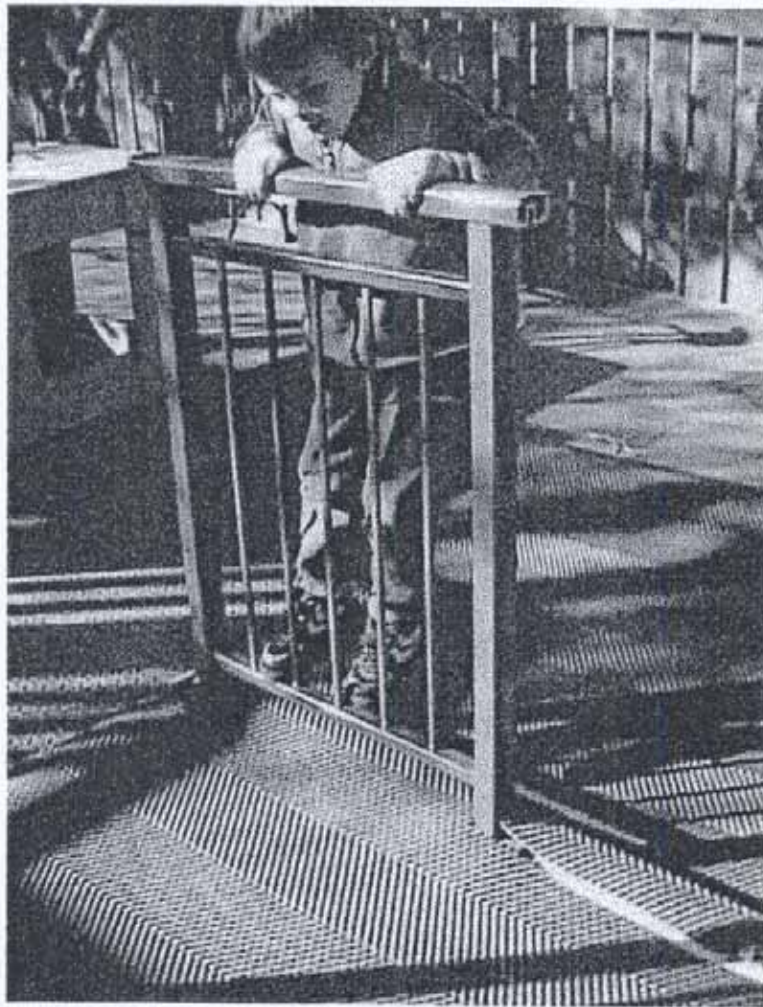


Child Resistant Barrier Tests



For the Building Industry Authority
By Alchemy Engineering & Design Limited

August 2000

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.

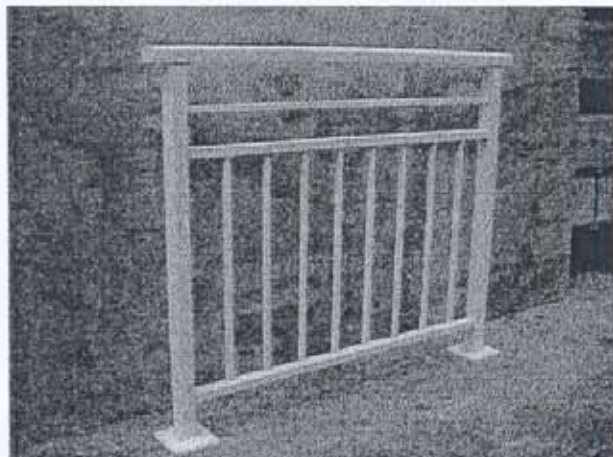
'Barriers shall restrict the passage of children under 6 years of age, when provided to guard a change of level in areas likely to be frequented by them'.

The standard barrier is 1.0 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 barrier.

