TECHNICAL REPORT

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Our Ref.: TCMSF08519
Date: 16/05/06
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Date of tests: 04/02/06

For the attention of Mr Kevin Jones

SAMPLE(S) FOR TEST :

One, Landing Balustrade ref: White Oak (Euro) Stairparts

TEST REQUIREMENTS :	**RESULT :**
BS 6180: 1999: Barriers in and about buildings – Code of practice - Communal domestic use – Clauses 6.4.1	Pass

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INTRODUCTION

As part of the BM TRADA Certification Ltd Balustrade Product Conformity Scheme, FIRA was commissioned to undertake structural testing of Richard Burbidge Landing Balustrade ref: White Oak (Euro) Stairparts 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 in communal domestic dwellings and could therefore be included in the BM TRADA Certification Ltd Balustrade Product Conformity Scheme.

TEST SPECIMEN(S)

Description of Specimen

General

White Oak, traditional draw bored mortise and tenon joint, horizontal unit set to a height of 1100mm and 2400mm handrail length between centres of newels.

System	**White Oak (Euro) Stairparts (Horizontal) Contemporary**
Timber Species	European Oak *Quercus robur/Quercus petraea* (Density 720kg/m3)
Handrail dimensions	59 x 59mm
Handrail length	2400mm between centre of newels
Baluster type	Stop Chamfered 900 x 41 x 41mm
Newel dimensions	90 x 90 x 1500mm
Base rail dimensions	55 x 22mm
String dimensions	Pine String at 250mm width x 28mm thick
Handrail to newel joint/connection	Draw bored mortise and tenon. Tenon a third the width of the handrail (20mm) with a length equal to a third/half the section size of the newel (45mm) draw bored with 9mm hardwood dowel
Adhesive	Urea Formaldehyde (Cascamite)

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.

TEST PROCEDURE

Balustrade Handrail Stiffness Test

The landing rail is laid horizontally and mounted in a universal test rig with both newels fully supported on steel channel sections. Both newels are clamped to the supporting steelwork at the top and bottom. The newels are clamped in this manner in order to simulate as closely as possible the fixing method commonly used in practice. A number of support columns are placed between the stringer and the floor in order to simulate the stiffening effect of the stairs or floor.

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

The landing rail is laid horizontally and mounted in a universal test rig with both newels fully supported on steel channel sections. Both newels are clamped to the supporting steelwork at the top and bottom. The newels are clamped in this manner in order to simulate as closely as possible the fixing method commonly used in practice. A number of support columns are placed between the stringer and the floor in order to simulate the stiffening effect of the stairs or floor.

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.

This test is conducted at two levels of severity. Firstly the uniformly distributed load applied is as specified in BS 5268: Part 2: 2002: Structural use of timber – Code of practice for permissible stress design, materials and workmanship. This is intended to show compliance to UK structural codes of practice. Secondly, a uniformly distributed load as specified by the BM TRADA Certification Ltd Balustrade Product Conformity Scheme is applied. This load is of increased severity when compared to the test to show conformance to UK structural codes of practice.

For more information see ANNEX A.

TEST RESULTS

BS 6180: 1999, Clause 6.4.1 Balustrade horizontal deflection test

Item: Landing Balustrade ref: White Oak (Euro) Stairparts
Enquiry No.: TCMSF08519
Test Level: Communal Domestic applications
Initial Inspection: No apparent faults.

Load Table

	Communal Domestic Level	UDL Required	UDL Achieved	Strength of Balusters
Design Load	0.74kN/m	178kg	178kg	-
DL x BS 5268: Part 2: 2002 Safety Factor	1.66kN/m	398kg	-	0.45kN
DL x Q-mark Safety Factor	1.85kN/m	444kg	-	0.50kN

Results Table

TEST	TEST REQUIREMENT		RESULT
Handrail Stiffness	Design Load	Initial Loading	PASS
		Deflection	<25mm
Handrail Strength	BS 5268: Part 2: 2002 Safety Factor	Initial Loading	N/R
		After 15 minutes	N/R
Handrail Strength	Q-mark Safety Factor	Initial Loading	N/R
		After 15 minutes	N/R
Strength of Balusters	BS 5268: Part 2: 2002 Safety Factor	Minimum 5 Balusters	PASS
	Q-mark Safety Factor	All Balusters	PASS

Comments

The balustrade was found to deflect less than the allowed 25mm when loaded with the specified design load. The pass result of the handrail stiffness test meant that the handrail strength test did not have to be conducted.

COMMENTS

It was noted that when tested in accordance with BS 6180: 1999 the Landing Balustrade ref: White Oak (Euro) Stairparts deflected less than 25mm. Therefore, in accordance with BS 6180: 1999 and the BM TRADA Certification Ltd Balustrade Product Conformity Scheme no further testing was required.

CONCLUSION

When tested the Landing Balustrade ref: White Oak (Euro) Stairparts 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.

When tested the Landing Balustrade ref: White Oak (Euro) Stairparts supplied by Richard Burbidge Ltd satisfied the aforementioned requirements of the BM TRADA Certification Ltd Balustrade Product Conformity Scheme.

The Landing Balustrade ref: White Oak (Euro) Stairparts is therefore considered to be suitable for communal domestic applications when used in spans of 2400mm between the centre of newel posts.

NOTE(S)
1. A, B, E and 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.
2. Communal domestic application, and applications A, B, E and C3 (with the exception of Ai) as defined by BS 6399: Part 1: 1996 are referred to as “Public applications” by BM TRADA Certification Ltd Balustrade Product Conformity Scheme

Tested by: B Pearce/D Hunter/L Jones

Reported by: B Pearce

Approved by: B Pearce

Market Development Engineer

Plate 1: Landing Balustrade ref: White Oak (Euro) Stairparts, initial application of design load

Plate 2: Landing Balustrade ref: White Oak (Euro) Stairparts, completion of application of design load

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:

$d_{h,net}$ = $d_{h,total} – d_{newel} - d_{stringer}$, 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 which ever 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 defection 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 15minutes 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} x 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} x 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.

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”.

Initially the Q-mark scheme was set-up for timber rails and balusters and therefore the safety factors from the timber design code BS 5268-2 – as described in section 5.1.2 for handrails- were used. As the Fusion balusters are of steel instead of timber and because steel is a more homogenous material it could be argued that these should not be tested in accordance with BS 5268-2 and instead a less onerous safety factor should be used. However since the balusters are fixed to timber rails and for consistency’s sake TRADA recommend that this procedure is still followed.

Experience has shown that if the baluster 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.

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.

Glass infill

The client has expressed an interest in adding a glass infill panel to the system as an alternative to the individual steel balusters. TRADA has no further details regarding the glass panel and how it is proposed to fix it to the rails. However, assuming the glass panel is to be fixed to timber rails it is proposed to use the same safety factors as for the steel or timber balusters.

The calculated test loads – based on design load in BS 6399-1 and safety factors in BS 5268 – are given in Table 6.1

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