Technical Manual

Part 1: Table of Contents, Introduction & Product Range & Properties

hebel®

The better way to build

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Our Business Development Team is actively involved in the organisation and presentation of product seminars and audio visual presentations.

National Distributor Network

CSR Hebel supplies its products to the marketplace via a national distributor network. These distributors have the support of the CSR Hebel to ensure their clients are offered the best service and technical assistance.

The location of your nearest distributor can be found by contacting CSR Hebel from the above listed contact details.

The product data contained in this manual is applicable only to CSR Hebel products manufactured from Autoclaved Aerated Concrete (AAC) produced by CSR Hebel, a division of CSR Building Products Ltd in Australia, and is current at the time of publication. CSR Hebel reserves the right to vary product specifications without notice. Additionally, design regulations and Standards can change and while CSR Hebel will seek to maintain this document, it is the responsibility of the user to ensure that the information provided is correct and relevant at the time of use. The data contained in this edition supersedes all previous editions.

New Zealand

The contents of this Technical Manual have been prepared with consideration to and in accordance with the relevant Australian standards, legislative requirements and building regulations. It is the responsibility of the user to ensure that the information provided in this manual is appropriate and similarly conforms to the relevant New Zealand Standards, legislative requirements and building regulations.

Use of Technical Manual for Hebel AAC Block Structures

In New Zealand, AAC block structures require specific engineering design. Such design must be undertaken by a suitably qualified structural engineer. Furthermore, specification of control joint requirements and locations in Hebel AAC block structures must be assessed and verified by the structural engineer with consideration to the information within this Technical Manual and to the relevant masonry block Standards and Codes of Practice existing in New Zealand, specifically with reference to seismic design.

Published by: CSR Building Products Limited, trading as CSR Hebel ABN 55 008 631 356.

About Designing with CSR Hebel AAC

The Hebel Technical Manual has been prepared as a source of information to provide general guidance to consultants – and in no way replaces the services of the professional consultant and relevant engineers designing the project. The recommendations of this guide are formulated along the lines of good building practice, but are not intended to be an exhaustive statement of all relevant data. No liability can therefore be accepted by CSR Hebel or other parties for its use.

CSR Hebel products and systems undergo constant research and development to integrate new technology and performance experience. As additional knowledge, technologies and methods become available, CSR Hebel will endeavour to make these readily available via our website: www.hebelaustralia.com.au

The systems and performance specifications detailed in this guide are guaranteed only for laboratory tested conditions. Actual site conditions should be checked, and advice obtained from an appropriate consultant. Any variations or substitution of materials or assembly requirements, or any compromise in assembly or in quality of the system components may result in failure under critical conditions.

It is the responsibility of the architectural designer and engineering parties to ensure that the details in the CSR Hebel Technical Manual are appropriate for the intended application. The recommendations of this manual are formulated along the lines of good building practice, but are not intended to be an exhaustive statement of all relevant data. CSR Hebel accepts no responsibility for or in connection with the quality of the recommendations or their suitability for any purpose when installed.

CSR Hebel is continuously developing its products. This on-going development may result in changes to product specifications, range and the performance characteristics from time to time. The specifications, range and performance characteristics on which the CSR Hebel Technical Manual are based, are those current in December, 2005.

Health & Safety

Information on any known health risks of our products and how to handle them safely is on their packaging and/or the documentation accompanying them. Additional information is listed in the Material Safety Data Sheet (MSDS). To obtain a copy of a MSDS, telephone 1800 807 668 or download from www.hebelaustralia.com.au > Tech Support > MSDS. Contractors are required by law to perform their own risk assessments before undertaking work. CSR Hebel has sample Safe Work Method Statements (SWMS) to assist in this. To obtain a sample SWMS, refer also to the above sources.

Performance & Certification

CSR Hebel is a business of CSR Building Products Limited A.B.N. 55 008 631 356. It is a manufacturer and supplier of CSR Hebel Autoclaved Aerated Concrete (AAC) products. Because it is a manufacturer and supplier only, CSR Hebel does not employ people qualified as Accredited or Principal Certifiers. CSR Hebel is therefore unable to provide Construction Compliance Certificates or Statements of Compliance.

CSR Hebel conducts appropriate testing of its products and systems to determine performance levels. These include structural, fire and acoustic tests. Testing is conducted and certified by appropriate specialists in these fields. When using CSR Hebel products and systems in specific projects, such specialists should be consulted to ensure compliance with the Building Code of Australia and relevant Australian Standards.

