

## TECHNICAL REPORT



Maxwell Road, Stevenage,  
Hertfordshire SG1 2EW, England  
Telephone +44 (0) 1438 777700  
Facsimilie +44 (0) 1438 777800  
e-mail: info@fira.co.uk  
website: www.fira.co.uk

### **RICHARD BURBIDGE LTD**

Whittington Road  
Oswestry  
Shropshire  
SY11 1HZ

Our Ref.: TCMSF15034/A

Date: 31 January 2007

Date delivered: 25 January 2007

Date of tests: 27 January 2007

For the attention of Mr Kevin Jones

### **SAMPLE(S) FOR TEST :**

One, Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400

### **TEST REQUIREMENTS :**

BS 6180: 1999: Barriers in and about buildings – Code of practice  
- General Contract use – Clauses 6.4.1

### **RESULT :**

PASS

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### **FIRA International Limited**

A member of the TTL Chiltern Group  
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Registered Office:  
Chiltern House, Stocking Lane,  
Hughenden Valley, High Wycombe,  
Buckinghamshire HP14 4ND, UK.

Registered No 3181481 England

# TECHNICAL REPORT

## INTRODUCTION

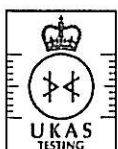
As part of the BM TRADA Certification Ltd Balustrade Product Conformity Scheme, FIRA was commissioned to undertake structural testing of Richard Burbidge Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400 in accordance with the requirements of the following documents:

BS 6180: 1999: Barriers in and about buildings – Code of practice

BS 6399: Part 1: 1996: Loading for buildings - Code of practice for dead and imposed loads

BS 5268: Part 2: 2002: Structural use of timber – Code of practice for permissible stress design, materials and workmanship

The intention of the testing was to assess whether the products were structurally suitable for use commercial arenas. Their failure mode and critical failure load were to be established in order to assess and improve upon future designs with the outcome that the developed design could be included in the BM TRADA Certification Ltd Balustrade Product Conformity Scheme.



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## TEST SPECIMEN(S)

### Description of Specimen

#### General

Commercial Softwood (Pine) Fusion Outdoor Round System. Horizontal unit set to a height of 1100mm and 2314mm overall handrail length between centres of newels.

System	Commercial Softwood Fusion Outdoor Round System
Timber Species	Sapele – <i>Entandrophragma cylindricum</i> , Sprague
Handrail dimensions	115 x 27mm - Flat Capping Rail
Handrail length	1800mm overall handrail length to centres of newels with 3 newels set at 900mm centres
Spindle	Hardwood Round Spindle 900 x 35mm Diameter Ø
Round Spindle Bracket	LM24 Aluminium Pre-Treated Chromated Powder Coated Brackets
Newel dimensions	Round Newel 1375 x 90 x 90mm
Round rail dimensions	54.5 x 47.5mm
Round Rail Length	1800m total to centres of newels with an intermediate newel fixed at 900mm.
String/Joist Dimensions	150mm Width x 50mm Thick
Handrail - Flat Capping Rail To Newel Fix	Zamak 3 Zinc Alloy Brackets Landscape Screws - 100mm x 6.3mm diameter C1002 Case Hardened Steel (used to fix the flat capping rail)
Fixings Used	Woodscrews 4.2 x 38mm, 4.2 x 25mm. Stainless Steel, Countersink, Raised & Flat, Pozi Drive, Landscape Screws 100mm x 6.3mm diameter C1002 Case Hardened Steel (used to fix the flat capping rail)

Product descriptions produced by FIRA International Ltd give basic Construction, Material and Dimensional information and are not intended to represent a complete product specification. Overall product dimensions will be recorded accurately. Where variations in material thickness occur, dimensions will be taken as standard thickness.



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## TEST PROCEDURE

The landing balustrade is laid horizontally and mounted in a universal test rig with both end newels fully supported by, and clamped too, steel channel sections. Both the end and the central newels are logged between supporting wall bars. A timber strut also supports the central newel. The newels are clamped in order to simulate as closely as possible the fixing method commonly used in practice. In this case the base is clamped.

### **Balustrade Handrail Stiffness Test**

A uniformly distributed load is applied to the handrail using calibrated weights and load bags suspended vertically from the handrail.

