

# Child Resistant Barrier Tests



For the Building Industry Authority  
By Alchemy Engineering & Design Limited

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## Child Resistant Barrier Tests

### 1. Introduction

The objective of the project is to test several barrier types in addition to the standard barrier given in F4/AS1, the 'acceptable solutions' document published by the Building Industry Authority. This provides a means of establishing compliance with Clause F4 of the Building Code.

'Barriers shall restrict the passage of children under 6 years of age, when provided to guard a change of level in areas likely to be frequented by them'.

The standard barrier is 1.00 metre in height on decks or balconies to houses, with no toeholds between the heights of 150mm and 760mm. One of the objectives of the testing was to establish if other barriers are equally as difficult for children to climb as the standard barriers.

### **Safety Barriers**

Ten different types of barriers were constructed. Nine were fabricated from aluminium then powder coated, while the tenth was fabricated from Stainless Steel. Each test barrier was constructed with an overall width of 1200mm, while heights and configurations were varied to generate the tests.

### **Test Barriers**

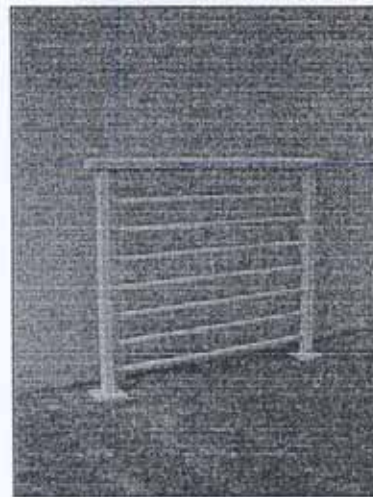
*Test Barrier 1A* – Barrier constructed to a height of 1000mm, with horizontal infill members with no opening exceeding 100mm. The top of the barrier consisted of an inward return of 150mm (from the underside, 205mm top surface) and was plated to prevent the ability to grasp the top rail.



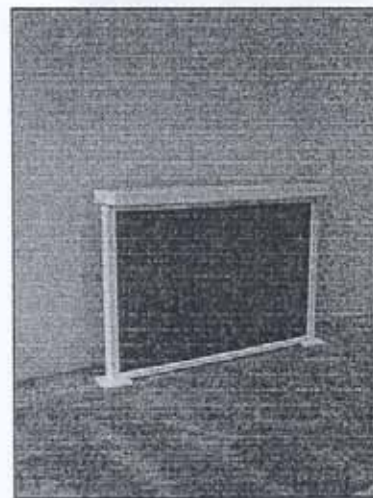
*Test Barrier 1B* – Barrier the same as *Test Barrier No. 1A* , but alternatively the testing was conducted from the opposing side where by the top generated a 150mm (from the underside, 205mm top surface) overhang.



*Test Barrier 1C* – Barrier the same as *Test Barrier No. 1A*, but alternatively tested with a 70mm wide handrail located centrally on the barrier frame.



*Test Barrier 2A* – Barrier constructed at 810mm high with no toeholds between ground and 810mm due to the use of Plywood infill. The testing was conducted using a centrally mounted 200mm wide top plate (55mm in thickness) with a 70 return (from the underside) created.



Test No.		2A		2B		3A		4A		4B		4C		5	
Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed
0	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0
0	2	3	0	2	3	0	2	4	0	1	4	0	1	4	0
0	1	3	2	0	2	1	1	2	0	2	2	0	2	2	1
7	0	0	7	0	0	3	2	2	6	1	0	3	4	0	6
1	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0
8	5	6	10	4	5	4	8	7	6	5	8	6	3	10	6
		19		19		19		19		19		19		19	
Test No.		2A		2B		3A		4A		4B		4C		5	
Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed
0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	100%
0%	40%	60%	0%	40%	60%	0%	40%	60%	0%	20%	80%	0%	20%	80%	0%
0%	25%	75%	50%	0%	50%	25%	25%	50%	0%	50%	50%	0%	50%	50%	25%
100%	0%	0%	100%	0%	0%	43%	29%	29%	86%	14%	0%	43%	57%	0%	86%
100%	0%	0%	100%	0%	0%	0%	100%	0%	100%	0%	0%	0%	100%	0%	100%