Guarantee

CSR Hebel guarantees the products manufactured by itself and the systems described in CSR Hebel literature for 7 years, subject to the terms and conditions of the CSR Hebel Guarantee which can be inspected in the CSR Hebel website at www.hebelaustralia.com.au. CSR Hebel does not however guarantee the components, products or services, such as installation, supplied by others. For terms and conditions of the product guarantee, contact your CSR Hebel representative.

Disclaimer

The information presented herein is supplied in good faith and to the best of our knowledge was accurate at the time of preparation. The provision of this information should not be construed as a recommendation to use any of our products in violation of any patent rights or in breach of any statute or regulation. Users are advised to make their own determination as to the suitability of this information in relation to their particular purpose or specific circumstances. Since the information contained in this document may be applied under conditions beyond our control, no responsibility can be accepted by CSR Hebel, or its staff for any loss or damage caused by any person acting or refraining from action as a result of misuse of this information.

1.1 The CSR Hebel Story

The Hebel story began over 45 years ago in West Germany, when a building contractor named Josef Hebel decided to develop a more cost-effective building system.

From the initial success of the first Autoclaved Aerated Concrete (AAC) products, Josef Hebel was encouraged to set up a mixing, moulding and cutting plant at Emmering near Munich. Architects and builders quickly saw the advantages of this strong yet lightweight material, and were soon utilising its range of properties in all types of construction.

In 1961 the first home was built from Hebel and in the next year a further division, Hebel House, was formed to specialise in residential projects throughout Germany.

Hebel's German success was soon noticed by overseas interests, and in 1967 the first joint manufacturing licence was signed with Asahi Chemicals of Japan. That partnership now accounts for six factories and supplies a major share of Japan is masonry requirements. In addition, Hebel now manufactures in 10 countries worldwide.

As one of Australia's largest suppliers of building products, it was logical for CSR to become involved with Hebel in the establishment of an Australian operation, and in early 1989 the two companies signed a joint venture agreement, the first stage of which was the building of a $34 million factory at Somersby on the NSW Central Coast.

Hebel AAC complements the already impressive product range of CSR Building Products Limited, including well known names such as Gyprock™, Bradford Insulation, PGH Bricks & Pavers and Wunderlich Roof Tiles.

CSR Hebel, Somersby, NSW

1.2 The Manufacturing Process

CSR Hebel AAC is manufactured from sand, lime and cement, to which is added a gas forming agent. Sand is ground to the required fineness in a ball mill and stored. Cement and lime are stored in silos.

The raw materials are then automatically weighed and measured in the mixer. To this mixture is added water and aluminium paste (the gas-forming agent). After mixing, the cement slurry is poured into a mould. The aluminium paste reacts with the alkaline elements in the cement and forms hydrogen gas.

The liberated gas expands the mixture forming extremely small, finely dispersed air spaces. The product is removed from the moulds after a few hours and transported to a cutting machine. The cutting machine cuts the moulds using cutting wires, into the required size building elements.

The final curing of the product takes up to 12 hours under steam pressure in an autoclave.

The blocks, panels and lintels are removed from the autoclave and are packed, ready for transport to site. In the case of reinforced panels and lintels, **corrosion protected steel reinforcing mesh** is placed in the mould before the cement mixture is added. The process is then the same as for unreinforced products.

