الفطيم إكسوفا
Al-Futtaim Exova

FAÇADE TESTING & ADVISORY SERVICES

Client: Faisal Jassim Industries

Project: System Development

Laboratory Performance Testing of a Sand Trap Louvre System (Flowtech)

Report no: DLR1213 Rev.0

October 2015

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Appendices

1. Summary of Test Results

The following summarises the results of the tests carried out. For full details refer to Sections 6 and 7.

1.1 Entry Loss Coefficient Test

The sample classified as '2' when tested in accordance with BS EN 13181:2001

1.2 Sand Rejection Test

The sample effectiveness at different air flow rates were recorded when tested in accordance with BS EN 13181:2001.

The above results are valid only for the tested sample as detailed and constructed as per the drawings with any marked variations as attached in Appendix B of this report and the conditions under which the tests were conducted.

2. Introduction

This report describes tests carried out at the Al Futtaim Exova L.L.C. (AFE) – Façade Testing & Advisory Services, Laboratory in Dubai at the request of:

Faisal Jassim Industries,
P.O. Box 1871,
Dubai,
U.A.E

AFE Job/Sample Number: PD 102062 / C2257

The test sample consisted of a sample of sand trap louvre system (Flowtech) manufactured by Faisal Jassim Industries for their system development.

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AFE is accredited to ISO/IEC 17025: 2005 by the United Kingdom Accreditation Service (UKAS), which assesses the technical competence of the laboratory, as well as its quality management systems.

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2.1 Purpose of Testing

The tests were carried out during September 2015 and were to determine the performance of a louvre system with respect to entry loss and sand rejection. The test methods were in accordance with the following standards.

- Entry Loss Coefficient — BS EN 13181 :2001
- Sand Penetration — BS EN 13181 :2001

This test report relates only to the actual sample as tested and described herein.

The tests were supervised by:

Vishal Vilaschandran (AFE) - ....

2.2 Using this Test Report

There are many reasons for pre-construction testing including,

- verifying the design,
- establishing an acceptable level of quality,
- resolving buildability issues,
- resolving aesthetic issues,

Testing a sample usually also reveals the parts of the system that require more focus than others. This allows the project team to concentrate on specific areas of the installation that require more careful attention.

The testing of a system is only one of the first stages in the quality control process. This report contains a large quantity of useful information that can assist the project team in producing a building envelope that performs as well as the successful laboratory sample.

We recommend the following approach.

1. Read and become familiar with the information provided in the 'Controlled Dismantle' (Section 7). The controlled dismantle was performed using the drawings that are attached in an appendix. Any differences observed between the sample tested, and the drawings provided were noted on the drawings, and a photograph taken where possible. This important process was carried out so that the interested parties have a full and clear record of the system as it was, when it passed the tests.
2. Convene a meeting between the parties on the project that are involved with the louvre. Discuss each of the items listed in the controlled dismantle in turn, deciding if the item is acceptable, or if another solution could be found.
3. Plan a focussed programme of quality control, based on the above discussions, and refer to the test report throughout the installation.

3. Description of the Test Sample

3.1 General Arrangement

The sample (0.912m² core area) was formed from standard, vertical aluminium sand trap louvre blades, with external, vertical aluminium blades. The test sample was mounted weather face out on the sand injection section. The total sample size was 0.995m tall x 0.995m wide. Photo DLP C2257/0034 shows an external view of the test arrangement.

Figure 1 Photo DLP C2257/0034 The Test Arrangement

The layout dimensions and full sample construction details are shown on the drawings in an appendix; including the dimensions of structural elements.

Any variations from these drawings are listed in Section 7.

3.2 Drawings

The test sample was as shown in the Faisal Jassim Industries sample drawing numbered:

- DWG - 01

(except for the variations as described in Section 7).

A copy of this drawing is included in Appendix B of this report.

4. Test Arrangement

4.1 Test Rig

The test rig comprised of a sand rejection section and an aerodynamic measurement section. A mechanical ventilation system was attached to the aerodynamic measurement section.

The test sample was mounted weather face out on the aerodynamic measurement section. The air flow measuring system comprised of an inlet cone and pressure transducers. Static pressure tappings were provided at the inlet cone to measure the air flow rate and were located at four locations as required by ISO 5221-1984.

The sand rejection equipment consisted of a fan, injector tube, main funnel, feeder cone, distribution tube and spreader plate. The injector was capable of creating an air velocity of 20 to 25 m/s in the distribution tube.

The mechanical ventilation system consisted of a ventilation fan capable of producing an air flow rate through the louvre under test over the range of 0.5 m^3/s to 3.5 m^3/s.