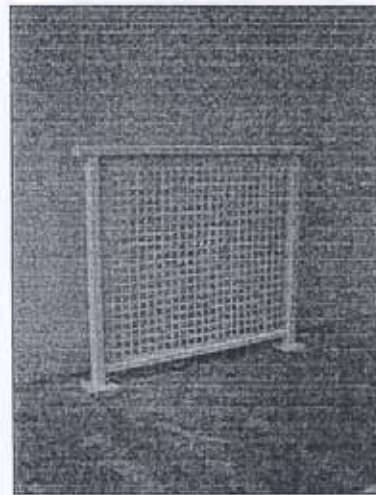
0-2  
2  
3  
4  
5

0-2  
2  
3  
4  
5

*Test Barrier 2B* – Same as barrier *Test Barrier No.2A* (810mm high) but alternatively tested with a 70mm wide handrail located centrally on the barrier frame.



*Test Barrier 3A*- Barrier at 1000mm metre height, with a perforated aluminium panel. Each perforation is 30mm square, providing a diagonal opening of 40mm. This is the maximum size opening currently acceptable.



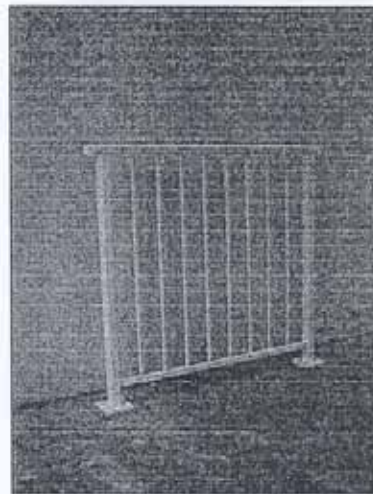
*Test Barrier 4A* – Barrier to a height of 900mm - Standard Slimline Eclipse 'Tekapo' Balustrade system with vertical tube infill (with no opening exceeding 100mm) from a height of 100mm from ground to handrail height of 900mm. This is typical of the currently comply standard balustrade BIA F4/AS1 for interior use.



*Test Barrier 4B* – Barrier to a height of 1000mm height- Standard Slimline Eclipse 'Tekapo' Balustrade system with vertical tube infill (with no opening exceeding 100mm) from a height of 100mm from ground to handrail height of 1000mm. This is typical of the currently comply standard balustrade BIA F4/AS1 for exterior use.



*Test Barrier 4C* – Barrier to a height of 1100mm height- Standard Slimline Eclipse 'Tekapo' Balustrade system with vertical tube infill (with no opening exceeding 100mm) from a height of 100mm from ground to handrail height of 1100mm.



*Test Barrier 5* –Barrier to simulate stair balustrade at a height of 1000mm (34° pitch) Wire infill spaced at 95mm, parallel to the 50mm top handrail. Vertical posts spaced at 1200mm.



## 2. Test Method

Children aged from 15 months to 5 years of age were asked to climb the test barriers, after receiving parental or custodial consent.

The method used involved securely mounting each test barrier to the purpose built timber platform. Once the rubber safety mat was in place, the children, grouped by age were asked to attempt to climb the barrier. Testing was carried out one child at a time to avoid an unmanageable situation.

Each child was timed for a successful climb of the barrier being tested. Failure to climb was also noted, as were those who did not attempt to climb the barrier.

## 3. Test Results

Nineteen children (11 males and 8 females) took part in these tests, of which several didn't co-operate in attempting to climb all of the barriers. This was either due to being scared or too shy.

### Age group Results

#### 0-2 year old

The two children aged between 15 months and 21 months (representative of the 0-2 year old age group) failed to climb any of the 10 test barriers.

