capable of producing identical environmental conditions, but having differing capital and running costs and life expectancy.

Life Cycle Costing Example

Assumptions and Details	System X	System Y
Capital cost	\$115,600	\$158,800
Life of plant	10 years	15 years
Annual fuel and maintenance costs, after deductions for tax allowance	\$37,800	\$28,200
Salvage value of plant	\$3,000	\$7,000

Assume an interest rate of 12% and investment period of 30 years.

System X–Cash Flow Table

Year	Details	Cash Outflow	Cash Inflow	Net Cash Flow	Present Worth of \$1	Discount Rate 12% NPW of outflow \$1
0	Install air–conditioning System X	115,600	0	-115,600	1.0000	115,600
1	Annual fuel and maintenance costs	37,800	0	-37,800	.8929	33,752
2		37,800	0	-37,800	.7972	30,134
3		37,800	0	-37,800	.7118	26,906
4		37,800	0	-37,800	.6355	24,022
5		37,800	0	-37,800	.5674	21,448
6		37,800	0	-37,800	.5066	19,150
7		37,800	0	-37,800	.4523	17,097
8		37,800	0	-37,800	.4039	15,367
9		37,800	0	-37,800	.3606	13,631
10	Replacement air conditioning system	115,600				
	Salvage value		3,000			
	Annual fuel and maintenance costs	37,800	0	-150,400	.3220	48,429
11		37,800	0	-37,800	.2875	10,868
12		37,800	0	-37,800	.2567	9,703
13		37,800	0	-37,800	.2292	8,664
14		37,800	0	-37,800	.2046	7,734
15		37,800	0	-37,800	.1827	6,906
16		37,800	0	-37,800	.1631	6,165
17		37,800	0	-37,800	.1456	5,504
18		37,800	0	-37,800	.1300	4,914
19		37,800	0	-37,800	.1161	4,389
20	Replacement air conditioning system	115,600				
	Salvage value		3,000			
	Annual fuel and maintenance costs	37,800	0	-150,400	.1037	15,597
21		37,800	0	-37,800	.0926	3,500
22		37,800	0	-37,800	.0826	3,122
23		37,800	0	-37,800	.0736	2,790
24		37,800	0	-37,800	.0659	2,491
25		37,800	0	-37,800	.0588	2,223
26		37,800	0	-37,800	.0525	1,985
27		37,800	0	-37,800	.0469	1,773
28		37,800	0	-37,800	.0419	1,584
29		37,800	0	-37,800	.0374	1,414
30		37,800	0	-37,800	.0334	1,263
	Total Present Worth Costs					\$468,025

System Y–Cash Flow Table

Year	Details	Cash Outflow	Cash Inflow	Net Cash Flow	Present Worth of \$1	Discount Rate 12% NPW of outflow \$1
0	Install air–conditioning system Y	158,800	0	–158,800	1.0000	158,800
1	Annual fuel and maintenance costs	28,200	0	–28,200	.8929	25,180
2		28,200	0	–28,200	.7972	22,481
3		28,200	0	–28,200	.7118	20,073
4		28,200	0	–28,200	.6335	17,921
5		28,200	0	–28,200	.5674	16,001
6		28,200	0	–28,200	.5066	14,286
7		28,200	0	–28,200	.4523	12,755
8		28,200	0	–28,200	.4039	11,390
9		28,200	0	–28,200	.3606	10,169
10		28,200	0	–28,200	.3220	9,080
11		28,200	0	–28,200	.2875	8,106
12		28,200	0	–28,200	.2567	7,239
13		28,200	0	–28,200	.2292	6,463
14		28,200	0	–28,200	.2046	5,770
15	Replacement air conditioning system	158,800				
	Salvage value		7,000			
	Annual fuel and maintenance costs	28,200	0	–180,000	.1827	32,886
16		28,200	0	–28,200	.1631	4,599
17		28,200	0	–28,200	.1456	4,106
18		28,200	0	–28,200	.1300	3,666
19		28,200	0	–28,200	.1161	3,274
20		28,200	0	–28,200	.1037	2,924
21		28,200	0	–28,200	.0926	2,611
22		28,200	0	–28,200	.0826	2,329
23		28,200	0	–28,200	.0738	2,081
24		28,200	0	–28,200	.0659	1,858
25		28,200	0	–28,200	.0588	1,658
26		28,200	0	–28,200	.0525	1,481
27		28,200	0	–28,200	.0469	1,323
28		28,200	0	–28,200	.0419	1,182
29		28,200	0	–28,200	.0374	1,055
30		28,200	0	–28,200	.0334	942
	Total Present Worth Costs					\$413,689

Note: for illustrative purposes the foregoing calculations are presented in full.