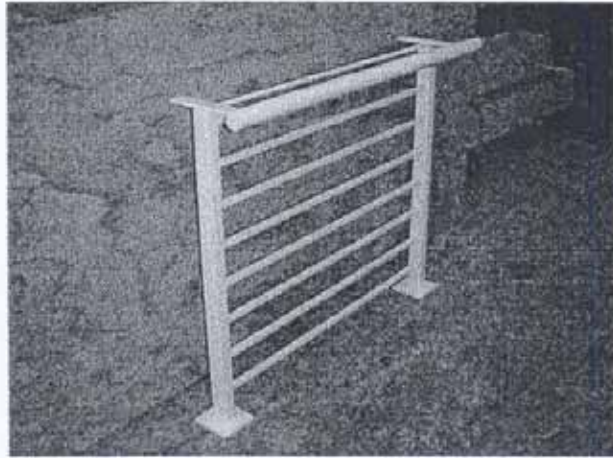
Safety Barriers

Nine different types of barriers were constructed. All were fabricated from aluminium then powder coated. Each test barrier consisted of a panel with a width of 1.2 metres and a height of 1.0 metre, and they were anchored to a timber and ply rigid frame to prevent toppling or movement.

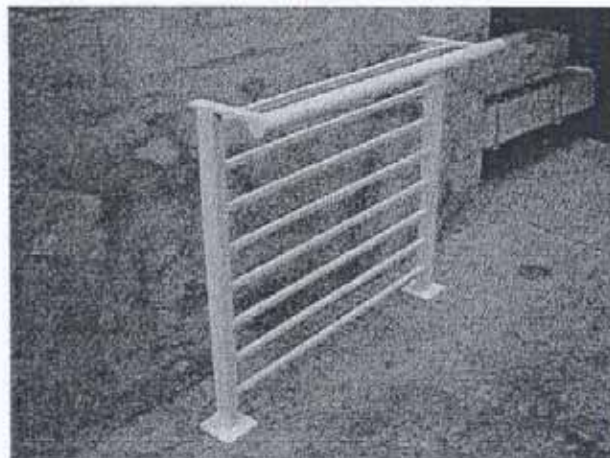
Test Barrier No.1 – Barrier as described in F4/AS1 with horizontal rails giving toehold at 760mm, and with two horizontal rails above 760mm to give a height of 1.0 metre. Vertical infill tube with spacings of 100mm between each tube was below the 760mm toehold.



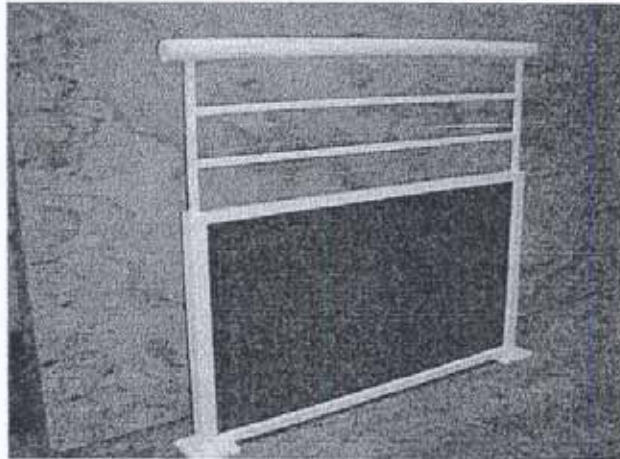
Test Barrier No.2a – Barrier at 1.0 metre height with horizontal rails spaced with no opening exceeding 100mm. Top of barrier with an inward return of 150mm (with no opening exceeding 100mm).