<b>2 year olds</b>	-	This sample group comprised of 5 children.
<i>Test Barrier 1A</i>		While 1 child did not attempt to climb this barrier, of the 4 children who attempted, 2 failed while 2 succeeded.
<i>Test Barrier 1B</i>		While 1 child did not attempt to climb this barrier, of the 4 children who attempted, 1 failed while 3 succeeded.
<i>Test Barrier 1C</i>		While 1 child did not attempt to climb this barrier, of the 4 children who attempted all 4 children successfully climbed this barrier.
<i>Test Barriers 2A, 2B, 3A</i>		While 3 children did not attempt to climb these, of the 2 children that did attempt to, both failed.
<i>Test Barriers 4A, 4B, 4C</i>		While 4 children did not attempt to climb, 1 child did attempt all of these but failed.
<i>Test Barrier 5</i>		While 4 children did not attempt to climb this barrier, the 1 child who did attempt it, failed.

**3 Year olds** - This sample group comprised of 4 children.

While 1 child did not attempt to climb *Test Barriers 1A, 1B, 1C* of the 3 who did to attempt these barriers, all succeeded.

*Test Barrier 2A* While 3 children did not attempt to climb, the 1 child who did, failed.

*Test Barrier 2B* While 2 children did not attempt to climb, the 2 that did both succeeded.

*Test Barrier 3A* While 2 children did not attempt to climb, of the 2 that did, 1 failed and 1 succeeded.

*Test Barriers 4A, 4B, 4C* While 2 children did not attempt to climb these, of the 2 children who did attempt to, both failed to climb all three barriers.

*Test Barrier 5* While 2 children did not attempt, of the 2 children that did, 1 succeeded and 1 failed.

**4 year olds** - This sample group comprised of 7 children.

All 7 children in this group successfully climbed *Test Barriers 1A, 1B, 1C, 2A, 2B*.

*Test Barrier 3A* While 2 children did not attempt, of the 5 children that did, 3 successfully climbed and 2 failed.

*Test Barrier 4A* Of the 7 children who attempted, 6 successfully climbed while 1 failed.

*Test Barrier 4B* Of the 7 children who attempted, 5 successfully climbed, while 2 failed.

*Test Barrier 4C* Of the 7 children who attempted, 3 were successful, while 4 failed.

*Test Barrier 5* While 1 child did not attempt to climb this barrier, of the 6 children who did, all were successful.

**5 year olds** - This sample group comprised of 1 child.

The single child attempted to climb all 10 Test Barriers, and successfully climbed 7 of the barriers. Those test barriers, which the child failed at were *Test Barriers 3A, 4B and 4C*.



#### 4. Summary

The sample children aged less than 2 years of age did not have the strength, co-ordination or physical dimensions to successfully climb the test barriers proposed.



The 2 year olds were older and able to use their strength to more effect and were also a little taller and were able to reach to the top handrail.

The 3 year olds again like the 2 year olds were more co-ordinated, had more strength and were taller. This age group could start to utilise their legs more to assist themselves to the top of, and over the barrier. The physical dimensions of this age group also identified that three sided objects (such as the inward return top railing, 55mm in thickness) were able to be grasped. Children in this age group have surprisingly high grip strength.



The 4 year olds had little trouble with many of the barriers, as they were able to think the process through before attempting to climb the barrier. However this age group also appeared to have more understanding of the danger to themselves when climbing.

## Barrier Commentary

The 200mm wide top capping to Test Barriers 1A & 1B seemed to be just the right dimension for climbers to place their hand on the further most edge and span it with their forearm. The top rail may have to be in the region of 400 to 500mm wide before the children would have any difficulty in reach across the top to achieve a hand hold.



One significant observation based on those successful climbers of all age groups, was their eagerness to stand on and then jump from the wide top of the barriers, as opposed to climbing down the other side. This is a worrying fact. The older children had the ability to judge the risk involved with jumping. The younger children did not have an adequate understanding of the consequences from jumping, or falling for that matter and were happy to stand on top of the balustrades.