Steel reinforcement preparation for panels and lintels

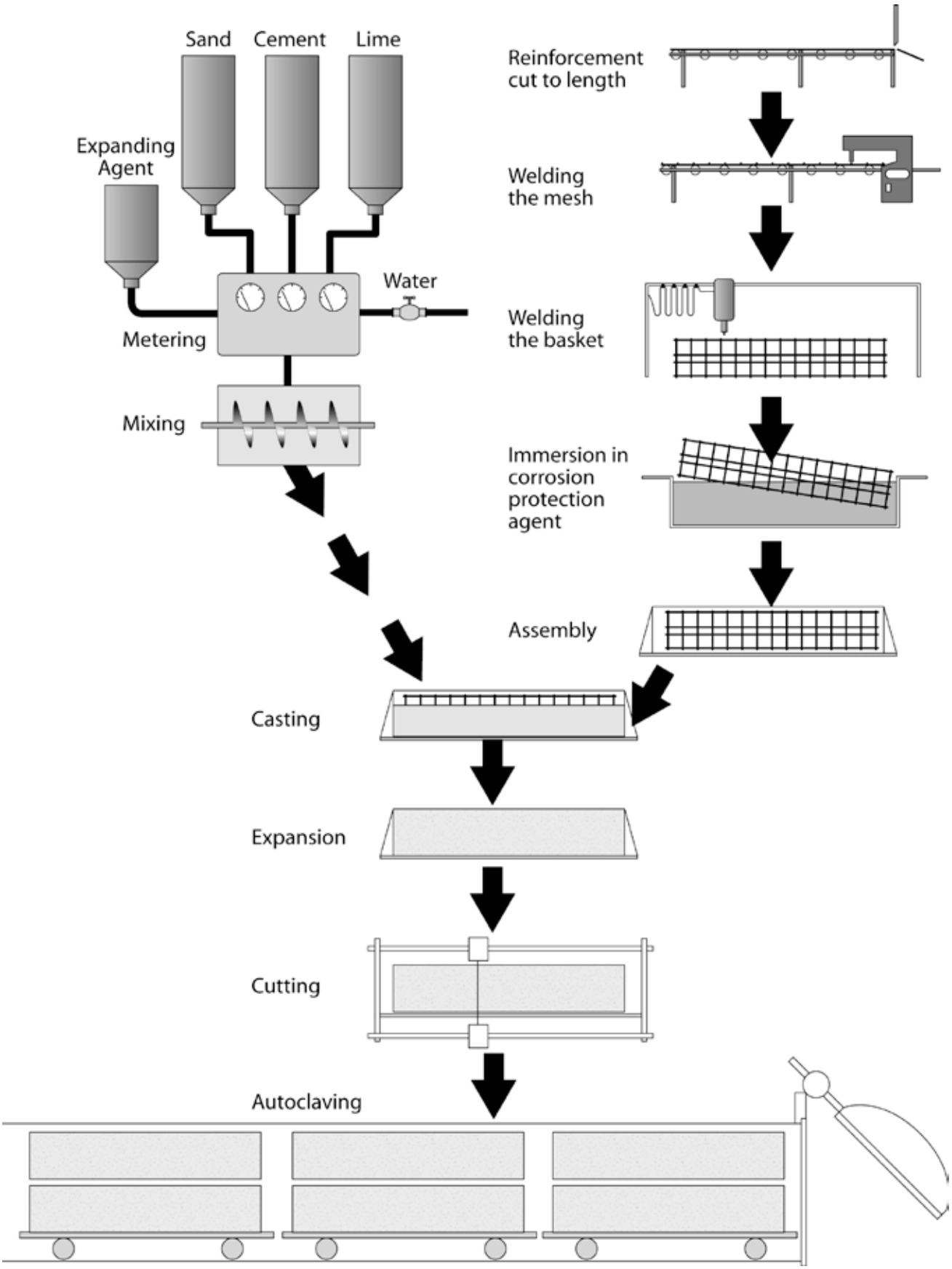
Casting

Expansion

Transfer to cutting machine

Autoclaving

Figure 2.2: Manufacturing Process Diagram



1.3 Benefits of CSR Hebel

CSR Hebel is produced in blocks, panels and lintels, for both loadbearing and non-loadbearing uses. The material has a number of unique properties, providing the following benefits:

Rapid on-site assembly
The product's lightweight and easy workability means that it is very quick to install on site.

Easily worked
CSR Hebel blocks and panels can be sawn, drilled, nailed and machined using off the shelf tools.

Accuracy of manufactured panels and blocks
The accurate manufacturing process ensures that CSR Hebel panels and blocks are always produced to size as they leave the factory. This results in less on-site trimming and reduced quantities of mortar and finishing materials use.

Versatility
CSR Hebel building systems can be used for all applications including walls, roofs, floors and balconies, in both loadbearing and non-loadbearing applications.

Lightweight
CSR Hebel blocks are one-fifth of the weight of concrete and are produced in easily handled sizes.

Excellent acoustic performance
CSR Hebel has excellent acoustic performance and can be used as an effective sound barrier, e.g., intertenancy walls.

Fire resistant
CSR Hebel is totally inorganic and is incombustible. The product is especially suited for fire-rated applications.