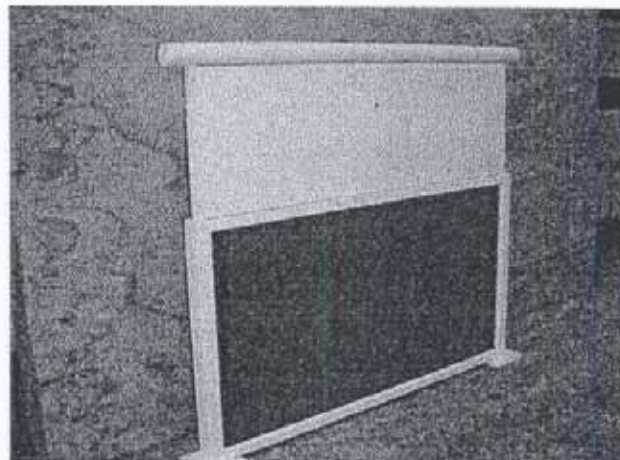
Test Barrier No.2b – Same as barrier 2a (1.0 metre height) with horizontal rails spaced with no opening exceeding 100mm. Top of barrier with an inward return of 200mm (with no opening exceeding 100mm).



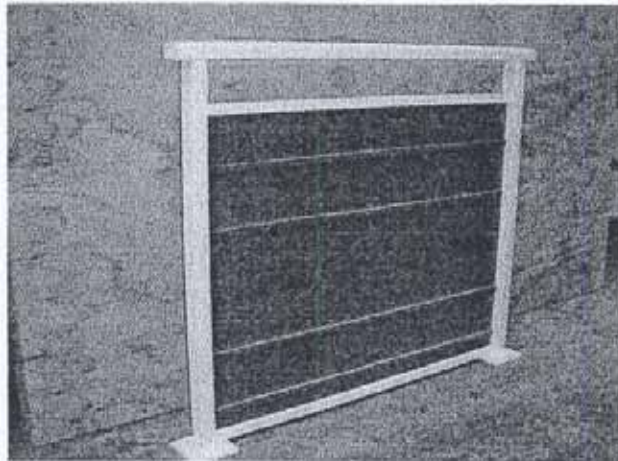
Test Barrier No.3a – Barrier at 1.0 metre height with no toeholds between ground and 610mm (with no opening exceeding 100mm), and horizontal rails above 610mm.



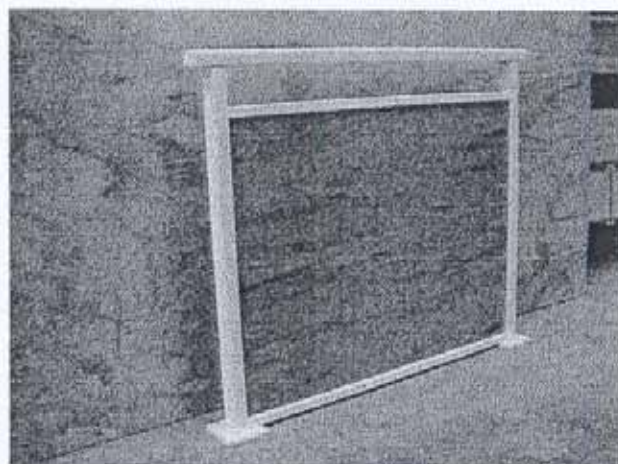
Test Barrier No.3b – Same as barrier 3a (1.0 metre height) with no toeholds between ground and 610mm, and solid panel above 610mm with a ledge of 15mm at 610mm height.



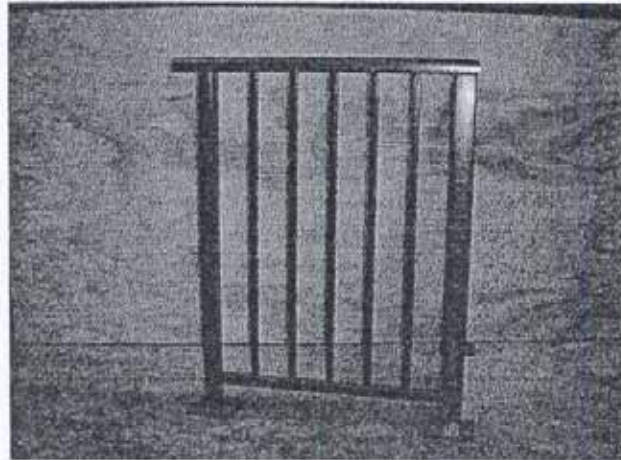
Test Barrier No.4a (Toeholds test) – Barrier at 1.0 metre height, with a ply panel with ledges of 10mm and 15mm at heights of 150mm, 300mm, 610mm and 760mm and a rail at 860mm with an opening of 100mm above 860mm.