It has been found that in general the aforementioned test method causes timber based balustrades to deflect by amounts greater than the 25mm required by the standard. However in such cases the increased deflection does not necessarily present a safety hazard to the user as the balustrade remains intact. In such cases the BM TRADA Certification Ltd Balustrade Product Conformity Scheme states that, where the aforementioned deflection limit is exceeded, the unit will be deemed to have satisfied the requirements of the scheme provided that it is capable of passing the strength of handrail test.

### **Handrail Strength Test**

A uniformly distributed load is applied to the handrail using calibrated weights and load bags suspended vertically from the handrail. The load is maintained for a period of 15 minutes, at the end of which the balustrade is inspected for structural damage.

### **In- fill strength**

A uniformly distributed load is applied to the handrail using calibrated weights and load bags laid on top of a foam sheet, which rests on the in-fills. The load is maintained for a period of 15 minutes, at the end of which the balustrade is inspected for structural damage. Experience has shown that if the in- fill can sustain the load when it is initially applied, then unless there is visual movement or lots of cracking noises at the fixings it not necessary to hold the load for 15 minutes.

### **Baluster Strength**

The point load is applied thought the application of calibrated weights and load bags hung from a hook in the middle of the baluster. Five balusters are subjected to the testing to establish consistency. Experience has shown that if the in- fill can sustain the load when it is initially applied, then unless there is visual movement or lots of cracking noises at the fixings it not necessary to hold the load for 15 minutes. At the end of which the balustrade is inspected for structural damage.



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## TEST RESULTS

### BS 6180: 1999, Clause 6.4.1 Balustrade horizontal deflection test

Item: One, Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400  
 Test Level: Contract applications  
 Initial Inspection: No apparent faults.

### Load Table

	Contract Level	DL x BS 5268: Part 2: 2002 Safety Factor
Load per Meter	1.5kN/m	3.36kN/m
UDL Required	270kg	806kg
UDL Achieved	270kg	N/A
UDL to In-fill	1. 5kN/m <sup>2</sup>	N/R
UDL <sup>2</sup> Required	309kN	N/R
UDL <sup>2</sup> Achieved	309kg	N/R
PL Balusters Required	0.75 KN	N/R
PL Balusters Achieved	75kg	N/R

### Results Table

TEST	TEST REQUIREMENT		RESULT- Commercial Level
Handrail Stiffness	Design Load	Initial Loading	PASS
		Deflection	21mm
Handrail Strength	BS 5268: Part 2: 2002 Safety Factor	Initial Loading	N/R
		After 15 minutes	N/R
In-fill Strength	Design Load	Initial Loading	PASS
Strength of Balusters	Design Load	Initial Loading	PASS

\* See COMMENTS



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## COMMENTS

As the balustrade did not deflect passed 25 mm during the test to commercial loading levels there was no need to assess the sample to the BS 5268: Part 2: 2002 Safety Factor for communal domestic applications.

## CONCLUSION

When tested the Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400 supplied by Richard Burbidge Ltd satisfied the selected combined rules of BS 6180: 1999: Barriers in and about buildings and BS 5268: Part 2: 2002: Structural use of timber – Code of practice for permissible stress design, materials and workmanship.

The Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400 is therefore considered to be suitable for commercial applications when used in spans of 2400mm between the centre of newel posts.

### NOTE(S)

A, B, D, E, F/G and C1, C2, C3 are the full range of applications for which the products are suitable as specified by BS 6399: Part 1: 1996. For more information see ANNEX B.

