



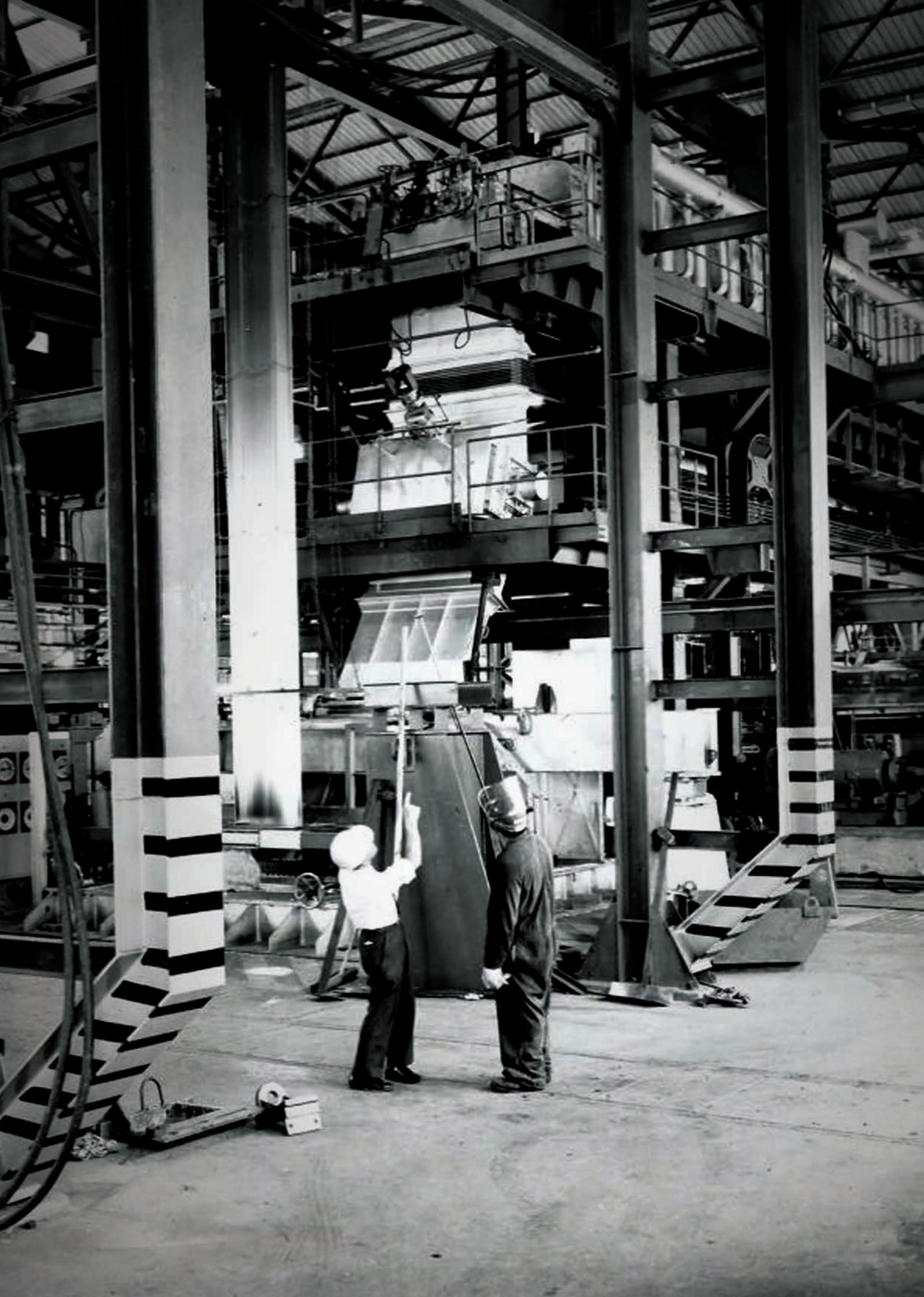
STRUCTURAL
ENGINEERING +
FABRICATION
STEEL GRADES



Auckland University Business School, AUCKLAND, built using Steltech® beams manufactured from New Zealand Steel plate.

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History

The story of New Zealand Steel is as much the story of the 'black sands' of the west coast of New Zealand's North Island. First noted by Captain James Cook in 1769, these ironsand deposits were long recognised as a rich reserve of metal ore.

The ironsand (titanomagnetite) was formed through the breakdown of rocks originating from volcanic activity in Taranaki 2.5 million years ago. Over time, the heavy, dark sands were transported by ocean currents and deposited on beaches, forming dunes of up to 90 metres high.

Early European settlers to the west coast were intrigued by the sand's magnetic qualities. But experiments to smelt the iron from the ironsand met with little success. It wasn't until the 1950's, with both the local economy and steel demand growing, that serious consideration was given to utilising this valuable resource in a home grown steel industry. At about the same time, new technologies were evolving overseas that made possible the use of ironsand in steelmaking.

So in 1959, the government established the New Zealand Steel Investigating Company to determine the technical and economic feasibility of manufacturing steel from indigenous raw materials.

New Zealand Steel Limited was incorporated in 1965. The long-term vision of those behind it was to establish a steel industry that would utilise the abundant local raw materials.

In 1966, construction started on a mill at Glenbrook, 65 kilometres south east of Auckland. Commercial operations began in 1968, with imported feed coil being used to produce GALVSTEEL® steel for domestic and Pacific Island markets.

Meantime, the company had been pioneering the direct reduction process for reducing iron oxide (ironsand) into metallic iron. This culminated in the commissioning in 1970 of iron and steelmaking facilities to produce billets for domestic and export markets.

Expansion continued with the commissioning of a pipe plant in 1972 and a COLORSTEEL® prepainting line in 1982. Total output at this time averaged 300,000 tonnes a year.

Major investment in the 1980's saw the commissioning of continuous slab-casting facilities and both Hot and Cold Strip mills. By 1987, New Zealand Steel was operating as a fully integrated steelworks, producing flat steel products made solely from New Zealand Steel feed stock with the current annual capacity of 660,000 tonnes.

The existing continuous galvanising line was modified in 1994 to produce ZINCALUME® steel, in addition to traditionally hot dipped galvanised products.