Non toxic
CSR Hebel products do not contain any toxic gas substances. The product does not harbour or encourage vermin.

Long life
CSR Hebel products are not affected by harsh climatic conditions and will not degrade under normal atmospheric conditions.

Energy saving
The remarkably good insulation properties of CSR Hebel mean a pleasant interior environment is achieved. In most cases the need for supplementary insulation can be avoided.

2.1 Product Range

CSR Hebel products are available in either blocks or reinforced panels, lintels and stair treads in a range of strength grades.

The diversity of the CSR Hebel product range is designed to cater for the large range of applications in Australian and overseas building industries.

CSR Hebel products are detailed in the following tables.

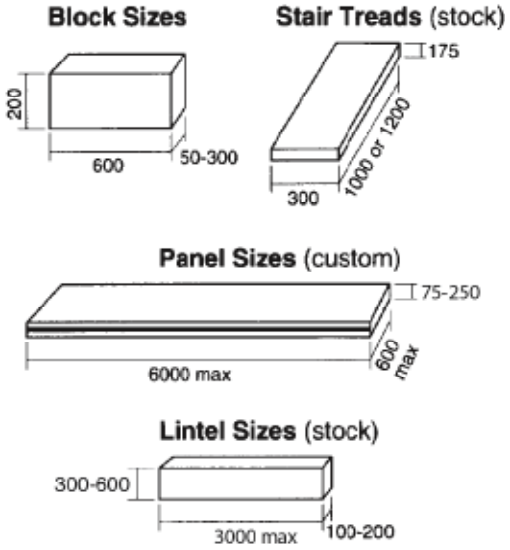


Table 2.1: Product Range for CSR Hebel Blocks, Lintels & Stair Treads

Property	Block Product						Panel Product		Units
	Thermoblok	Sonoblok	Closure	Jumbo	Sill^	Artist	Lintel	Stair Tread	
Nominal AAC Dry Density	525	650	525	525	525	525	650	580	kg/m^3
Length	600	600	600	600	600	1200, 1500	1200, 1900, 2200, 3000, 6000	1000, 1200	mm
Height	200	200	200, 225, 250	400	200	300, 400	300, 400, 600	300	mm
Thickness*	75 - 300	100, 150, 225, 275, 300	50	100	50, 100	300, 400	100, 150, 200	175	mm

Notes: Thermoblok is supplied as a standard product. Sonoblok is subject to minimum order quantities. Sonoblok is marked with black ink on one end of each block for easy identification.
* Thicknesses are available in 25mm increments.
^ These products are supplied in small quantities and have a 30° profile.

Table 2.2: Product Range for CSR Hebel Panel Products

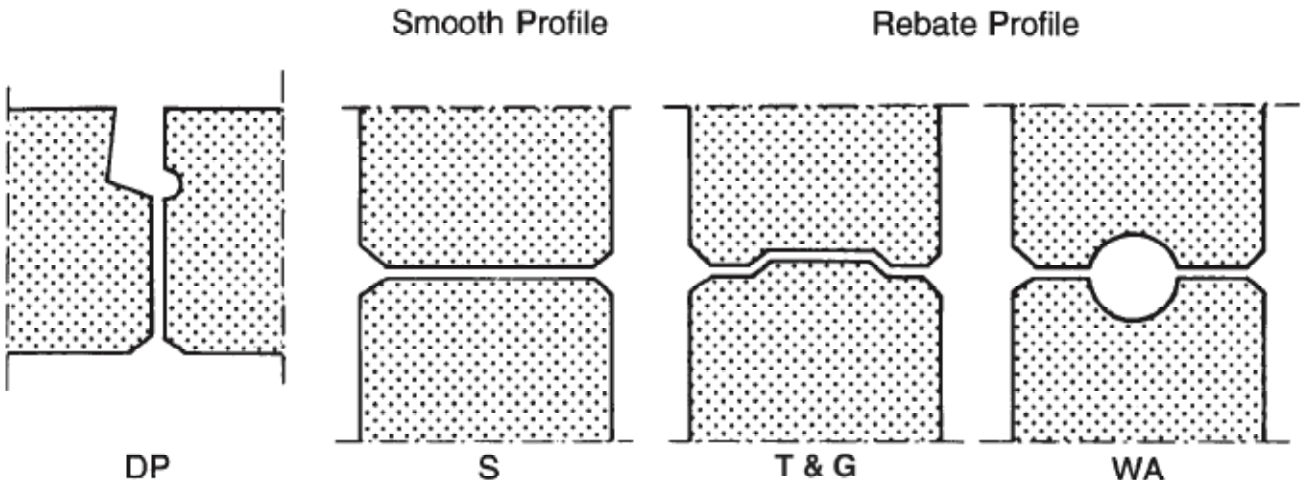
Property	Application						Units
	PowerWall		PowerFloor		SoundFence	SoundBarrier	
	Panel Products						
	75mm PowerPanl	> 100mm PowerPanel	75mm PowerFloor	> 150mm PowerFloor	SoundFence	SoundBarrier	
Nominal AAC Dry Density	510	550	510	580	510	550	kg/m3
Length	1200, 2400, 2550, 2700, 2850, 3000	6000 max.	1800	6000 max.	2000	3000, 4000	mm
Width	300, 600	450, 600	600	600	600	300, 600	mm
Thickness*	75	100 - 250	75	150 - 250	75	100, 125	mm