ALTERNATIVE CALCULATION METHOD

By using uniform and aggregated present worth tables the calculations can be presented as follows:

Alternative calculation method

	System X	System Y
Capital costs (in \$)	115,600	158,800
Replacement costs		
X-system life 10 years.	47,934	
Assume replacement at year 10 and year 20		
$\$(115,600-3,000) \times 0.4257$		
Y-system life 15 years.		27,734
Assume replacement at year 15		
$\$(158,800-7,000) \times 0.1827$		
Running costs		
X- $\$37,800 \times 8.055$	304,479	
Y- $\$28,200 \times 8.055$		227,151
Total Present Worth Costs	\$468,103	\$413,685

The foregoing example illustrates that although X is initially a lower capital investment than Y, X has a higher LCC than Y, due to increased running and maintenance costs, over a 30 year investment period, at a discount rate of 12%.

LCC Analysis Generally

Prior to making an investment decision it is imperative to test the robustness of an LCC analysis to changes in the key parameters of the investment model. This can be done by selecting minimum and maximum value for interest rates, system lives, investment periods, etc.

As previously mentioned, LCC analysis is best used in a comparative situation to provide an approximate answer to a precise question rather than a precise answer to an approximate question.

PROFESSIONAL FEES

Traditionally fees for professional services have been governed by a minimum scale of charges laid down by the various professional institutes and organisations. Members who charged less than the set fees were liable to be disciplined by their Institute.

The advent of the Commerce Act 1987 legislated that any scale of fees for professional services would hence become non-mandatory, although some professionals pre-empted this decision and had previously removed restrictions on scales of charges for their members. Fee scales are issued only as a recommended document and a guide to the scope of services carried out by each profession.

Removals of limitations on charges means that clients and consultants now openly negotiate the conditions of engagement and fees on any terms or basis they deem appropriate. The recommended scales however are still generally considered to represent the best interests of both parties.

Aside from the above changes a more competitive market has resulted from decline in construction activity. Other important factors to consider when determining professional fees are the building type, i.e. its intended use, and the scope of the services required.

Further information and recommended fee documents are available from the professional bodies.

The following table is indicative of the likely range of fees for consultants engaged on a "full service" basis.

Likely range of consultants fees on various project types

Building type	Value \$	Consultants	Fee %
1-3 storey administration	1,500,000	a, se, ee, me, la, qs	11.0-12.5
City hall, 2,000 capacity	7,000,000	a, se, ee, me, sc, la, qs	10.0-13.0
Secondary school, laboratory building	950,000	a, se, ee, qs	10.0-12.0
Multi storey general hospital	60,000,000	a, se, ee, me, sc, qs	10.0-12.0
Warehouse	3,000,000	a, se, qs	7.0-9.0
Other building, 20 storey	18,000,000	a, se, ee, me, qs	9.0-11.5
Parking building, multi-storey	6,000,000	a, se, ee, me, qs	9.0-11.5
Residential-high quality house	750,000	a, se, qs	8.0-11.5
Residential-medium quality house	350,000	a, ad, se	6.0-8.0
Residential-medium quality house	200,000	a, ad, se	4.0-6.0

a =	architect	la =	landscape architect
se =	structural engineer	qs =	quantity surveyor
ee =	electrical engineer	sc =	specialist consultant
me =	mechanical engineer	ad =	architectural designer

Note: additional to above fees: clerk of works, town planner, interior designer, project manager, programmer, surveyor, valuer.

Project management fees can be in the order of 2% to 5%, depending on the value of the contract.

For smaller value contracts, project management fees tend to be a lump sum amount rather than a percentage.

VALUE MANAGEMENT

Introduction

Value management is a disciplined procedure directed towards the achievement of required function for minimum cost without detriment to quality, reliability, performance or delivery. In the United States the procedure is known as value engineering.