Today, the rich 'black sands' of the North Island continue to underpin steelmaking at Glenbrook producing a tough New Zealand made steel with a finer grain due to the unique ore. This grain size enables steel to be produced with a lower carbon content leading to a superior weldability making it a favourite for fabricators and engineers.

New Zealand Steel is a subsidiary of BlueScope Limited (BSL) which operates principally in Australia, New Zealand, North America, and Asia. BSL manufactures and distributes flat steel products and steel building products as well as metallic coated and painted steel products. It also designs and manufactures pre-engineered steel building and building solutions. Domestically New Zealand Steel's products are marketed under five core brands: COLORSTEEL®, ZINCALUME®, GALVSTEEL®, AXXIS® and Steltech® Structural.

New Zealand Steel is proud of its involvement in supporting New Zealand's infrastructure, construction & manufacturing industries.

Through our distributor network our steel has played an integral part in countless projects including structural steel for buildings, bridges and manufactured goods as well as major pipelines, tunnels and other infrastructure projects.

New Zealand Steel is a member of the following organisations:



Contact Energy Bridge, Taupo
Image courtesy of Fulton Hogan





Process

(1) Iron rich ore is sourced from the iron sand deposits at Waikato North Head on New Zealand's West Coast. This resource, the product of volcanic eruptions that occurred 2.5 million years ago, is estimated to be in the order of 600 million tonnes. After travelling to the steel mill via a 16km slurry pipeline, the dewatered ore is combined with Huntly coal and lime from Otorohanga and fed into multi-hearth furnaces converting the coal to char.

(2) This hot dry mix is then transferred to direct reduction rotary kilns, converting it to a reduced primary concentrate (RPC). The RPC is fed into the two large electric 'melters' where further reduction occurs, resulting in the production of molten iron which is tapped into ladles and transferred to the slab making plant.

(3) The molten iron undergoes a process to recover a valuable vanadium rich by-product and is then charged into the oxygen steel making vessel or KOBM along with alloy additives and a quantity of recycled scrap steel. In this vessel oxygen is blown into the 70 tonnes of molten metal at temperatures of up to 1700°C, reducing the carbon content further to produce steel.



(4) The steel is tapped into a ladle and processed through the ladle treatment station which eliminates any oxygen still present, as well as fine tuning the temperature and alloy content to suit the grade being produced. The steel is then processed through the continuous slab caster where it is cooled through a series of rollers, producing a 210mm thick slab ranging from 8 to 20 tonnes, depending on the required width and length.

(5) After cooling and inspection, slabs are reheated in the hot strip mill and reduced to the required thickness by passing back and forth through a series of high pressure rollers. The picture shows the coil box which is an intermediate step in the rolling process, required due to the temperature variation from the huge increase in length of the slab.

(6) The steel strip is then cut to the required length ready for dispatch to the customer. For thinner plate the strip is coiled and cooled. These coils are dispatched directly to some customers or turned into plate through a flattening and shearing process.



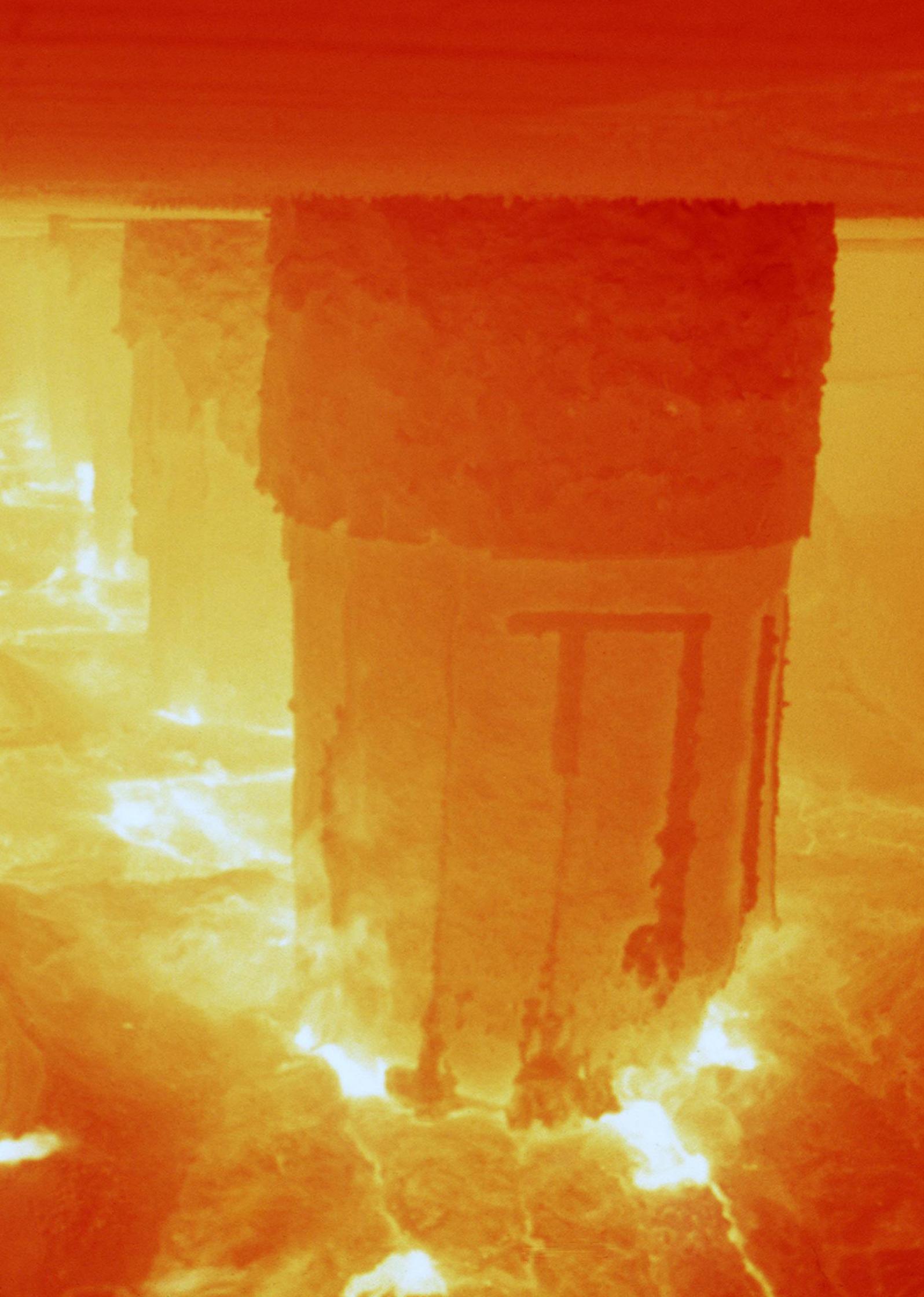
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Grade Summary