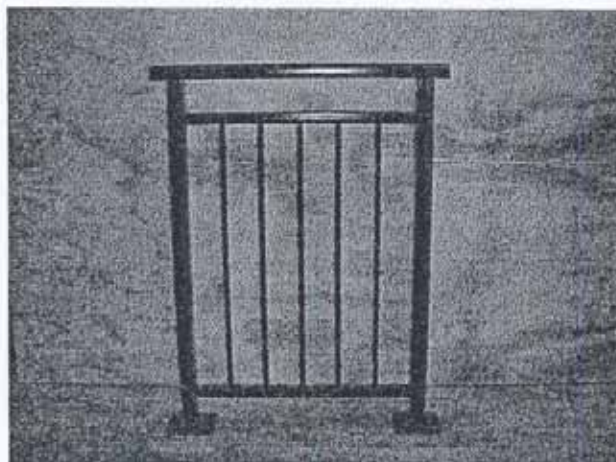
Test Barrier No.4b – (Used barrier 4a but turned it around to use blank panel). Barrier at 1.0 metre height, with a ply panel with no toeholds to a rail at 860mm with a 100mm gap above 860mm to the handrail.



Test Barrier No.5 – (Additional Test) Barrier at 1.0 metre height - Standard Slimline Eclipse 'Tekapo' Balustrade system with vertical tube infill (with no opening exceeding 100mm) from a height of 90mm from ground to handrail height of 1.0m.



Test Barrier No.6 – (Additional Test) Barrier at 1.0 metre height - Standard Slimline Eclipse 'Coromandel' Balustrade system with double rail and vertical tube infill (with no opening exceeding 100mm) from a height of 90mm from ground to second rail with height of 860mm, then 90mm gap to handrail.

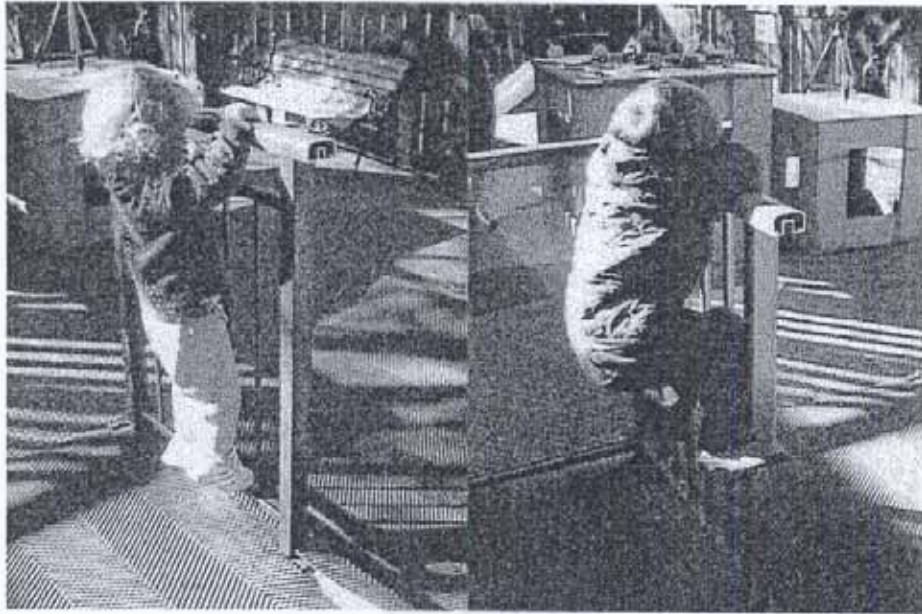


2. Test Method

Children aged from 9 months old to 4½ years old were asked to climb, after receiving parental or custodial consent

The method used was to put two different types of barriers on a timber platform, with rubber overlay, at the same time and to get the children by age group to attempt to climb each barrier.