Notes: * Thicknesses are available in 25mm increments.

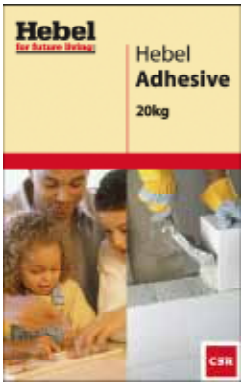
CSR Hebel floor panels are supplied with a recess and slot groove (DP). CSR Hebel vertical wall panels can be used with either a smooth (NIL) or rebate profile (such as tongue & groove, T&G or WA).

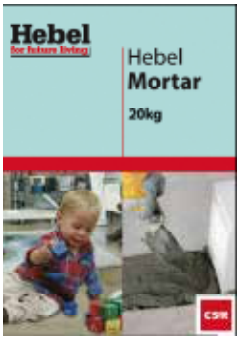
CSR Hebel floor slabs are supplied with a recess and slot groove.

CSR vertical wall panels can be used with either a smooth or rebate profile.

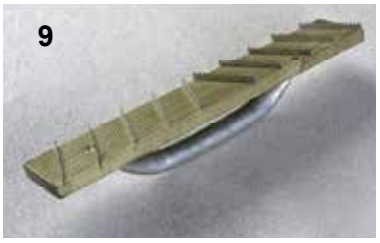


CSR Hebel offers the following adhesive, mortar and render products to complement the CSR Hebel AAC products.





An addition to blocks and panels, CSR Hebel supplies an extensive range of appropriate hand tools, some of which are displayed below:



1. Stirrer
2. Panel Lifting Handles
3. Mixing Bucket
4. Handsaw
5. Hand-Router
6. Sanding Float
7. Trowels
8. Fentak Dipcoat - anticorrosion agent
9. Leveling Plane Teeth
10. Rubber Mallet
11. Cutting Square (and in usage)

2.2 Product Weight

The CSR Hebel products are manufactured to a nominal target dry density range of 525kg/m^3 to 650kg/m^3. Thermoblok product (525kg/m^3) is one quarter the weight of normal concrete. The weight of blocks and panels for various thicknesses and densities is shown in Table 2.3 and Table 2.4. These weights have been determined from the working densities shown in Table 2.5.

Table 2.3: Block Weights (using working densities and face dimensions of 600mm and 200mm)

Product	Product Weight (kg)										
	Block Thickness (mm)										
	50	75	100	125	150	175	200	225	250	275	300
Thermoblok, Closure, Jumbo & Sill (600 x 200mm)	4.1	6.1	8.2	10.2	12.3	14.3	16.4	18.4	20.5	22.5	24.6

Table 2.4: Panel Weights (using working densities)

Product	Product Weight (kg/m2)									
	Panel Thickness (mm)									
	75	100	125	150	175	200	225	250	275	300
Wall & Sound Barrier	-	76	95	113	132	151	170	189	208	227
Floor & Stair Tread	-	80	99	119	139	159	179	199	218	238
Lintel	-	93	-	139	-	185	-	-	-	-
PowerPanel™	50	-	-	-	-	-	-	-	-	-
SoundFloor™	50	-	-	-	-	-	-	-	-	-

Notes: The total weight can be determined by multiplying the value in the table by the length or height, and width of the product.
The weight of the panels may vary due to variation in the reinforcement quantity.