The procedure is conducted through a workshop or series of workshops involving the client, the design team and other relevant stakeholders (where appropriate). The workshops are led by a value management facilitator who takes the participants through a structured problem solving agenda intended to find creative solutions to the client's requirements.

Experience has shown that the value management procedure is extremely useful as a means of reviewing a design proposal. However, it has been found that the decisions that have the greatest impact on cost are made at the outset of the project when strategic decisions regarding the purpose and required functions of the project are made. Current practice with value management is therefore to break it into a two stage process—strategic value management and design value management.

Strategic Value Management

Strategic value management is used to review the strategic intent of the project. It is most commonly conducted during the pre brief stage. It is used to clarify the strategic intent of the project and the functional requirements of the project. The use of a value management workshop enables matters such as the project priorities and economic restraints to be fully examined and alternative solutions considered.

Whilst cost savings cannot be clearly defined at this stage—as the project itself is not clearly defined—experience suggests that conducting value management at this stage can have a very significant impact on project cost.

Design Value Management

Design value management is used to review design proposals. During the workshop consideration is given to whether all the client's requirements are being fulfilled, whether additional value can be added to the project and whether cost savings are possible without detriment to quality, reliability, performance or delivery. Typically, cost savings achieved at a design value management workshop are in the order of 10%.

PROGRESS PAYMENTS

NZIA STANDARD CONDITIONS OF CONTRACT SCC:2009

Architect to assess claims in not more than 10 working days.

Principal to pay (within) 17 working days from the date of Receipt of the Payment Claim.

Retentions:

10% on first \$200,000	\$ 20,000
5% on next \$800,000	\$ 40,000
1.75% on balance	\$140,000 (max)
Maximum Retention	\$200,000

Advances on value of materials and prepared work:

On Site – 100%.

Off Site with Employer's consent, and subject to Schedule G2 Security for off-site goods/materials.

Release of Retentions:

40% of retention released at Practical Completion.

Balance released after end of Defects Liability period and after remedial work completed.

NZS 3910:2013

Progress Certificates and Payments:

Engineer to issue progress payment certificate within 10 working days of receipt.

Principal to pay within 7 working days of date of certificate.

Retentions:

Only as required by the Special Conditions.

Release of Retentions:

50% of retention released at practical completion.

Progressively Release surplus Defects Liability Retentions after deduction of Engineers assessment of the value of incomplete Contract Works after the expiry of the Defects Liability Period.

Defects Liability Retention released 10 working days after the date of the Final Completion Certificate.

FLUCTUATION ADJUSTMENT AND COST INDICES

EXPLANATION OF INDICES USED

Labour Cost Index–LCI

The LCI–Salary & Wages series measures movements in salary and ordinary time wage rates, and overtime wage rates. Series represented:

- SG53E9–All Sectors Combined: Group 15–Construction
- SG43E9–Private Sector: Group 15–Construction

The latter is the index ‘L’ referred to in NZS 3910:2013–Appendix A, Cost Fluctuation Adjustment by Indexation.

The SE59E9–LCI–All Costs Combined series includes non–wage labour–related costs: annual leave and statutory holidays, superannuation, ACC employer premiums, medical insurance, motor vehicles available for private use, and low interest loans, and is published each June.

Consumer Price Index–CPI

The CPI provides a measure of the changes in the prices of goods and services to consumers, and, in 2006, underwent a major review of method and items surveyed. Series represented:

- SE9A–All Groups

Capital Goods Price Index–CGPI

The CGPI records the average level of productive capital assets paid by New Zealand industries.

Series represented:

- S2BA–Non–Residential–Shops and Offices
- S2AA–Residential–Dwellings and Out–buildings
- SGC–Other Construction (includes transport ways, pipelines, electrical works, earthmoving and sitework)

Note: Statistics New Zealand include the following statement for series S2BA.

“This index does not purport to reflect all price changes in building work because of measurement difficulties, particularly with respect to margins and discounts on labour and material prices.”

Producers Price Index–PPI

The PPI measures prices relating to the production sector of the economy.