Each child was timed for a successful climb or failure to climb for each test barrier. (The blank spaces on the results table represent the child not attempting to climb the barrier, either due to being scared or too shy).



3. Test Results

(Refer to Spreadsheet)

Twenty-four children (10 males and 14 females) took part in these tests, of which several didn't co-operate in attempting to climb all of the barriers.

Five children aged from 9 months to 1 year old
Failed to climb any of the 9 test barriers.

Eight children in the 2 year old group

Test No.1	2 attempted (1 from either gender) and both failed to climb.
Test No.2a	3 out of the 5 attempted and climbed the barrier with ease.
Test No.2b	3 of 3 attempted and climbed the barrier with a little more resistance.
Test No.3a	2 attempted and 1 climbed.
Test No.3b	none attempted.

Test No.4a 1 attempted and failed to climb.
Test No.4b none attempted.
Test No.5 4 attempted and all failed to climb.
Test No.6 the same 4 attempted and again failed to climb the barrier.

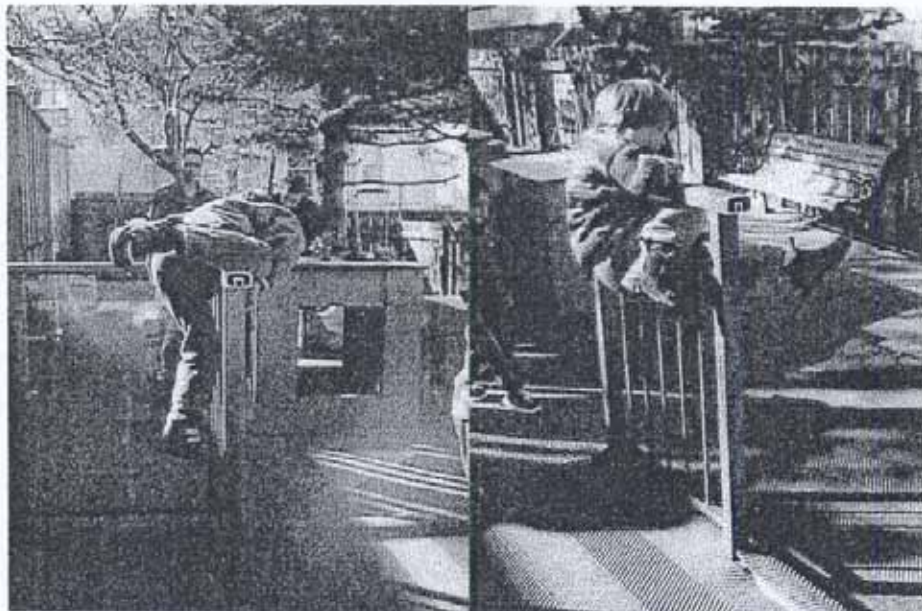
Six children in the 3 year old group

Test No.1 2 of the 3 attempted and climbed the barrier.
Test No.2a 4 attempted and climbed with ease.
Test No.2b 5 attempted and also climbed with ease.
Test No.3a 5 of 6 attempted and climbed the barrier.
Test No.3b 1 of 4 attempted and climbed.
Test No.4a 2 of 5 attempted and climbed.
Test No.4b 4 attempted and failed to climb the barrier.
Test No.5 all 5 that attempted failed to climb the barrier.
Test No.6 5 attempted and failed.