2.3 Material Properties

Table 2.5: Material Properties of CSR Hebel AAC Products

Material Property		Application							
		PowerWall			PowerFloor		SoundFence	SoundBarrier	
		Block Products	Panel Products						
		Thermoblok	75mm PowerPanel	> 100mm PowerPanel	75mm PowerFloor	> 150mm PowerFloor	SoundFence	SoundBarrier	Units
Nominal Dry Density of AAC		525	510	550	510	580	510	550	kg/m^3
Working Density (30% M.C. of AAC)		682	688	751	688	794	688	751	kg/m^3
Mean Compressive Strength of Unit, fuc		2.50*	3.20	4.50	3.20	4.50	3.20	4.50	MPa
Characteristic Unconfined Compressive Strength, f'uc		2.25*	n/a	n/a	n/a	n/a	n/a	n/a	MPa
Characteristic Compressive Strength, f'm (AS3700: f'uc=f'm)		2.25	2.80	4.00	2.80	4.00	2.80	4.00	MPa
Characteristic Shear Strength, f'ms		0.30	n/a	n/a	n/a	n/a	n/a	n/a	MPa
Shear Factor, kv		0.12	n/a	n/a	n/a	n/a	n/a	n/a	MPa
Characteristic Modulus of Rupture, f'ut		0.44	0.60	0.60	0.60	0.60	0.60	0.60	MPa
Characteristic Modulus of Elasticity, E	RILEM#	1435	1595	1755	1595	1875	1595	1755	MPa
	AS3700 S.T.	1125	n/a	n/a	n/a	n/a	n/a	n/a	MPa
	AS3700 L.T.	562	n/a	n/a	n/a	n/a	n/a	n/a	MPa
Characteristic Flexural tensile Strength, f'mt	AS3700 (kmt=1.3)	0.20	n/a	n/a	n/a	n/a	n/a	n/a	MPa

Notes: * CSIRO Test Report DTM318 , M.C. = moisture content. S.T. = short-term, L.T. = long-term, n/a = not applicable.
RILEM Recommended Practice 'Autoclaved Aerated Concrete - Properties, Testing and Design', RILEM Technical Committees 78-MCA and 51-ALC

CSR Hebel Products may contain up to 30% residual moisture (by weight) as supplied. This will increase the product weight to the figures shown in Table 2.3 as Working Density.

Average reinforcement weights have been included in the panel and lintel working densities. Some of the panel products may have higher reinforcement contents and consequently higher weight. Contact CSR Hebel to confirm weight of delivered product. The properties f'_m and f'_{mt} are applicable to constructed walls. These values can only be applied to Hebel walls constructed with CSR Hebel Thin Bed Adhesive.

To adopt CSR Hebel f'_{mt} values, CSR Hebel recommends testing in accordance with AS3700- 1998 Clause 3.3.3 and Appendix D.

2.4 Frost Resistance

The cellular nature of CSR Hebel, incorporating millions of pockets of trapped air, gives the product remarkable protection against frost. Tests have shown than CSR Hebel products have greater resistance to frost compared with traditional masonry products such as clay bricks. As a matter of principle however, building materials should be protected against excessive wetting in severe winter climates.

2.5 Workability

CSR Hebel blocks can be sawn, drilled, nailed and routed using normal wood working tools. This greatly increases on-site productivity as applicable services can

be routed in after the structure has been erected. Note, the recommendations of the Building Code of Australia should be followed with regards to routing/chasing and services.

The fact that CSR Hebel blocks can be easily cut means curves and mites can be used to add to the creativity which the designer can express on any project