Output indices measure changes in prices received by producers, input indices measure changes in the cost of production, excluding labour and capital costs. Series represented:

- SQNEE0000–Construction Industry Group EE–Inputs, base Dec 2010
- SQNEE0011–Construction Industry Building Construction EE11–Inputs, base Dec 2010

These represent the index ‘M’ referred to in NZS 3910:2013–Appendix A, Cost Fluctuation Adjustment by Indexation.

COMPENSATING FOR BASE DATE CHANGES

Periodically Statistics New Zealand redevelop indices and 'recalibrate' them back to 1000. A *pro rata* adjustment will allow conversion of the new indices for periods occurring before the new base date applies.

Example. CPI was redeveloped and recalibrated in June 1999. In the original series, the June 1999 value is 1097. In the new series, the June 1999 value has been re-set to 1000.

The March 1997 value is 1082 in the original series. What is the equivalent value for the March 1997 index in the revised series beginning June 1999?

- June 1999 index, reset to 1000 = $\frac{1000}{1097}$
- divided by original June 1999 index value = 1097
- multiplied by March 1997 index 1082 = 0.911577×1082
- Equivalent value for March 1997 index
- in the revised series = 986

Expressed as an equation, thus: $\frac{1000}{1097} \times 1082 = 986$

Note: this calculation should not be applied to the PPI index, which was redeveloped in 1998.

Statistics New Zealand provided back calculations for two years—included above (note that these do not quite match the original figures—due to the redevelopment).

Indices Release Dates

Index	Quarter	Approximate Release Dates	
		Day of month	Month
Capital Goods Price Index	March	3rd Thursday	May
	June	3rd Thursday	August
	September	3rd Thursday	November
	December	3rd Thursday	February
Consumers Price Index	March	3rd Monday	April
	June	3rd Monday	July
	September	3rd Monday	October
	December	3rd Monday	January
Labour Cost Index (Sals and Wages)	March	1st or 2nd Thursday	May
	June	1st or 2nd Thursday	August
	September	1st or 2nd Thursday	November
	December	1st or 2nd Thursday	February
Producers Price Index	March	4th Thursday	May
	June	4th Thursday	August
	September	4th Thursday	November
	December	4th Thursday	February

STATISTICS NEW ZEALAND - INDICES INFORMATION RELEASES

[Labour Cost Index \(All Labour Costs\)](#) – information releases (Annually June Quarter)

[Labour Cost Index \(Salary and Wage Rates\)](#) – see Labour Market Statistics - information releases

[CPI – Consumers Price Index](#) – information releases

[Business Price Indexes](#) – information releases

The [producers price index \(PPI\)](#) and [capital goods price index \(CGPI\)](#) information releases have been combined into one quarterly business price index information release from 19 May 2015.

COST INDEXATION FORMULA

Indexation Formula

NZS 3910:2013 contains provision for calculating and adjusting contract values for cost fluctuations in accordance with published indices.

NZS 3910:2013 can be purchased from Standards New Zealand at www.standards.co.nz.

Appendix A, clause A2

$$C = V \left| \frac{0.4(L-L1)}{L1} + \frac{0.6(M-M1)}{M1} \right|$$

- C** = Cost fluctuation adjustment for the quarter under consideration.
- V** = Valuation of work shown as payable in any Payment Schedule in respect of work having been completed during the quarter under consideration subject to A3, but without deduction of retentions and excluding the Cost fluctuation adjustment.
- L** = Labour Cost Index; Private Sector: Industry Group–Construction: All Salary and Wage Rates: published by Statistics New Zealand, for the quarter under consideration.
- L1** = Index as defined under L but applying for the quarter during which tenders close.
- M** = Producers Price Index; Inputs: Industry Group–Construction, published by Statistics New Zealand, for the quarter under consideration.
- M1** = Index as defined under M but applying for the quarter during which tenders close.

Example

Contract for \$6,000,000 of civil works, tendered in August 2000.

- V = \$1,550,000 (value of work carried out in quarter ended June 2001)
- L = 1131 (LCI index for quarter ended June 2001)
- L1 = 1115 (LCI index for quarter ended September 2000)
- M = 1130 (PPI index for quarter ended June 2001)
- M1 = 1085 (PPI index for quarter ended September 2000)

$$C = \$1,550,000 \times \left| \frac{0.4(1131-1115)}{1115} + \frac{0.6(1130-1085)}{1085} \right|$$

$$C = \$1,550,000 \times \left| \frac{0.4 \times 16}{1115} + \frac{0.6 \times 45}{1085} \right|$$

$$C = \$1,550,000 \times [0.00573991 + 0.0248847]$$

$$C = \$1,550,000 \times 0.0306247$$

$$C = \$47,468.29$$

Therefore, the cost fluctuation adjustment for the quarter under consideration is \$47,468.29.

