MACDATA

WEATHERTIGHTNESS OF WINDOWS

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***Abstract**: This report analyses the data obtained from windows tested for the manufacturing industry since the inception of new test methods in 1983. The tests were conducted in accordance with BS 5368 and the results classified according to BS 6375: Part 1: 1983:* Classification for weathertightness. *Possible trends in design and limitations in the application of test results are indicated.*

INTRODUCTION

The weathertightness of windows prior to 1983 was governed by BS 4315, the windows being classified according to BS Draft for Development 4: 1971: "Recommendations for the grading of windows". An article in *Building* 22 June 1979 illustrated the marked improvement in window performance brought about by the introduction of BS 4315. New test methods were introduced in 1983 for evaluating window performance, the test methods being in accordance with BS 5368 and the performance evaluation being in accordance with BS 6375: Part 1: 1983: "Classification for weathertightness". This report analyses the data obtained from tests on 134 windows at the MACDATA Unit of Paisley College of Technology since the inception of the new standards and also indicates possible trends in design and limitations in the application of the test results.

DESCRIPTION OF WINDOWS TESTED

The distribution of the windows provided for test is given in Table 1. All windows were supplied with weatherseals as standard fittings and, with a few exceptions, all windows had a minimum of two fixing points. Table 1 indicates that, of the windows tested, 38% were of the horizontal pivot type, 33% were of the side/top/bottom hung type and 25% were of the tilt-and-turn type. The materials of the window frames were 64% timber, 30% pvc and 6% aluminium.

TEST METHODS AND PERFORMANCE CLASSIFICATIONS

The test methods specified in BS 5368 are not substantially different from the BS 4315 methods. The determination of performance classification specified in BS 6375 is governed by similar criteria to those specified in DD4 but with additional requirements.

The pressure classification for air infiltration is determined by the quantity of air passing through the window per metre length of opening joint and the applied pressure difference across the window. This infiltration includes leakage through fixed joints and glazing.

The pressure classification for water penetration is determined by the pressure difference at which leakage of water occurs and this again includes leakage through fixed joints and glazing.

Table 1 Distribution of tests

Type	No of tests	Material	No of Tests
Horizontal pivot	51 (38%)	Timber	48 (94%)
		Pvc	0 (0%)
		Aluminium	3 (6%)
		Total	51 (100%)
Side hung Top hung Bottom hung	44 (33%)	Timber	31 (71%)
		Pvc	8 (18%)
		Aluminium	5 (11%)
		Total	44 (100%)
Tilt-and-turn	34 (25%)	Timber	2 (6%)
		Pvc	32 (94%)
		Total	34 (100%)
Vertical pivot	2 (1.5%)	Timber	1 (50%)
		Aluminium	1 (50%)
		Total	2 (100%)
Vertical slider	3 (2.5%)	Timber	2 (67%)
		Pvc	1 (33%)
		Total	3 (100%)
TOTAL	134 (100%)		

The pressure classification for wind resistance is determined on the basis of:

(a) deflection of members subjected to gusting at the design pressure.

(b) no significant deterioration of performance in repeat air infiltration and water penetration tests carried out after the gusting tests.

OVERALL PERFORMANCE ANALYSIS

The overall performance of the 134 windows tested at Paisley is based on the pressure classifications specified in BS 6375: Part 1: 1983 for air infiltration, water penetration and wind resistance, which correspond most closely to the severe grades of exposure contained in BS Draft for Development 4: 1971.

The window performance is assessed on a pass/fail criterion based on the above pressure classification requirements. The results are tabulated in Table 2, which also indicates the particular test causing failure.

The results indicate that 59% of the windows tested attained the required pressure classifications. Comparison with the data presented in *Building* June 1979 indicates a further improvement in windows achieving an equivalent severe exposure category from 21% in 1970, to 53% in 1978, to 59% in 1984.

Table 2 Overall performance analysis

No of tests	No passing	No failing	No failing test for: Air infiltration	Water penetration	Wind resistance
134 (100%)	79 (59%)	55 (41%)	3 (2%)	39 (29%)	13 (10%)

PERFORMANCE COMPARISON OF DIFFERENT TYPES OF WINDOWS

The performance results for the different types of windows are tabulated in Table 3. The results indicate that side/top/bottom hung and tilt-and-turn windows have, respectively, a 66% and 68% pass rate compared with horizontal pivot windows, which only indicate a 49% pass rate. Comparison with the data presented in *Building* June 1979 indicates a similar level of performance for horizontal pivot windows and an improvement in the performance for side/top/bottom hung windows. Comparison of vertical pivot and vertical slider windows is not possible due to the small number tested.

Table 3 Performance comparison

Type	No of tests	No passing	No failing
Horizontal pivot	51 (100%)	25 (49%)	26 (51%)
Side, top and bottom hung	44 (100%)	29 (66%)	15 (34%)
Tilt-and-turn	34 (100%)	23 (68%)	11 (32%)
Vertical pivot	2 (100%)	0 (0%)	2 (100%)
Vertical slider	3 (100%)	2 (67%)	1 (33%)

LIMITATIONS OF TEST RESULTS

Although experience at Paisley shows an improvement of window performance in the tests for classification, the tests are not an infallible predictor of the performance on site.

Windows are tested straight from the factory and as such will be at the peak of their performance. The test does not give any indication of the long-term performance of the window. Part 2 of BS 5368: "Performance requirements for the operation and strength of windows", currently under preparation, is unlikely to depart from this testing "as new".

It is possible to make a subjective assessment of the long-term performance of a window, as the following examples illustrate.

CASE A

A window which had satisfied the tests and obtained a high performance classification was giving problems with air infiltration and water penetration, some 80% of the windows in the particular development being affected.

The window had an opening joint which was closed off by a wiper-type seal which, if removed, gave direct access for both air and water to the interior of the building. Weathertightness is achieved when the gap between sash and frame is small and the deflection of the seal great. Normal usage resulted in seals being broken and pulled out within two years of installation. Although the window had been tested and passed, a closer inspection would have revealed that the geometry of the sash/frame meeting joint offered no protection once the weatherseal had been breached.

CASE B

The hardware fitted to windows has become more sophisticated over recent years and as such requires skilled adjustment to allow the window to perform as in the test. The windows fitted were causing problems with water penetration to an unacceptable extent. Investigation showed that the windows were well designed, but after installation there appeared to have been no final adjustment of fixings beyond that carried out at the time of manufacture. During transport and installation, windows are subjected to handling which must leave fixings operating at less than 100% efficiency. This particular problem was quickly and satisfactorily solved when the fixings were properly adjusted.

TRENDS IN DESIGN

A comparison between the materials and types of windows tested since 1983 with those presented in *Building* June 1979 is given in Table 4.

Table 4 Window material and type comparison

Window material	1978 (%)	1984 (%)
Timber	78	64
Metal	8	0
Aluminium	11	6
Pvc	3	30

(a) Material comparison

Window type	1978 (%)	1984 (%)
Horizontal pivot	59	38
Side/top/ bottom hung	27	33
Tilt-and-turn	0	25
Vertical pivot	4	1.5
Horiz/vert slider	10	2.5

(b) Type comparison

The table indicates an increase in the testing of pvc and tilt-and-turn type windows, with a corresponding decrease in timber and horizontal pivot type windows. Inspection of Table 1 indicates that these trends are related in so far as 94% of horizontal pivot windows are timber-framed and 94% of tilt-and-turn windows are pvc-framed. It would therefore appear that pvc tilt-and-turn windows are being used as an alternative design option to timber horizontal pivot windows, and that there is an apparent trend to canopy and tilt-and-turn windows.