	DESCRIPTION	COMMON USES*
HEAVY PLATE AS/NZS 3678 250, 300, 350 (Including L0, L15 charpy options)	Hot finish structural steels with specified minimum yield strengths and good ductility	Structural applications, welded steel beams, bridges, commercial buildings
HEAVY PLATE AS/NZS 3678 Seismic Grade 300 S0	Hot finish steel plate with nominal minimum yield strength, impact testing and additional requirements according to AS3678 appendix D	Application in steel structures and fracture critical elements as specified in NZS3404.1:2009
COIL PLATE AS/NZS 1594 Formable HA1, HA3	Commercial grade steel with or without guaranteed mechanical properties, suitable for simple bending and forming operations through to pressing, drawing and expanded mesh forming	General fabrication, shelving, brackets, automotive parts, furniture, security fencing
Structural HA200, HA250, HA300, HA350	Structural steels with increasing guaranteed minimum yield strengths	Light structural, shelving, racking through to heavy structural, press forming, general fabrication
Weather Resistant HA350	Structural Steels with guaranteed minimum yield strengths and improved resistance to atmospheric corrosion (imported)	Architectural finishes, structural applications, cladding
FLOOR PLATE HA1, HA250	Commercial grade floor plate with or without guaranteed mechanical properties, suitable for simple bending and forming operations	Anti-slip surfacing, steps, treads, flooring, general fabrication

*The common uses listed above are examples only and should not be solely relied upon as evidence of suitability for your specific application. Before selecting individual grades, we recommend you obtain independent advice from appropriate professionals.

International Standards Comparison

	EUROPEAN - EN		JAPANESE - JIS		AUSTRALIA/NZ - AS/NZS		AMERICAN - ASTM		EXPECTED MINIMUM TENSILE
COMMERCIAL GRADES	Standard	Grade	Standard	Grade	Standard	Grade	Standard	Grade	MPa
					1594	HA1	A1011 & A1018	CS TYPE A&B	N/A
MODERATE FORMING GRADES	Standard	Grade	Standard	Grade	Standard	Grade	Standard	Grade	MPa
			G3131	SPHC, SPHD					270
			G3132	SPHT-1					270
					1594	HA3, HA200			300
STRUCTURAL GRADES	Standard	Grade	Standard	Grade	Standard	Grade	Standard	Grade	MPa
			G3101	SS330					330
			G3132	SHPT-2			A1011 & A1018	30	340
					1594	HA250			350
	10025	S235J0					A1011 & A1018	33	360
							A1011	36 TYPE 1	365
			G3101	SS400			A1011 & A1018	36 TYPE 2	400
					1594	HA300	A36		400
	10025	S275JR & J0			3678	250 & 250L15	A1011 & A1018	HSLA-S 50 CLASS 2	410
					3678	300, 300LO, 300L15 & 300S0			430
					1594	HA350			430
					3678	350 & 350L15	A1011	SS GRADE 50	450
							A1018	HSLA-S 50 CLASS 1	450
FLOOR PLATE	Standard	Grade	Standard	Grade	Standard	Grade	Standard	Grade	MPa
					1594	HA1	A786		N/A
					1594	HA250			350

Note: This table indicates approximate relationships only. For more detailed comparisons contact New Zealand Steel directly.



Heavy Plate - AS / NZS 3678

- Edge condition is untrimmed (mill edge) only.
- Thickness options in 0.1mm increments are available on request.
- To calculate theoretical weight in kg multiply thickness (mm) x length (m) x width (m) x 7.85.

STANDARD PLATE SIZES

THICKNESS (mm)	WIDTH (mm)	LENGTH (mm)
10, 12	1220	2400
	1520	3600, 7200
16, 20, 25, 32, 40, 50	1220	2400, 7200
	1520	3600, 7200

CHEMICAL COMPOSITION

Typical Weight Percent

THICKNESS (mm)		C	Si	Mn	S	P	V
250	≤ 20	0.180	0.012	1.000	0.017	0.014	
	> 20	0.120	0.240	1.300	0.017	0.014	
250LO, 250L15	All	0.120	0.240	1.300	0.017	0.014	
300, 300LO, 300L15	10-32	0.160	0.240	1.300	0.017	0.020	0.016
	32-50	0.150	0.250	1.300	0.016	0.012	0.035
350, 350LO, 350L15	All	0.140	0.270	1.450	0.016	0.016	0.075

MECHANICAL PROPERTIES

Typical Values (with guaranteed min)

	THICKNESS (mm)	YIELD STRENGTH (MPa)	TENSILE STRENGTH (MPa)	ELONGATION % ON LO=5.65 mm V SO
250, 250LO, 250L15	10.00 - 12.00	310 (260)	470 (410)	32 (22)
	12.01 - 20.00	300 (250)	465 (410)	31 (22)
	20.01 - 52.00	300 (250)	465 (410)	31 (22)
300, 300LO, 300L15	10.00 - 12.00	350 (310)	510 (430)	32 (21)
	12.01 - 20.00	340 (300)	500 (430)	28 (21)
	20.01 - 32.00	320 (280)	480 (430)	27 (21)
350, 350LO, 350L15	10.00 - 12.00	420 (360)	550 (450)	25 (20)
	12.01 - 20.00	400 (350)	505 (450)	24 (20)
	20.01 - 32.00	380 (340)	530 (450)	23 (20)

FABRICATION PERFORMANCE (1=LIMITED, 5=EXCELLENT)

	BENDING					WELDING				
	1	2	3	4	5	1	2	3	4	5
250, 250LO, 250L15										
300, 300LO, 300L15										
350, 350LO, 350L15										

IMPACT PROPERTIES

(Sample size: 10mm x 10mm x 55mm)

	TEMPERATURE	GUARANTEED MINIMUM (AVE 3 TESTS)
LO	0°C	27 Joules
L15	-15°C	27 Joules

DIMENSIONAL CAPABILITIES

	THICKNESS (mm)	WIDTH (mm)	LENGTH (mm)
250, 250LO, 250L15	10.00 - 52.00	730 - 1540	2400 - 13000
300, 300LO, 300L15	10.00 - 12.00	730 - 1540	2400 - 13000
	14.00 - 32.00	730 - 1540	2400 - 13000
350, 350LO, L15	10.00 - 32.00	730 - 1540	2400 - 13000

Heavy Plate - Seismic Grade AS / NZS 3678

- Edge condition is untrimmed (mill edge) only.
- Thickness options in 0.1mm increments are available on request.
- To calculate theoretical weight in kg multiply thickness (mm) x length (m) x width (m) x 7.85.