LABOUR INDICES-CURRENT

		All Costs Combined		Salary / Wages			
		published annually		All Sectors		Private Sector	
Base Date		Jun-01	Jun-09	Jun-01	Jun-09	Jun-01	Jun-09
Year	Qtr	SE59E9	SG59E9	SE53E9	SG53E9	SE43E9	SG43E9
2010	Mar				1012		1012
	Jun		1014		1016		1016
	Sep				1020		1020
	Dec				1026		1026
2011	Mar				1031		1030
	Jun		1046		1037		1036
	Sep				1043		1042
	Dec				1051		1050
2012	Mar				1055		1054
	Jun		1068		1060		1059
	Sep				1067		1066
	Dec				1077		1076
2013	Mar				1081		1079
	Jun		1097		1085		1083
	Sep				1088		1087
	Dec				1096		1094
2014	Mar				1102		1100
	Jun		1119		1108		1106
	Sep				1114		1112
	Dec				1122		1120
2015	Mar				1125		1123
	Jun		1142		1132		1131
	Sep				1137		1135
	Dec				1142		1140
2016	Mar						1149
	Jun						1153
	Sep						1159
	Dec						1164

CPI, CGPI, PPI Indices—Current

		CPI	CGPI			PPI		
		All Groups	Non-residential, shops and Offices	Residential, dwellings	Other Construction	Construction Inputs		
Base Date		Jun-06	Sep-99	Sep-99	Sep-99	Jun-97	Dec-10	
Year	Qtr	SE9A	S2BA	S2AA	S2GC	SNE	SQNEE 0000	SQNEE 1100
2010	Mar	1097	1280	1609	1519	1679	978	976
	Jun	1099	1280	1616	1521	1691	885	987
	Sep	1111	1280	1623	1533	1706	994	995
	Dec	1137	1273	1620	1539	1716	1000	1000
2011	Mar	1146	1274	1619	1558	1741	1012	1008
	Jun	1157	1281	1634	1601		1023	1015
	Sep	1162	1281	1647	1614		1026	1019
	Dec	1158	1284	1655	1630		1031	1021
2012	Mar	1164	1286	1666	1648		1035	1025
	Jun	1168	1287	1680	1650		1038	1028
	Sep	1171	1287	1697	1667		1043	1038
	Dec	1169	1291	1707	1678		1046	1041
2013	Mar	1174	1293	1723	1650		1048	1043
	Jun	1176	1301	1751	1654		1049	1045
	Sep	1187	1312	1767	1665		1058	1054
	Dec	1188	1322	1786	1677		1057	1053
2014	Mar	1192	1332	1809	1685		1061	1059
	Jun	1195	1351	1830	1689		1065	1065
	Sep	1199	1361	1850	1703		1069	1071
	Dec	1197	1374	1882	1710		1067	1072
2015	Mar	1195	1388	1897	1720		1064	1072
	Jun	1200	1396	1924	1723		1071	1079
	Sep	1204	1402	1950	1726		1079	1087
	Dec	1198	1411	1973	1730		1076	1086
2016	Mar	1200	1423	1990	1729		1071	1084
	Jun	1205	1442	2030	1736		1078	1091
	Sep	1209	1454	2071	1739		1081	1096
	Dec	1214	1474	2099	1754		1094	1107