Five children in the 4 year old group

Test No.1 2 attempted and were successful in climbing the barrier.
Test No.2a we didn't get them to climb as the 3 year olds were able to climb so moved them onto;
Test No.2b all 5 successfully climbed the barrier with ease.
Test No.3a & 3b 4 attempted and all climbed the barriers.
Test No. 4a & 4b the same 4 successfully climbed both barriers, but two of the females attempts on 4b were their second attempts.
Test No.5 only 1 of 4 successfully climbed the barrier.
Test No.6 3 of 4 successfully climbed the barrier.

We also had the male that climbed Test barrier No.5 (the only child to climb this barrier), climb an increased height Test barrier No.6 (1100mm height) and again he successfully climbed this barrier with ease.



4. Summary

The 0-1 year old children didn't have enough strength and co-ordination to pull themselves up and over the barriers. Also the barrier was too high. This age group appeared to be happy to stand holding on to the barrier and look through.

The 2 year olds were able to use their strength to more effect and were a little taller. They were able to reach to the top handrail. This group is possibly at the most dangerous age, they can climb some barriers but have not yet gained the judgement to avoid injury.

The 3 year olds, again like the 2 year olds, were more co-ordinated, had more strength and were taller still so they were able to use their knees on the rails and feet on the toeholds far more effectively to lever themselves over the barrier.

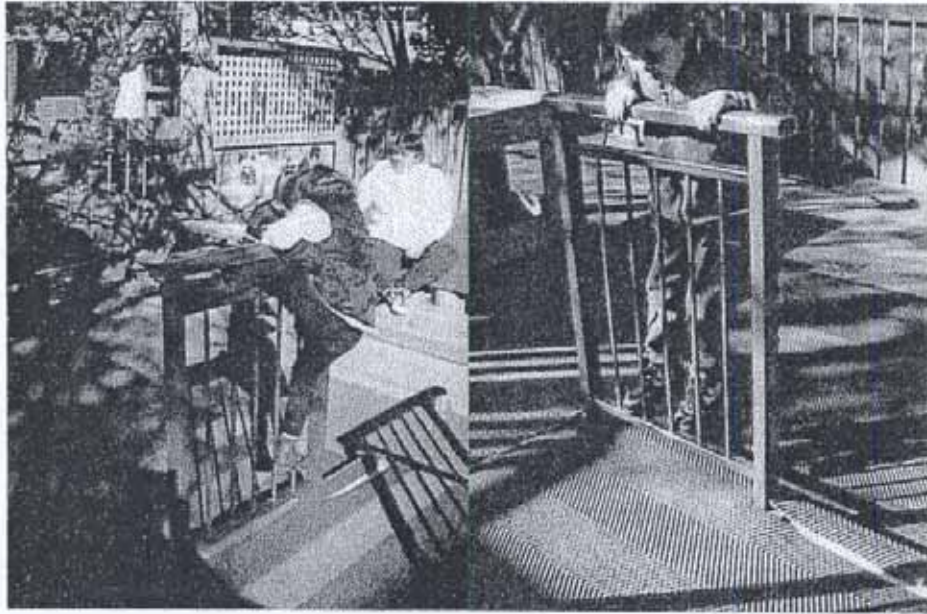
The 4 year olds didn't have much trouble with any of the barriers, as they were able to think the process through before attempting to climb the barrier. On several occasions if they failed to climb on the first attempt they succeeded on the second attempt. This age group also displayed enough judgement in general not to excessively risk injury.

The only barrier that prevented all but one child from climbing it was a vertical infill tube with a toehold at 100mm from the ground and a handrail at 1.0 metre (Test Barrier 5). The children weren't able to wedge or place feet or knees on a horizontal member to assist them in a successful climb, as these tubes were vertical.

One significant observation from this testing was in Test Barrier 4a (the barrier with small horizontal toeholds). Children tall enough to reach the handrail, were able to get sufficient toehold to climb the barrier, even though the toehold was only 10mm wide. See photo below.



It was found that the older children had more strength in their arms, therefore it was easier for them to climb the barriers by simply pulling themselves up. Also the older children solved problems of how to climb the barriers, particularly the females, and on several occasions if at first they failed to climb the barrier, on the second attempt they succeeded.