Cutting

Planing

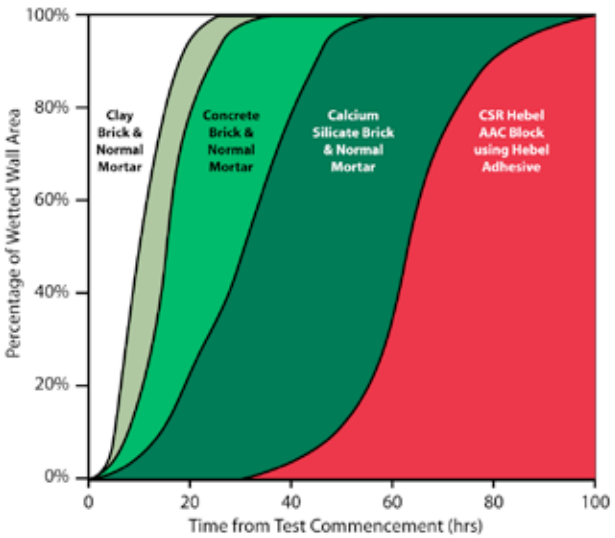
Installing

2.6 Moisture Resistance

CSR Hebel is superior to normal concrete in water permeability because of its cellular structure and discontinuous microstructure. Tests conducted at CSR Building Materials Research Laboratory to British Standard 4315 Part 2 1970 "Methods of Test for Resistance to Air and Water Penetration" demonstrate the superior moisture resistance of walls constructed out of CSR Hebel blocks compared with traditional masonry products. The test results are shown in Chart 2.1.

Note, the results of the testing clearly indicate that the CSR Hebel AAC products (such as block walls) are not waterproof, yet exhibit a slower water penetration to the other masonry types assessed.

Chart 2.1: Water Penetration – Masonry Wall System Nominal Wall Thickness 100mm



Note: Test procedure in accordance with BS4315 Part 2, 1970: Methods of Test for Resistance to Air and Water Penetration. Tested at CSR Building Materials Research Laboratory, November 1989

Test Results

At 48 hours after commencement of the test, all other masonry products had a fully wetted unexposed surface, while the unexposed surface of the CSR Hebel wall (uncoated) was only 10% wetted.

A wall coated with 3mm of CSR Hebel External Render showed no sign of moisture penetration on the unexposed surface, to the end of the test at 7 days (168 hrs).

For external walls, CSR Hebel recommends a coating system consisting of: an AAC compatible render; a water-resistant, vapour permeable texture coating; and other product manufacturer recommendations. An important feature of the coating system is vapour permeability (breathability). This is required to allow vapour to move in and out of the AAC product. Coatings using an acrylic binder allow the surface to breathe (vapour permeable), while at the same time providing a water repellent coating. Further performance requirements for coatings are outlined in Section 9.0 of this manual.

2.7 Drying Shrinkage

Expected moisture content varies between 30% (by weight) ex-factory and an installed equilibrium value of approximately 5% to 10%. For this range, the value of drying shrinkage is in the order of 0.2mm/m. Depending on site conditions this decrease can take up to 1 year to occur.

A comparison of the movement between Hebel AAC and common masonry systems is given in the Table 2.6. Sign indicates growth (+) or shrinkage (-). For further infomation contact CSR Hebel.

Table 2.6: Long-term permanent change in dimensions

Unit	Movement (mm/m)
Clay Bricks*	up to 1.8 (+)
Concrete Blocks*	up to 0.8 (-)
Concrete**	up to 0.7 (-)
Lime Silicate Brick*	up to 0.4 (-)
Hebel ***	up to 0.2 (-)

Notes: * Figures from Australian Masonry Manual 2nd. Ed. 1991.
** Figure from AS3600 1998 Concrete Structures Code.
*** CSIRO Test Report DTM 262.

2.8 Other Physical Properties

Thermal Expansion

The thermal expansion co-efficient of CSR Hebel is 10 x 10^{-6}/˚C which is lower than that of normal concrete. Movement over a 24 hour period is negligible due to the insulation properties discussed in Section 3.0.

Air Permeability

The air conductance coefficient of CSR Hebel Thermoblok is 31 x $10^{-6}m^3$/m.h.Pa. The coefficient for panels is 18 x $10^{-6}m^3$/m.h.Pa.

Melting Point

CSR Hebel, like most cement materials, melts at approximately 1600˚C.

Chemical Properties

CSR Hebel is alkaline (pH9.0-10.5) and will not corrode other building materials. Like other cement- based products, CSR Hebel should be protected against high concentrations of carbon dioxide, sulphates, chlorides and strong acids.

Toxicity

CSR Hebel does no contain any toxic substances and emits no odour.

Vermin Resistance

CSR Hebel will not harbour or encourage vermin. CSR Hebel recommend detailing in accordance with BCA or relevant standards to discourage/ prevent the ingress of vermin.

Hardness

CSR Hebel has been tested by the CSIRO and the AAC product was assessed as being satisfactory in terms of AS2185 and is not less hard than plaster.