INDICES ARCHIVE

Labour Indices–Archive

		LCI								
		Construction								
		All Costs Combined			Salary/Wages					
					All Sectors			Private Sector		
Base Date		Dec 1992	Jun 2001	Jun 2009	Dec 1992	Jun 2001	Jun 2009	Dec 1992	Jun 2001	Jun 2009
Year	Qtr	SA59P1	SE59E9	SG59E9	SA53P1	SE53E9	SG53E9	SA43P1	SE43E9	SG43E9
1995	Mar	1039			1029			1029		
	Jun	1048			1034			1034		
	Sep	1057			1042			1043		
	Dec	1063			1048			1050		
1996	Mar	1067			1052			1054		
	Jun	1081			1056			1057		
	Sep	1087			1060			1061		
	Dec	1092			1065			1066		
1997	Mar	1096			1069			1070		
	Jun	1097			1074			1076		
	Sep	1100			1077			1078		
	Dec	1104			1080			1082		
1998	Mar	1102			1083			1084		
	Jun	1099			1089			1090		
	Sep	1101			1091			1092		
	Dec	1103			1093			1094		
1999	Mar	1101			1095			1096		
	Jun	1098			1097			1098		
	Sep	–			1101			1102		
	Dec	–			1105			1106		
2000	Mar	–			1109			1110		
	Jun	1112			1111			1112		
	Sep	–			1115			1115		
	Dec	–			1118			1119		
2001	Mar	–			1122			1123		
	Jun	1129	1000		1130	1000		1131	1000	
	Sep	–			1136	1007		1137	1007	
	Dec	–			1143	1012		1143	1011	

		LCI								
		Construction								
		All Costs					Salary/Wages			
		Combined			All Sectors		Private Sector			
Base Date		Dec 1992	Jun 2001	Jun 2009	Dec 1992	Jun 2001	Jun 2009	Dec 1992	Jun 2001	Jun 2009
Year	Qtr	SA59P1	SE59E9	SG59E9	SA53P1	SE53E9	SG53E9	SA43P1	SE43E9	SG43E9
2002	Mar		-		1147	1016		1146	1016	
	Jun		R1015		1152	1019		1152	1018	
	Sep		-			1027			1026	
	Dec		-			1034			1034	
2003	Mar		-			1039			1038	
	Jun		R1040			1044			1044	
	Sep		-			1053			1052	
	Dec		-			1060			1060	
2004	Mar		-			1066			1066	
	Jun		1067			1075			1074	
	Sep		-			1089			1089	
	Dec		-			1101			1100	
2005	Mar		-			1107			1107	
	Jun		1108			1119			1118	
	Sep		-			1136			1136	
	Dec		-			1145			1145	
2006	Mar		-			1152			1152	
	Jun		1154			1163			1162	
	Sep		-			1174			1173	
	Dec		-			1183			1182	
2007	Mar		-			1190			1190	
	Jun		1201			1199			1198	
	Sep		-			1211			1210	
	Dec		-			1221			1220	
2008	Mar		-			1229			1228	
	Jun		1245			1240			1239	
	Sep		-			1256			1255	
	Dec		-			1269			1267	
2009	Mar		-			1273			1271	
	Jun		1279			1278	1000		1276	1000
	Sep		-				1006			1005
	Dec		-				1010			1010