TOE HOLD TEST BARRIER RESULTS

Age of Groups		Test Barrier No.1			Test Barrier No.2a			Test Barrier No.2b			Test Barrier No.3a			
Name	Age (yr)	Gender	Climbed	Failure	Time (s)	Climbed	Failure	Time (s)	Climbed	Failure	Time (s)	Climbed	Failure	Time (s)
Eliza	11 Mths	F			10									
Ryan	9 Mths	M			30									

Charlotte	1.9	F		✓	9			11					✓	60
Georgia	1.7	F		✓	36			16					✓	10
Tim	1.5	M		✓	38			30						

Caroline	2	F		✓	30			30						
Victoria	2.4	F												
Gabriella	2.9	F				✓		26			50			
Julie	2	F				✓		25						
Lucy	2.7	F				✓		20			50			50
Sian	2.7	F									10			
Andrew	2.2	M		✓	25			16					✓	15
Mathew D	2.2	M												

Beatrice	3.6	F		✓	23			10			40		✓	8
Alexandra	3.1	F		✓	12			25			23		✓	9
Jordana	3.2	F											✓	23
Mathew S	3.6	M						20			57		✓	34
Kahurangi	3.4	M		✓	12			20			15		✓	17
Sam	3.6	M									10		✓	15

Celine	4.4	F											✓	6
Annabelle	4.5	F		✓	35						20		✓	8
Duncan	4	M									10		✓	10
James	4.8	M		✓	10						10		✓	6
Mithunan	4.1	M									48		✓	

* Second attempt (as first attempt failed).

** James climbed Test No.6 at an increased height (1100mm) at a time of 28 seconds.

Note: Beatrice on Test No.5 had a second attempt and climbed in 10 seconds.
 Annabelle on Test No.6 had a second attempt and climbed in 40 seconds.
 All Toehold Tests children were wearing shoes

Age of Groups		Test Barrier No.3b			Test Barrier No.4a			Test Barrier No.4b			Test Barrier No.5			
Name	Age (yr)	Gender	Climbed	Failure	Time (s)	Climbed	Failure	Time (s)	Climbed	Failure	Time (s)	Climbed	Failure	Time (s)
Eliza	11 Mths	F												
Ryan	9 Mths	M												

Charlotte	1.9	F					√	60						
Georgia	1.7	F					√	15					√	30
Tim	1.5	M												

Caroline	2	F											√	30
Victoria	2.4	F											√	30
Gabriella	2.9	F												
Julie	2	F											√	30
Lucy	2.7	F											√	30
Sian	2.7	F											√	30
Andrew	2.2	M					√	10					√	30
Mathew D	2.2	M												

Beatrice	3.6	F		√	7		√	9				√	20	30
Alexandra	3.1	F	√		27	√		30				√	30	30
Jordana	3.2	F												
Mathew S	3.6	M					√	23					√	5
Kahurangi	3.4	M		√	60	√		30				√	60	30
Sam	3.6	M		√	60		√	8				√	30	10

Celine	4.4	F	√		7	√		8				*√	15	30
Annabelle	4.5	F	√		12	√		8				*√	13	10
Duncan	4	M	√		10	√		10				√	10	30
James	4.8	M	√		7	√		8				√	7	5
Mithunan	4.1	M												

Percentage of Children able to Climb Barrier by Age.

Age	Test 1	Test 2a	Test 2b	Test 3a	Test 3b	Test 4a	Test 4b	Test 5	Test 6
0	0%	0%	0%	0%	0%	0%	0%	0%	0%
1	0%	0%	0%	0%	0%	0%	0%	0%	0%
2	0%	60%	100%	50%	0%	0%	0%	0%	0%
3	67%	100%	100%	83%	25%	40%	0%	0%	0%
4	100%	100%	100%	100%	100%	100%	100%	25%	75%