STANDARD PLATE SIZES

THICKNESS (mm)	WIDTH (mm)	LENGTH (mm)
10, 12	1220	2400
	1520	3600, 7200
16, 20, 25, 32, 40	1220	2400, 7200
	1520	3600, 7200

CHEMICAL COMPOSITION

Typical Weight Percent

	THICKNESS (mm)	C	Si	Mn	S	P	V
300S0	10.00 - 32.00	0.160	0.240	1.300	0.017	0.020	0.016
	32.01 - 40.00	0.150	0.250	1.300	0.016	0.012	0.035

MECHANICAL PROPERTIES

Typical Values (with guaranteed min)

	THICKNESS (mm)	YIELD STRENGTH (MPa)	TENSILE STRENGTH (MPa)	ELONGATION % ON L ₀ =5.65mm √ S ₀	MAXIMUM YIELD TO TENSILE RATIO (F _y /F _U)
300S0	10.00 - 12.00	350 (310)	510 (430)	32 (25)	0.80
	12.01 - 20.00	340 (300)	500 (430)	29 (25)	0.80
	20.01 - 40.00	320 (280)	480 (430)	28 (25)	0.80

FABRICATION PERFORMANCE (1=LIMITED, 5=EXCELLENT)

	BENDING					WELDING				
	1	2	3	4	5	1	2	3	4	5
300S0										

IMPACT PROPERTIES (AS/NZS 3678 S0)

(Sample size: 10mm x 10mm x 55mm)

	TEMPERATURE	GUARANTEED MINIMUM
300S0	0°C	50 Joules (Individual test)
	0°C	70 Joules (Average three tests)

DIMENSIONAL CAPABILITIES

	THICKNESS (mm)	WIDTH (mm)	LENGTH (mm)
300S0	10.00 - 40.00	730 - 1540	2400 - 13000

Coil Plate - AS / NZS 1594

- Thickness options in 0.1mm increments are available on request.
- Custom plate lengths available in 50mm increments from 1.8 to 10.0m.
- Edge condition is untrimmed (mill edge) only.
- Options for Pickled and Oiled surface treatment available on request.

STANDARD PLATE SIZES

THICKNESS (mm)	WIDTH (mm)	LENGTH (mm)
3, 4, 5, 6, 8	1220	2400
	1520	3600
10, 12	1220	2400

CHEMICAL COMPOSITION

Typical Weight Percent

	THICKNESS (mm)	C	Si	Mn	S	P	V
HA1	All	0.050	0.007	0.200	0.018	0.011	
HA3	All	0.030	0.007	0.180	0.016	0.011	
HA200	All	0.050	0.007	0.200	0.017	0.011	
HA250	2.0 - 2.4	0.050	0.007	0.200	0.018	0.014	
	2.5 - 6.0	0.075	0.008	0.600	0.018	0.016	
	6.1 - 13.0	0.170	0.008	0.600	0.018	0.016	
HA300	3.1 - 4.9	0.170	0.007	0.600	0.017	0.016	
	4.9 - 13.0	0.170	0.010	1.600	0.017	0.014	
HA350	3.21 - 4.9	0.170	0.013	1.050	0.017	0.016	
	4.91 - 8.99	0.150	0.250	1.300	0.015	0.014	0.035
	9.0 - 13.0	0.110	0.150	1.300	0.014	0.014	0.075

Typical Weight Percent

	THICKNESS (mm)	C	Si	Mn	S	P	Cu	Cr	Ni
HW350	3 - 6	0.090	0.450	0.800	0.010	0.090	0.250	0.700	0.2

MECHANICAL PROPERTIES

Typical Values (with guaranteed min)

	THICKNESS (mm)	YEILD STRENGTH (MPa)	TENSILE STRENGTH (MPa)	ELONGATION % ON LO=5.65mm V SO
HA1	2.00 - 13.00	N/A	N/A	N/A
HA3	2.00 - 3.00	280 (200)	360 (300)	30 (22)
	3.10 - 13.00	270 (200)	350 (300)	31 (24)
HA200	2.00 - 2.50	250 (200)	360 (300)	32 (17)
	2.51 - 13.00	260 (200)	370 (300)	31 (19)
HA250	2.00 - 3.00	280 (250)	390 (350)	32 (16)
	3.10 - 6.00	300 (250)	410 (350)	30 (17)
	6.10 - 13.00	290 (250)	540 (350)	27 (17)
HA300	3.10 - 4.90	340 (300)	480 (400)	28 (16)
	4.90 - 13.00	350 (300)	490 (400)	25 (16)
HA350	3.21 - 13.00	390 (350)	520 (430)	23 (15)
HW350	3.00 - 6.00	420 (340)	550 (450)	22 (15)

FABRICATION PERFORMANCE (1=LIMITED, 5=EXCELLENT)

	DRAWING					PRESSING				
	1	2	3	4	5	1	2	3	4	5
HA1	■					■				
HA3	■					■				
HA200	■					■				
HA250	■					■				
HA300	■					■				
HA350	■					■				
	BENDING					ROLL FORMING				
	1	2	3	4	5	1	2	3	4	5
HA1	■					■				
HA3	■					■				
HA200	■					■				
HA250	■					■				
HA300	■					■				
HA350	■					■				

FABRICATION PERFORMANCE

WELDING	1	2	3	4	5
HA1	████████████████████				
HA3	████████████████████				
HA200	████████████████████				
HA250	████████████████████				
HA300	████████████████████				
HA350	████████████████████				

DIMENSIONAL CAPABILITIES

Dry Coil & Coil Plate

	THICKNESS (mm)	WIDTH (mm)
HA1, HA3, HA200	2.00 - 2.20	730 - 1290
	2.21 - 2.49	730 - 1378
	2.50 - 13.0	730 - 1540
HA250	2.00 - 2.44	730 - 1290
	2.45 - 2.89	730 - 1260
	2.90 - 13.00	730 - 1540
HA300	3.10 - 3.23	730 - 1000
	3.24 - 3.99	730 - 1260
	4.00 - 13.00	730 - 1540
HA350	3.21 - 3.60	730 - 900
	3.61 - 4.90	730 - 1290
	4.91 - 13.00	730 - 1540
HW350	3, 4, 5, 6	1250

(Other dimensional combinations may be available by enquiry.)