4.2 Instrumentation

A pressure transducer, capable of measuring rapid changes in pressure to an accuracy within 2%, were used to measure the differential pressures.

An inlet cone mounted in the mechanical ventilation system was used with pressure transducers to measure the air flow rate though the specimen. This device was capable of measuring airflow through the sample to an accuracy within $\pm$5%.

A digital weighing scale to an accuracy of 0.5% of the reading was used for weight measurements.

An anemometer was used to measure the wind velocity to an accuracy of $\pm$10%.

A barometer was used to measure the atmospheric pressure.

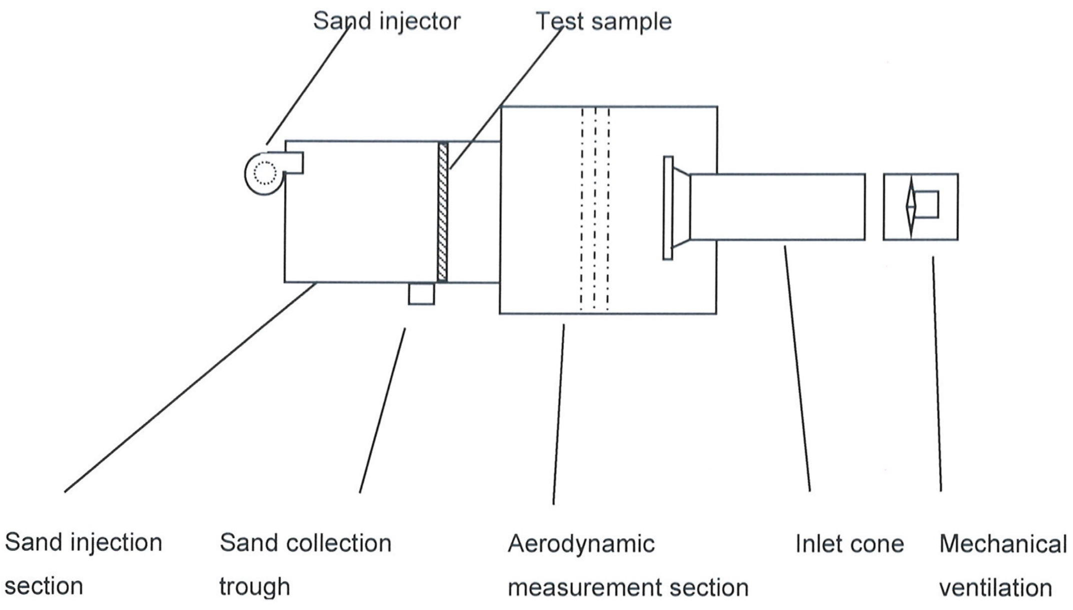
A stopwatch with an accuracy of 0.2 seconds was used as the timer.

Temperatures were measured using platinum resistance thermometers (PRT).

All measuring instruments and relevant test equipment used were calibrated and traceable to national or international standards.

Figure 2 **Test Rig Schematic Arrangement – Section Through the Test Chamber**

(note that this drawing is intended to convey the general principles only, not necessarily the actual test sample dimensions, shape or orientation).



5. Test Procedures

Note: The tests were performed in the order given in Section 5.1. The sample was built onto the chamber with its internal face on the interior of the chamber.

5.1 Sequence of Testing

1. Entry loss coefficients test
2. Sand rejection test
3. Controlled dismantle

5.2 Entry Loss Coefficients (BS EN 13181)

To derive the entry loss coefficient, five different air flow rates were created through the louvre. The lowest flow rate in the range was such that it produces a pressure difference greater than 10 Pascals. The highest was 3.5 m^3/s.

The pressure across the louvre was measured at the static pressure measurement points, 100mm behind the weather louvre, on the sides of the aerodynamic test section.

The airflow was measured using an inlet cone, positioned at the end of the discharge side. Uniform flow approaching the conical inlet was obtained by fitting resistance screens.

The entry loss coefficient (Ce) was calculated for each ventilation air flow rate used in the test.

Ce = Actual flow / theoretical flow (theoretical flow is defined as the flow with a loss coefficient =1)

$Ce = q_{vn} ((A (2 p_{sn} . \rho_{in}^{-1})^{½})^{-1}$

(A – Core area of the louver, q_{vn} – Air flow rate, p_s – Static gauge pressure, ρ_{in} – Density of air)

5.3 Pre-testing of Sand Distribution

The sand rejection equipment was positioned such that its outlet is centrally located at the top of the approach duct and 1.5m from the louver under test. Nine squares of cardboards approximately 25mm x 25mm were covered with double sided adhesive tape. Each square was individually identified and weighed before being fixed to the sand trap louver in three rows of three.