Tested by: D Gardner/ K Daly / T Slater

Reported by: Tom Slater

Approved by: Phil Reynolds  
Testing Manager



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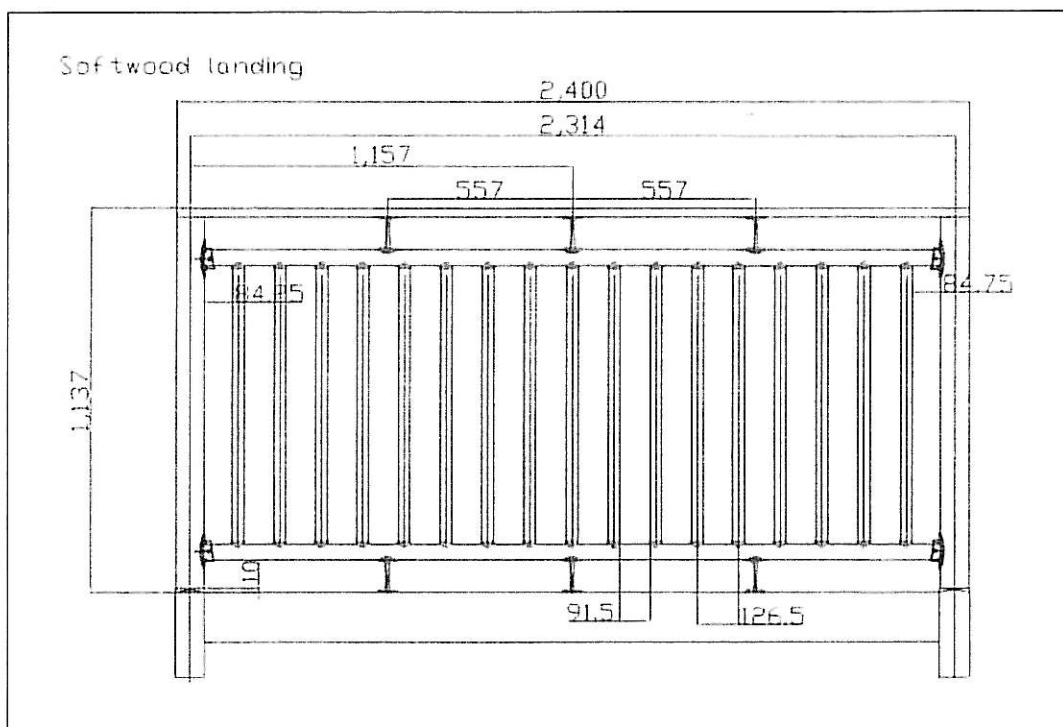