Some plate widths may not be feasible due to corresponding standard slab widths. Check with your distributor for more details.



Floor Plate - AS / NZS 1594

- Our slip resistance floor plate (chequer plate) grades feature the ASTM A786 pattern A.
- The mean coefficient of friction meets Acceptable Solution D1/AS1, Min 0.4 μ . NZS Chequer, 0.49 Wet and 0.65 Dry.
- The Lozenge dimensions are 29.5mm x 10mm x 1.83mm, adding a total of 2.1kg/m² to the weight of the plate.

STANDARD PLATE SIZES

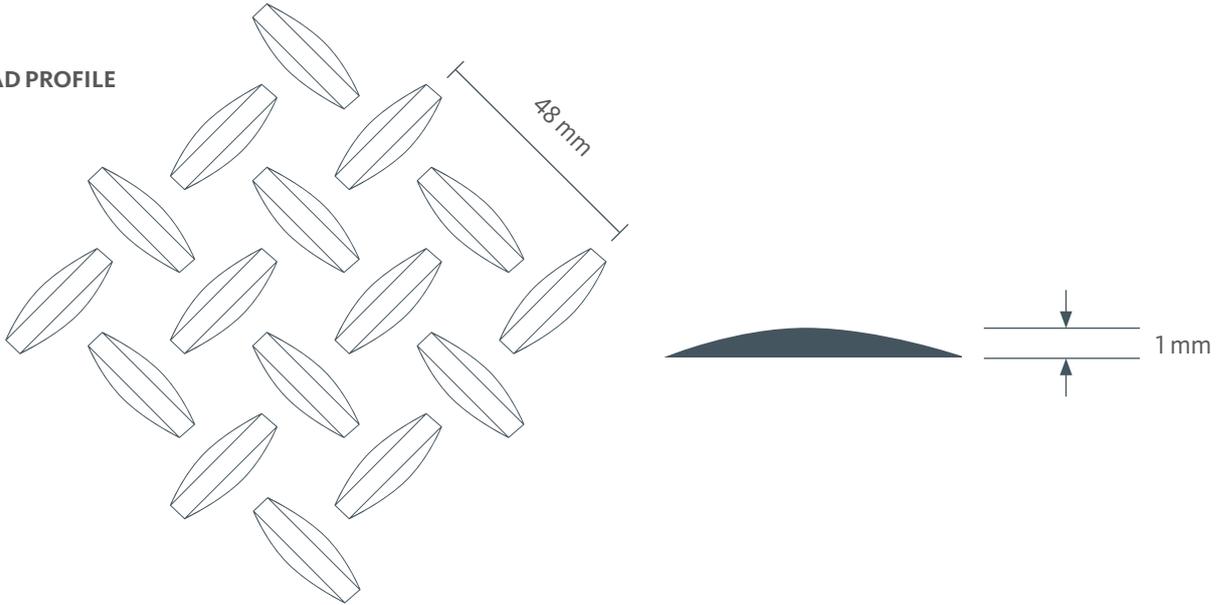
THICKNESS (mm)	PLATE SIZE (mm)
3.2, 4, 5, 6, 8, 10	1220 X 2400 1520 X 3600
12	1220 X 2400

CHEMICAL COMPOSITION

Typical Weight Percent

	THICKNESS (mm)	C	Si	Mn	S	P
HA1	All	0.050	0.007	0.200	0.018	0.011
HA250	2.8 - 2.9	0.050	0.007	0.200	0.017	0.014
	3.0 - 4.9	0.080	0.008	0.600	0.017	0.016
	4.9 - 10.0	0.170	0.008	0.600	0.016	0.014

TREAD PROFILE



MECHANICAL PROPERTIES

Typical Values (with guaranteed min)

	THICKNESS (mm)	YEILD STRENGTH (MPa)	TENSILE STRENGTH (MPa)	ELONGATION % ON LO=200mm
HA1	All	N/A	N/A	N/A
HA250	All	290 (250)	420 (350)	34 (-)

FABRICATION PERFORMANCE (1=LIMITED, 5=EXCELLENT)

	BENDING					WELDING				
	1	2	3	4	5	1	2	3	4	5
HA1	[Progressive bar from 1 to 5]					[Progressive bar from 1 to 5]				
HA250	[Progressive bar from 1 to 5]					[Progressive bar from 1 to 5]				

DIMENSIONAL CAPABILITIES

Dry Coil & Coil Plate Only

	THICKNESS (mm)	WIDTH (mm)
HA1, HA250	2.80 - 3.20 3.21 - 10.00	730 - 1240 730 - 1540

(Other dimensional combinations may be available by enquiry.)

Grades & Sizes Available on Request

Through our parent company, BlueScope Limited in Australia, New Zealand Steel is able to offer the range of XLERPLATE® sizes and grades that extends the offer available from New Zealand manufactured product.

Xlerplate® is available in standard grades with thicknesses up to 150mm, widths up to 3.2m and lengths up to 18.3m (Note thickness, width and length combinations vary depending on grade and dimensional combinations).

Grades available include:

- AS/NZS 3678 250, 350 (Charpy grades included)
- AS 1548-7-430R & 460R

Please refer to www.xlerplate.com.au for more information or email xlerplate@bluescopesteel.com

Wind farm, Codrington, VICTORIA,
built using BlueScope Steel XLERPLATE®.





Quality

All New Zealand Steel products can be traced back through each of their processing stages by the material's unique identification number.