The currently complying standard typified by products such as the Slimline Eclipse 'Tekapo' Balustrade system, proved to be a successful barrier. The 900mm high (*Test Barrier 4A*) proved to be less of an obstacle than the 1000mm (*Test Barrier 4B*) and 1100mm (*Test Barrier 4C*) equivalents. These proved to be very effective barriers for all age groups. Interestingly there was little extra deterrent from the 1100mm as compared with the 1000mm high barrier



Of the children who attempted to climb the perforated infill barrier (*Test Barrier 3A*), it appeared that their success or failure were more determined by the child's footwear and whether sufficient grip between their feet and the perforation panel could be obtained to provide an adequate boost to climb the barrier. Only one test candidate actually used the square perforations as a toehold. This candidate successfully climbed the barrier.



One of the most interesting results from this testing period was from *Test Barrier 5*. This barrier design, which is frequently requested, was climbed extremely easily. The predominant climbing zone was not next to the post at the lower end as expected, but in fact mid span. The majority of the 4 and 5 year olds climbed the barrier with ease, as did one 3 year old (with and without shoes when multiple attempts were allowed)



BIA Barrier Test		16-Apr-2002																					
Name	DOB	Age (mths)	Age	Gender	Present/ Absent from testing	Test No.		1A		1B		1C											
						Climbed	Failure	Time	Climbed	Failure	Time	Climbed	Failure	Time									
Kahurangi Mill	6-Mar-1997	62.23	5.19	F	A	C		8	C		6	C		6									
Jordana Jensen	10-May-1997	60.07	5.01	F	P	C		7	C		7	C		5									
Alexandra Gooch	1-Jul-1997	58.33	4.86	F	A	C		7	C		7	C		7									
Daniel Mackey	19-Jul-1997	57.73	4.81	F	P	C		8	C		6	C		6									
Gabriella Shea	13-Aug-1997	56.95	4.74	F	P	C		10	C		7	C		5									
Sian Allen	2-Nov-1997	53.87	4.49	F	P	C		5	C		6	C		6									
Lucy England	2-Dec-1997	53.20	4.43	F	P	C		7	C		11	C		6									
Victoria Hunter	13-Mar-1998	49.83	4.15	F	P	C		7	C		10	C		7									
Brooke Gordon	16-Mar-1998	49.73	4.14	F	P	C		15	C		10	C		7									
Mathew Hitchings	30-Apr-1998	48.23	4.02	M	P	DNA			DNA			DNA											
Andrew Preist	15-May-1998	47.73	3.98	M	P	C		13	C		10	C		8									
Mathew Drake	30-May-1998	47.23	3.94	M	P	C		55	C		13	C		10									
Caroline Morris	28-Jul-1998	45.27	3.77	F	P	C																	
Georgia Woodhouse	2-Nov-1998	42.03	3.50	M	A	C		10	C		7	C		6									
Connall Deacon	1-Dec-1998	41.07	3.42	M	P	C																	
Adam McLean	2-Dec-1998	41.03	3.42	M	A	C																	
Tim Loretto	14-Feb-1999	38.57	3.21	M	A	C																	
Ben Davis	5-May-1999	35.90	2.99	M	P	C		14	C		10	C		8									
Owen Wright	7-Jul-1999	33.80	2.82	M	P	C																	
Eliza England	21-Aug-1999	32.30	2.69	F	P	DNA			DNA			DNA											
Ryan Skene	22-Oct-1999	30.23	2.52	M	P	C			C		21	C		18									
Arvalan Sathiyandra	28-Dec-1999	28.00	2.33	M	P	C			F			C		25									
Jock Gordon	15-Dec-1999	28.43	2.37	M	P	C		15	C		12	C		13									
Mirren Craig	14-Jul-2000	21.37	1.78	M	A	C																	
Thomas Wood	7-Nov-2000	17.50	1.46	M	A	C																	
Liam Walters	15-Aug-2000	20.30	1.69	M	A	C																	
Hamish Priest	4-Oct-2000	18.63	1.55	M	A	C																	
Patrick White	24-Oct-2000	17.97	1.50	M	P	C			F			F		F									
Max Allen	16-Oct-2000	18.23	1.52	M	P	C			F			F		F									
Alice Loretto	11-Dec-2000	16.37	1.36	M	A	C																	
Jack Davis	7-Dec-2000	16.50	1.38	M	A	C																	
Stephanie Braakuis	4-Jan-2001	15.57	1.30	M	A	C																	
DS Denotes Down Syndrome				M				13			14			15									
Denotes Absent From Testing				F				4			3			2									
Total				19				19			19			19									