Plate 1: Drawing of Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400

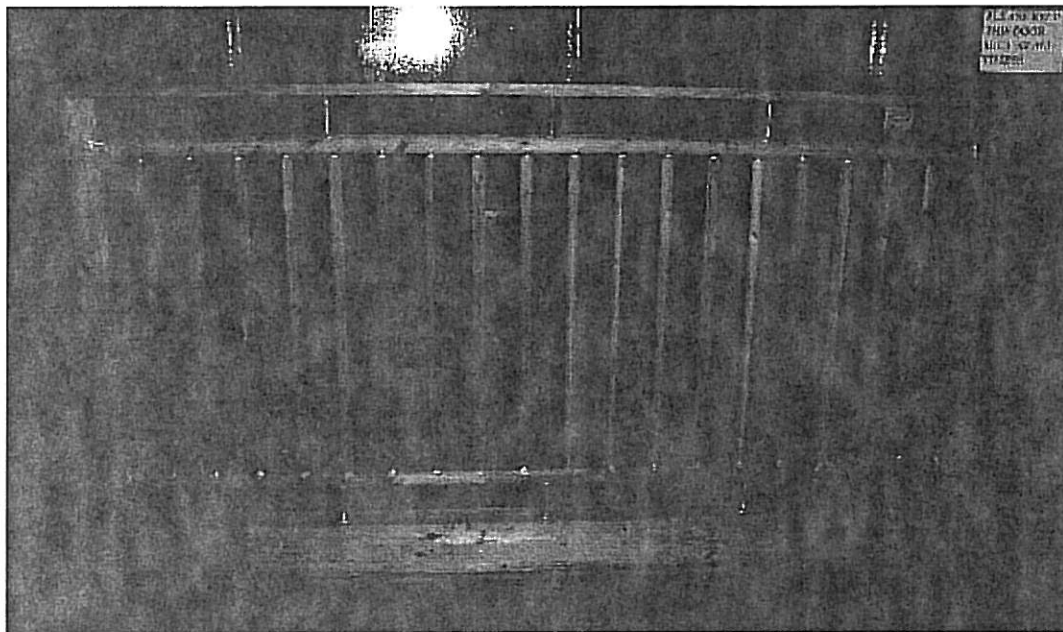


Plate 2: Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400, Before test

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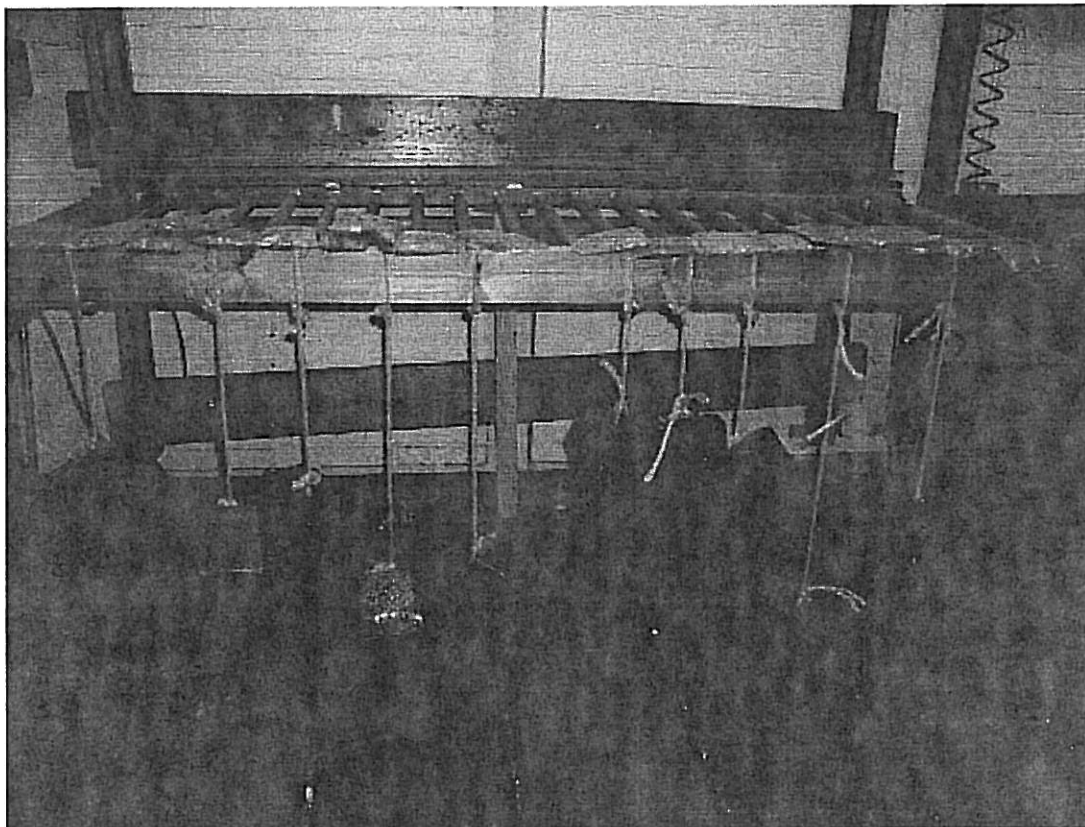


Plate 3: Decking round handrail Ref: PINE HORIZONTAL 1100 mm x 2400, during test



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## ANNEX A

### Test Requirements

#### Hand rail test

##### **Stiffness test**

Initially a stiffness test is to be carried out by applying the test loads for 15 minutes checking that the net deflection of the handrail at mid length between supports is less than 25mm. In accordance with BS 6180, the test loads were taken from BS 6399-1, table 4. These are based on the building-use categories, which are defined in Table 6.2.

The net handrail deflection is defined as:

$$d_{h,net} = d_{h,total} - d_{newel} - d_{stringer}, \text{ where}$$

$d_{h,total}$	Total deflection at mid span of handrail in the direction of the load
$d_{newel}$	Deflection of the newel in the direction of the load. Deflection is to be measured at the crossing point between centreline of hand rail and centre line of newel.
$d_{stringer}$	Deflection of mid span of the stringer in the direction of load. Deflection is to be measured at mid span of the stringer. This measurement is not applicable to balustrades with cut stringers (raised bottom rail).

For balustrades with glass components, the maximum deflection is  $L/65$  or 25 mm whichever is the smaller. The definition of  $L$  should be sought in sections 8.3, 8.4 or 8.5 in BS 61800, as it is dependent on the actual design.

If the balustrade fails the deflection test, without experiencing permanent damage, it is suggested that a strength test be carried out.