PRODUCT		
	Heavy Plate AS/NZS 3678	Floor & Coil Plate AS/NZS 1594
EDGE CAMBER	Edge camber will be limited to ensure that the dimensions of the ordered plate are within the delivered size. If agreed to at the time of ordering, edge camber will be limited to 0.3% of the actual length of the plate.	The maximum deviation of the side edge from a straight edge will not exceed 0.4% of the actual length.
OUT OF SQUARE	For all sizes the cut lengths shall be such that plates conforming to the ordered nominal dimensions can be obtained.	For all sizes the cut lengths shall be such that sheets or plates conforming to the ordered nominal dimensions can be obtained. When measured in accordance with the procedure described previously, the out of squareness of a cut length from trimmed edge steel strip will not exceed 1.0%.
FLATNESS	Tolerances for flatness vary with the nominal thickness of the product. Details are provided in AS/NZS 1365 and shown over the page.	Tolerances for flatness vary with the nominal thickness of the product. Details are provided in AS/NZS 1365 and shown over the page.

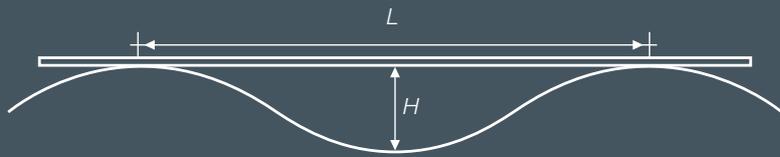


Diagram A: Between two points of contact.

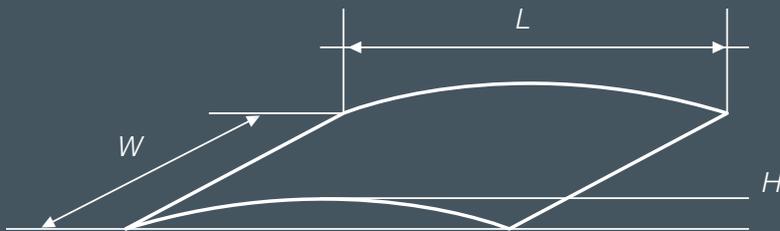


Diagram B: Where two points of contact do not exist.

Legend: H = deviation from flatness, W = width of sheet,
L = length of sheet between two points of contact.

To measure flatness, the product, resting under its own weight, is placed on a flat horizontal surface in such a manner that any deviation from flatness is in the centre, not at the ends.

Deviations from flatness are measured by allowing a straight edge to rest on at least two points on the product surface and then measuring the distance between the product and the straight edge. (Diagram A)

Only that portion between two consecutive points of contact is taken into consideration. The straight edge may be placed in any direction. Where two points of contact do not exist, the deviation may be determined by measuring the distance between the flat horizontal surface and the bottom surface of the product. (Diagram B)

STEEPNESS RATIO

This is an alternative method for expressing flatness. The product resting under its own weight is placed on a flat horizontal surface with the depression to be measured facing upwards. The steepness ratio, expressed as a percentage, is calculated by determining the maximum distance between the product surface and straight edge in accordance with the procedures specified. (Illustrated in Diagram A and B), then applying the following equation:

$$\text{Steepness ratio} = H/L \times 100\%$$

Where: H = deviation from flatness (wave height) in millimetres, L = length of sheet between two points of contact, in millimetres.

Processing

CORROSION PREVENTION

The various environments that steel is exposed to can be broadly categorised as follows:

- Interior atmospheric (buildings, containers)
- Exterior atmospheric
- Immersed (salt & fresh water)
- Buried in soil
- Chemical (fume, splash, solids and immersion)

AS/NZS2312 'Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings' provides comprehensive advice on the selection and specification of various coating systems including organic coatings, galvanising and hot metal spray. It also provides advice on corrosiveness of various atmospheric environments in New Zealand and on structural design to minimise the effects of corrosion.

Advice can also be obtained from protective coating manufacturers and suppliers on the selection of coating systems for various environments.

FORMING & BENDING

Forming steel can vary from simple cold bending in a press brake to deep drawing in complex, multi-stage die presses. The chemical composition, mechanical properties, metallurgical microstructure, surface condition, thickness, edge condition and forming direction can all have an influence on the plate forming properties.

COLD FORMING

This involves plastic deformation, or stretching, of the material surface on the outside of the bend. To ensure the limits of the materials ductility are not exceeded, controls are placed on the minimum radius of bend for a particular application. Plastic deformation also results in strain hardening, in turn affecting the mechanical properties, decreasing ductility and fracture toughness. For critical applications it may be necessary to restrict the radius of the bend further or undertake subsequent heat treatment to restore the original properties. The major factors affecting the extent to which forming is possible without failures are:

STEEL TYPE Low strength steels are generally more ductile than higher strength steels and are therefore capable of being shaped into more restrictive forming radii. Product data sheets give information on minimum bend radii and generally low carbon content equals good formability.

DIRECTION OF FORMING The properties of steel plates are directionally dependant due to the rolling process which elongates the metallurgical structure parallel with the principal rolling direction (i.e. length direction) of the plates. Plates will therefore exhibit different properties depending on the orientation relative to the original rolling direction. The extent of this dependence varies, but better forming properties will generally be obtained in the longitudinal, or principal steel mill rolling direction. Ductility follows this rule and for this reason plates are more readily formed, or stretched, with the bend axis transverse to the principal rolling direction of the plate.

**RECOMMENDED MINIMUM INSIDE RADIUS FOR COLD BENDING OF
NEW ZEALAND STEEL PLATE GRADES DURING FABRICATION (I)**

Thickness, T, mm		Bend Direction (2,3)	AS 3678 250 & 300 AS 1524 7/460	AS 3678 350 & 400 AS 1524 5/490
>	≤			
6	10	Transverse Longitudinal	1.5T 2.25T	2.0T 3.0T
10	20	Transverse Longitudinal	2.0T 3.0T	2.5T 3.75T
20	50	Transverse Longitudinal	4.0T 6.0T	Hot form ⁽⁴⁾ Hot form ⁽⁴⁾
50	-	Both	Hot form ⁽⁴⁾	

Notes

- 1 The recommended bending radii of floorplate are as above except where the raised pattern is in tension, when a more liberal radii should be used.
- 2 A transverse bend is one where the axis of the bend is at right angles to the direction of the rolling.
- 3 A longitudinal bend is one where the axis of the bend is parallel to the direction of the rolling.
- 4 Hot forming – refer comments under 'Hot Forming'.