CPI, CGPI, PPI Indices—Archive

		CPI			CGPI						PPI			
		All Groups			Non-Residential Buildings, Shops/Offices		Residential Buildings, Dwellings		Other Construction		Construction Inputs			
Base Date		Dec	June	June	Dec	Sep	Dec	Sep	Dec	Sep	Dec	Jun	Dec '10	
		1993	1999	2006	1989	1999	1989	1999	1989	1999	1982	1997		
Year	Qtr	SE9A	SE9A	SE9A	SBA	S2BA	SAA	S2AA	SGC	S2GC		SNE	SQNEE	
													0.000	1100
1991	Mar	1131			1021						1732			
	Jun	1132			1025						1732			
	Sep	1136			1026						1725			
	Dec	1135			1025						1735			
1992	Mar	1140			1015						1700			
	Jun	1143			1007						1694			
	Sep	1147			1008						1695			
	Dec	1150			1008						1705			
1993	Mar	987			1007	*924					1751			
	Jun	993			1007	*924					1756			
	Sep	998			1021	*937					1774			
	Dec	1000	*912		1038	*952					1785			
1994	Mar	1000	*912		1038	*952					1791			
	Jun	1004	*915		1041	*955					1798			
	Sep	1016	*926		1042	*956	1212				1814			
	Dec	1028	*937		1056	*969	1256				1829			
1995	Mar	1040	*948		1069	*981	1287				1844			
	Jun	1050	*957		1071	*983	1294				1849			
	Sep	1052	*959		1081	*992	1306				1853			
	Dec	1058	*964		1087	*997	1330				1868			
1996	Mar	1063	*969		1091	*1001	1355				1877			
	Jun	1071	*976		1090	*1000	1385				1881	996		
	Sep	1077	*982		1093	*1003	1385				1882	994		
	Dec	1085	*989		1094	*1004	1389				1892	1003		
1997	Mar	1082	*986		1098	*1007	1376				1893	996		
	Jun	1083	*987		1091	*1001	1379				1898	995		
	Sep	1088	*992		1084	*994	1393				1902	998		
	Dec	1094	*997		1091	*1001	1403		1112		1906	1000		
1998	Mar	1096	*999		1091	*1001	1409		1114		1905	999		
	Jun	1101	*1004		1086	*996	1407		1123			1003		
	Sep	1107	1009		1086	996	1399	998	1134	991		1005		
	Dec	1098	1001	833	1087	997	1396	996	1133	990		1002		
1999	Mar	1095	998	830	1086	996	1399	998	1133	990		998		
	Jun	1097	1000	832	1089	999	1399	998	1130	988		1004		
	Sep		1004	835		1000	1402	1000	1144	1000		1019		
	Dec		1006	837		1000		1006		1008		1030		
2000	Mar		1013	843		1003		1013		1013		1040		
	Jun		1020	849		1003		1023		1027		1049		
	Sep		1034	860		1003		1027		1039		1085		
	Dec		1046	870		1005		1036		1060		1132		

		CPI			CGPI						PPI			
					Non-Residential Buildings, Shops/Offices		Residential Buildings, Dwellings		Other Construction		Construction Input			
Base Date		Dec 1993	June 1999	June 2006	Dec 1989	Sep 1999	Dec 1989	Sep 1999	Dec 1989	Sep 1999	Dec 1982	Jun 1997	Dec '10	
Year	Qtr	SE9A	SE9A	SE9A	SBA	S2BA	SAA	S2AA	SGC	S2GC		SNE	SQNEE	
												0.000 1100		
2001	Mar		1044	869		1009		1043		1065		1128		
	Jun		1053	876		1014		1045		1075		1130		
	Sep		1059	881		1017		1048		1094		1132		
	Dec		1065	886		1024		1055		1105		1133		
2002	Mar		1071	891		1028		1069		1109		1134		
	Jun		1082	900		1028		1075		1113		1150		
	Sep		1087	904		1031		1082		1111		1157		
	Dec		1094	910		1031		1100		1110		1161		
2003	Mar		1098	913		1048		1116		1116		1173		
	Jun		1098	913		1060		1135		1121		1164		
	Sep		1103	918		1065		1154		1122		1166		
	Dec		1111	924		1080		1192		1133		1162		
2004	Mar		1115	928		1104		1216		1144		1178		
	Jun		1124	935		1151		1246		1165		1205		
	Sep		1131	941		1162		1272		1181		1222		
	Dec		1141	949		1185		1293		1191		1238		
2005	Mar		1146	953		1188		1313		1210		1253		
	Jun		1156	962		1199		1342		1229		1285		
	Sep		1169	973		1209		1355		1248		1310		
	Dec		1177	979		1212		1376		1273		1327		
2006	Mar		1184	985		1228		1390		1283		1364		
	Jun		1202	1000		1246		1409		1300		1407		
	Sep			1007		1270		1437		1310		1467		
	Dec			1005		1278		1450		1330		1473		
2007	Mar			1010		1276		1471		1335		1489		
	Jun			1020		1279		1496		1340		1510		
	Sep			1025		1282		1523		1357		1536		
	Dec			1037		1291		1543		1374		1548		
2008	Mar			1044		1301		1557		1384		1565		
	Jun			1061		1310		1577		1405		1606		
	Sep			1077		1330		1598		1436		1656		
	Dec			1072		1329		1596		1449		1647		
2009	Mar			1075		1324		1597		1472		1649	961	973
	Jun			1081		1306		1599		1486		1664	970	977
	Sep			1095		1293		1598		1494		1665	970	973
	Dec			1093		1281		1606		1515		1667	971	974

ACKNOWLEDGEMENTS

Acknowledgements are made to the following who assisted with information in the preparation of this Handbook.

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