##### **Strength test**

BS 6180 "Code of practice for barriers in and about buildings" only refers to a maximum deflection limit under design load. However for timber balustrades this limit has proven difficult to comply with although timber balustrades have been used safely for many years.

TRADA has taken a practical view on this and suggests that the overall deflection is of less importance providing the balustrade passes a strength test in accordance with Section 8 of BS 5268-2.

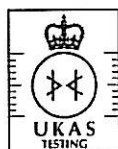
In accordance with this method the balustrade is to be loaded with an ultimate load of design load multiplied with the product of  $K_{73}$  and  $K_{85}$  of BS 5268-2. The balustrade is to sustain this load for 15 minutes without failing (breaking).

As per guidance in BS 6180, the design loads have been taken from Table 4 in BS 6399-1.

TRADA suggests that loads on stairs can be considered "medium term", which means that the overall load safety factor ( $K_{73} \times K_{85}$ ) will range from 1.79 (if five identical balustrades are tested) and 2.24 (if only one balustrade is tested).

The Q-mark scheme was set up when an earlier version of BS 5268-2 was governing. At that time the safety ranged between 2 (for five tests) and 2.5 (for one test). These are equivalent to the overall load safety factor ( $K_{73} \times K_{85}$ ) for "long term" loads on the current version of BS 5268-2. For consistency these factors are still used for the Q-mark tests.

It is suggested that initially the "medium term" loads (given as "5268" loads in table 6.1 is applied for 15 minutes. If the rail passes, additional load to fulfil the Q-mark regulations is applied and the whole load is held for another 15 minutes.



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If the balustrade fails to withstand the 15 minutes with "Q-mark" loading, but passes the "5268" load the client will not be able to have the balustrade Q-mark certified, but can receive a test report claiming compliance with combined rules of BS 6180 and 5268-2.

## Spindle / infill tests

### **Individual spindles**

BS 6180 does not give a deflection limit for spindles, which means that a strength test is required unless calculations can prove that the spindles can withstand the design load given in BS 6399-1, Table 4. Clause 6.3.1 in BS 6180 allows the design load to be halved when the infill "consist of successive balusters".

As these tests are relatively "quick and easy" to do, it is suggested that a minimum of 5 balusters are tested, giving a safety factor of 1.79 for "5268" loads and 2.00 for Q-mark loads. The test loads to be applied are given in table 6.2 in Annex B. It should however be noted that the Q-mark scheme requires all spindles to be tested.



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## ANNEX B

Table 6.2 Use of buildings or part buildings

Taken from BS 6399: Part 1: 1996: Loading for buildings - Code of practice for dead and imposed loads.

Building-Use category	Type of occupancy for part of the building or structure	Descriptive title
A	Domestic and residential activities	(i) All areas within or serving exclusively one single family dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs (see C3 ix)
		(ii) Other residential, (but also see C)
B and E	Offices and work areas not included elsewhere including storage areas	(iii) Light access stairs and gangways not more than 600 mm wide (not applicable to stair rails)
		(iv) Light pedestrian traffic routes in industrial and storage buildings except designated escape routes
		(v) Areas not susceptible to overcrowding in office and industrial buildings also industrial and storage buildings except as given above
C	Areas where people may congregate	
C1/C2	Areas with tables or fixed seating	(vi) Areas having fixed seating within 530 mm of the barrier, balustrade or parapet
		(vii) Restaurants and bars
C3	Areas without obstacles for moving people and not susceptible to overcrowding	(viii) Stairs, landings, corridors, ramps
		(ix) External balconies and edges of roofs. Footways and pavements within building curtilage adjacent to basement/sunken areas
C5	Areas susceptible to overcrowding	(x) Footways or pavements less than 3 m wide adjacent to sunken areas
		(xi) Theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studio. Footways or pavements greater than 3 m wide adjacent to sunken areas
		(xii) Grandstands and stadia
D	Retail areas	(xiii) All retail areas including public areas of banks/building societies or betting shops. For areas where overcrowding may occur, see C5
F/G	Vehicular	(xiv) Pedestrian areas in car parks including stairs, landings, ramps, edges or internal floors, footways, edges of roofs
		(xv) Horizontal loads imposed by vehicles