**EDGE & SURFACE
CONDITION**

Ductility can be reduced by the presence of sharp corners on sheared edges, gouge marks on flame cut edges and other similar stress-concentrating sources which should be removed prior to cold forming. The 'outside' or tension side of the edge or surface is most important in this respect, particularly in thicker plate where it is necessary to utilise restrictive bend radii.

Grinding or similar methods should be employed to remove gouge marks, notches, heavy scoring and sharp edges. Similarly the localised edge hardening associated with shear cut edges and flame cutting, may impair the cold bending performance. For critical applications it may be necessary to apply some form of edge conditioning to remove the metallurgically affected edge area.

**OTHER PRACTICAL
FACTORS**

Forming dies should exhibit chamfered corners and openings. The provision of liberal die radii, consistent with the finished component, will minimise excessive local strains and thereby reduce the risk of forming failure.

The risk of failure on forming heavy plate or particularly restrictive bends may be reduced by preheating to about 75°C prior to bending. This is particularly applicable to plate thicknesses above 20mm. For similar reasons forming should not be undertaken where the plate temperature is below 15°C. For high yield strength steels a slightly greater 'over bending' may be required to compensate for spring back on removal of the bending press force.

**PROPERTIES
OF COLD FORMED
COMPONENTS**

Where particular processing is to be carried out subsequent to cold forming, it may be necessary to adopt alternative procedures. On most hot-rolled plates mechanical properties can be restored by a normalising heat treatment, typically at 900°C, followed by air cooling.

Heat treatment of controlled rolled steels (especially micro alloyed steels) may significantly lower the mechanical properties and should not be undertaken except with specialist advice.

Strain ageing can cause a delayed increase in strength, and loss of ductility and toughness in susceptible steels as a result of strains induced by cold working. Changes are time and temperature dependant and exposure of severely cold worked plate to elevated temperatures (up to about 450°C) can result in unacceptable loss of ductility, requiring that the component be subjected to additional heat treatment.

The extent to which strain ageing occurs depends on a large number of factors including steel type, thickness, and degree of cold work and can be influenced by such things as welds adjacent to cold worked areas, hydrogen embrittlement from acid pickling and even the thermal effects from hot dip galvanising. Brittle failure at quite low stress can occur if precaution is not observed, particularly where cold bending is carried out using a sharp edge former.

HOT FORMING

During hot forming (usually near 900°C) the strain hardening and the distorted grain structures are rapidly eliminated by the formation of new strain free grains via recrystallisation. Therefore a much greater degree of forming may be carried out than with cold working. Additionally, because the strength of the steel decreases with increasing temperature, the total energy necessary to deform a given component will be much lower than for cold forming.

There are however, limitations to hot forming. Surface oxidation (or scaling) may be a problem. It may also be difficult to avoid rolling or pressing into the plate and allowance must be made for thermal expansion and contraction. Plate grades such as AS/NZS 3678-350, WR 350 and impact grades rely on controlled thermo-mechanical processing at the steelworks in order to establish their mechanical properties. Such grades have their mechanical properties modified markedly by heat treatment or hot forming above 600°C and are therefore not readily amenable to such processing without specialist guidance. As a general rule plates should not be soaked for prolonged periods above 950°C, and it is preferable to form within normalising range near 900°C.

WELDING

Welding has many variables in terms of matching methods and materials. By properly selecting a welding process, many hours may be saved. The object of welding, whether it's done on a production basis or occasionally, is the same: to produce a quality weld in the least amount of time. The specification of the appropriate weld quality is the responsibility of the designer of the structure or fabrication. Welding standards such as the AS/NZS 1554 series provide levels of quality to ensure welds are fit for their intended purpose; using this approach ensures that the fabricator meets the customer's expectations at a reasonable cost.

There is no single welding process suitable for all welding situations. For this reason, it is necessary to weigh the advantages and disadvantages of each welding process which includes gas metal arc welding (MIG), flux cored welding, gas tungsten arc welding (TIG) and shielded metal arc welding (stick electrode). Factors to consider include the grade and thickness of the material, the welding position, type of welding power source, the amount of current available, and time requirements.



New Zealand's Heavy Engineering Research Association's (HERA) Welding Centre has the specific aim to cover the advancement of welding and joining technology across the New Zealand metal fabrication industry. The centre offers a wide range of welding-related services including: consultation, failure investigations and corrective actions, research, educational courses and seminars. For more information visit www.hera.org.nz or phone 09 262 4840.

FLAME CUTTING

Oxygen is fundamental to the process of flame cutting as it chemically combines with preheated steel (at around 700°C) producing more heat which melts the oxide formed. The high pressure oxygen jet also sweeps away the molten products from the cut section (kerf). Acetylene and LP gas are the most commonly used fuel gasses for the preheating flame. A hardened heat affected zone will be left adjacent to the cut edge, the size of which will depend on the cutting speed, steel thickness and steel chemistry.

In many applications removal of the heat affected zone may not be required, however if the cut face is to be welded, light dressing of the cut surface with a grinder is recommended to remove the thin carbide layer formed during flame cutting.

PLASMA CUTTING

Plasma cutting speeds can be up to 2 or 3 times faster than flame cutting on thinner sections. As thicknesses approach 25mm or more the speed advantages diminish rapidly. Plasma cutting typically produces a wider kerf than flame cutting and it is difficult to create a square cut face. The hardened heat affected zone from plasma cutting will not be as large as that from a flame cut however; it is still recommended the surface layers of the plasma cut be at least lightly ground to remove the hardest layers prior to subsequent processing.

LASER CUTTING

Laser cutting has advantages of speed, precision and quality over more conventional cutting methods. Due to the concentrated beam, only a small kerf and narrow heat affected zone are produced, suiting applications requiring high accuracy and minimal distortion. Laser cutting is however only suitable up to a certain thicknesses and grade, surface quality and flatness can all have a large impact.

Kopu Bridge, THAMES



Steel is the most recyclable material in the world today.

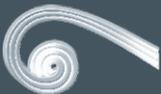
SUSTAINABLE STEEL

Steel is one of the most common materials that we come into contact with everyday. It occupies this position because of its versatility, strength and recyclability. There are few other materials that are 100% recyclable over and over again, without loss of properties. It is the most recyclable material in the world today.