Test No. 2A		Test No. 2B		Test No. 3A		Test No. 4A		Test No. 4B		Test No. 4C		Test No. 5	
Climbed	Failure Time	Climbed	Failure Time	Climbed	Failure Time	Climbed	Failure Time	Climbed	Failure Time	Climbed	Failure Time	Climbed	Failure Time
C	6	C	11	F	3	C	6	F			F	C	24
C	3	C	2	C		C	5	C	3	C	5	C	12
C	5	C	5	F		C	10	C	12	F		C	21
C	4	C	4	F		C	5	C	13	F		C	11
C	10	C	4	C	14	C	18	C	14	C	26	C	10
C	4	C	2	C	7	C	5	F		F		C	12
C	8	C	6	DNA		C		C	10	C	13	C	12
C	7	C	30	DNA		C	9	F		F		C	12
DNA		DNA		DNA		DNA		DNA		DNA		DNA	
DNA		DNA		DNA		DNA		DNA		DNA		DNA	
F		C	40	C	18	F		F		F		C	15
DNA		C	10	F		F		F		F		F	
F		F		F		F		DNA		DNA		DNA	
DNA		DNA		DNA		DNA		DNA		DNA		DNA	
DNA		DNA		DNA		DNA		DNA		DNA		DNA	
DNA		DNA		DNA		DNA		DNA		DNA		DNA	
F		F		F		F		F		F		F	
F		F		F		F		F		F		F	
8		10		4		7		5		3		8	
5		4		8		6		8		10		4	
6		5		7		6		6		6		7	
19		19		19		19		19		19		19	

4

3

2

1

		1A		1B		1C							
		Climbed	Failure	DNA	Climbed	Failure	DNA	Climbed	Failure	DNA			
Age group Summary		Test No.		Test No.		Test No.							
Age Group		Climbed		Failure		DNA		Climbed		Failure		DNA	
0-2 year olds		0	2	0	2	0	0	0	2	0	2	0	0
2 year olds		2	2	1	3	1	1	4	0	1	0	1	1
3 year olds		3	0	1	3	0	1	3	0	1	0	1	1
4 year olds		7	0	0	7	0	0	7	0	7	0	0	0
5 year olds		1	0	0	1	0	0	1	0	1	0	0	0
Sub- Total		13	4	2	14	3	2	15	2	2	2	2	19
Total													
Age group Summary in Percentage form		Test No.		Test No.		Test No.		Test No.		Test No.		Test No.	
Age Group		Climbed		Failure		DNA		Climbed		Failure		DNA	
Age group total		Climbed		Failure		DNA		Climbed		Failure		DNA	
0-2 year olds		0%	100%	0%	0%	100%	0%	0%	100%	0%	100%	0%	0%
2 year olds		40%	40%	20%	60%	20%	20%	80%	0%	80%	0%	20%	20%
3 year olds		75%	0%	25%	75%	0%	25%	75%	0%	75%	0%	25%	25%
4 year olds		100%	0%	0%	100%	0%	0%	100%	0%	100%	0%	0%	0%
5 year olds		100%	0%	0%	100%	0%	0%	100%	0%	100%	0%	0%	0%