New Zealand Steel approaches sustainability in two streams. We assess our manufacturing process and the products we create based on recognised international standards. We categorise these as Sustainable Manufacture and Sustainable Building.

New Zealand Steel is a member of the Sustainable Steel Council.

NEW ZEALAND STEEL
100% RECYCLABLE





SUSTAINABLE MANUFACTURE

In 1976 New Zealand Steel established its environmental laboratory to monitor and improve its environmental performance. In the early 1990's the company volunteered to lower its carbon emissions through the introduction of a Co-generation plant and has since generated around 60% of its electricity requirements. Since the early 90's New Zealand Steel developed its environmental management system (EMS) and in 2003 gained ISO14001 accreditation. The EMS is audited by external auditors twice yearly and continuous improvement is an integral component of the system. Over the years, New Zealand Steel has been recognised for its achievements with a number of national environmental and energy awards.

New Zealand Steel recycles 99% of the water used in manufacturing, including all stormwater collected from the 190 hectare site. Up to 80% of waste from the steel making process is recycled back into the process, or sold as co-products.

New Zealand Steel is an integrated site where raw steel and finished products, including painted products, are all manufactured. This is unusual in the global steel industry and by its very nature eliminates extensive transportation between each manufacturing process. Conveyor belts and slurry pumps are used to transport the iron ore significantly reducing our carbon footprint for raw material supply. Without these a truck would be required to travel 18 kilometres from the mine site to the Glenbrook plant every 3 minutes 24/7. Coal is also sourced close to the Glenbrook mill in northern Waikato and transported by purpose-built rail.

Twenty five percent of mined sand is extracted as Titanomagnetite (ironsand). The remainder is returned to the mined areas, which are then planted with marram grass and eventually planted in productive pine trees. Once restored there is little or no trace of mining and the area is returned to the larger recreational reserve at the Waikato River mouth.

The biggest percentage of the company's capital investment in environmental control is in treating process emissions before discharge to the atmosphere. The scale of the air cleaning operation is enormous, with more than 3 million cubic metres of waste gas being cleaned and monitored each hour.

SUSTAINABLE BUILDING

To encourage more sustainable building design the sustainability of materials must be considered over the entire life of the product, building or material from extraction of resources to recycling or disposal at end of life. The relative impact of materials must be understood using rigorous assessment of the life cycle impact. The life cycle assessment is undertaken to an international standard and independently peer reviewed.

Steel has many unique characteristics, which make it ideal for sustainable construction and long-term environmental performance:

- Steel does not suffer product degradation through endless recycling.
- Steel is relatively easy to recover from waste streams and the metal recycling industry in New Zealand is well established.
- It is estimated that at least 80% of all steel products in New Zealand are recycled (MfE 2007 study) and overseas studies have shown that up to 99% of steel from heavy framing products can be captured or re-used (BCSA - The whole story: From cradle to grave, 2011).
- Steel products are lightweight and easily transported to building site.
- Steel is strong, long lasting and versatile, non-combustible and nontoxic.
- Factory applied finishes (paint or metal alloy) add durability and are more durable than post installation application.
- Steel lends itself to design for disassembly and re-use.
- Many steel products are easily precision prefabricated minimising waste.

COMMITMENT TO RESEARCH

New Zealand Steel is conducting and participating in research for product improvement and sustainable building solution including:

- Lighter structures
- Design for reuse
- Composite materials
- Energy efficiency

New Zealand Steel is a member of Beacon Pathway Inc. – a collaborative consortium to improve the sustainability of residential buildings in New Zealand.

The Glenbrook site is also host to a major research operation of LanzaTech, a prominent technology provider in the industrial bio-commodities arena with a goal of developing and commercialising proprietary technologies for the production of low-carbon fuels that do not compromise food or land resources.

New Zealand Steel has a zero waste program targeting a further significant reduction in waste to landfill, through innovative associations with other New Zealand businesses.

Further environmental information on New Zealand Steel activities can be found at www.nzsteel.co.nz.



Ordering and Contact

The following checklist should be used to ensure that your requirements are correctly specified for order placement or product enquiry.

CHECKLIST

PRODUCT

Specify your requirement for plate, coil plates, floor plates or hot rolled coil.

GRADE

Standard, General, or Negotiated. Include any special requirements.

DIMENSIONS

Specify width (mm) x thickness (mm) x length (m). Mill edge untrimmed plates should be re-squared prior to their use. Because there may be minor surface imperfections it is recommended that a minimum of 50mm additional allowance per edge be included for critical applications. These additional allowances should be included at the design stage to ensure allowance for gas cutting to final dimensions. Sufficient additional thickness should be allowed for machining to achieve final dimensions and clean-up surface.

QUANTITY

Orders are normally expressed in terms of numbers of plates or coil plates, and mass (tonnes). The minimum ordering quantity for standard grades will vary so talk to your distributor about this including any additional charges for smaller or exact quantities.

The theoretical mass of plain plates and coil plates is calculated using the nominal dimensions and the density factor 7.85 tonnes per cubic metre.

With floor plates, 2kg per square metre of plate is added to the mass of plain plate of the same nominal dimensions to account for the pattern projections.

CERTIFICATION

Test certificates will be supplied from the manufacturer to the distributor if specified at the time of order.

MARKING

Specify any special identification requirements.

END USE

Specify end use or project, or whether the product is required for stock. Where flatness is critical make sure you make this known to our distributor.

DESTINATION

The address to which delivery is to be made.

LEAD TIME

This should be established in consultation with your distributors representative.

WHERE TO BUY

New Zealand Steel Plate and BlueScope Xlerplate is available from an extensive network of New Zealand Distributors who offer a range of value adding services.

If you would like assistance, or you require information about a product or process that is not shown here, contact your nearest New Zealand Steel distributor.

MAJOR NEW ZEALAND SUPPLIERS:

FLETCHER EASYSTEEL
www.easysteel.co.nz
0800 EASYSTEEL

HJ ASMUSS
www.hja.co.nz
0800 276 877

STEEL & TUBE
www.steelandtube.co.nz
04 570 5000

VULCAN STEEL
0800 VULCAN

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For more information about New Zealand Steel structural, engineering and fabrication steel grades including queries regarding product specification, purpose or application call 0800 100 259, visit www.nzsteel.co.nz or email us at info@nzsteel.co.nz