Two strips of cardboard, approximately 25mm high across the full width of the test duct, covered with double sided adhesive tape at both sides, was fixed in an upright position at 250mm and 350mm from the face of the louver.

The specified amount of test sand was fed into the sand injector equipment with the ventilation fan off and the sand injection fan operating.

The squares were removed and individually weighed. The ratio of weight difference between the sand in any two squares did not exceed 4 to 1. The strips attached to the floor were checked to verify that the sand has adhered only to the downstream side of the strips. This procedure repeated until a satisfactory result was obtained.

5.4 Sand Rejection Test (BS EN 13181)

The sand distribution pre-test was performed satisfactorily as described above.

The test was then carried at different core velocities varying from 0.5 to 3.5m/s. The grade of sand used ranged from 76 – 700 micron.

Table 1 below shows the weight of sand and discharge duration for different core velocities.

Table 1 Weight of Sand and Discharge Duration at Different Core Velocities

Quantity	Tolerance	Unit	Values				
Core air velocity	±5%	m/s	0.5	1.3	2	2.8	3.5
Weight of sand	±5%	kg	1	1	2	2	2
Discharge duration	±25%	seconds	200	75	100	70	60

With both the fans operating, the quantity of sand by weight relative to the air velocity as described in Table 1 was injected into the test duct. After the measured weight of sand has been injected into the duct, the fans continued to run for further five minutes.

The rejected sand was collected and weighed.

5.5 Controlled Dismantle

AFE witnessed the dismantling of the test sample and compared the as-built (and therefore as-tested) installation against the drawings supplied. See Section 7 for details.

6. Test Results

The following table summarises the classification of the louvres based on the performance test results

6.1 Entry Loss Coefficients

6.1.1 Test pass/fail criteria

The louvre shall be classified as follows.

Classification	Entry loss coefficient
1	0.4 – 1.0
2	0.3 - 0.399
3	0.2 - 0.299
4	0.199 and below

6.1.2 Louvre (C2257) test results

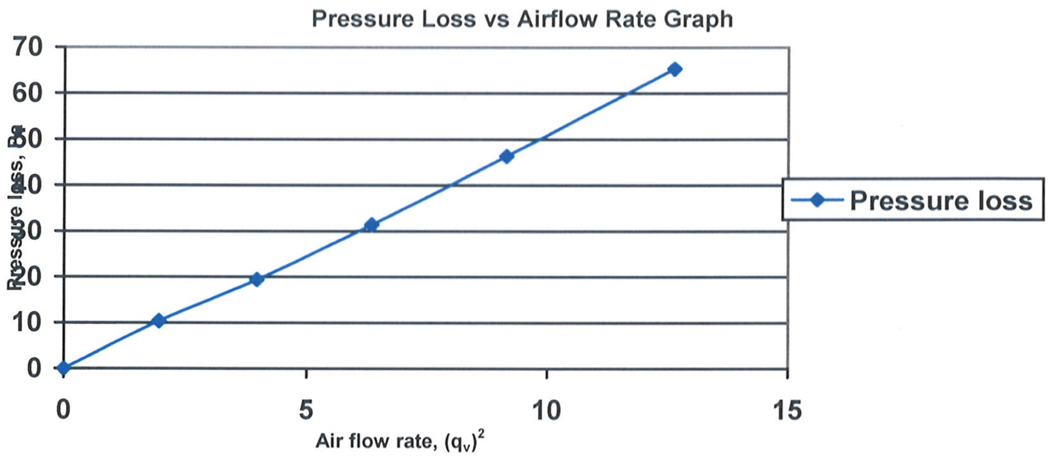
Date: 10 Sep. '15 Time: 12.00pm

Table 2 Air Flow Test Results

Pressure	Air flow		C_E	
Louvre Pressure Loss (Pa)	Flow rate (qv) m^3/sec	Flow rate squared (qv^2) $(m^3/sec)^2$	Value	Variance from mean
10.3	1.403	1.968	0.354	1.9
19.3	1.995	3.980	0.368	-2.0
31.3	2.518	6.340	0.365	-1.1
46.3	3.024	9.144	0.360	0.1
65.3	3.555	12.638	0.356	1.1
			Mean C_E = 0.360	

The classification value of **2** is based on an entry loss coefficient value of **0.360**.

Figure 3 Pressure Loss as a Function of Air Flow Rate



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6.2 Sand Rejection

6.2.1 Test pass/fail criteria

The sand trap louvre shall be rated at each air flow by rejection effectiveness, defined as

$$\text{Effectiveness (\%)} = \frac{\text{Total weight of sand rejected} \times 100}{\text{Total weight of sand injected}}$$

6.2.2 Louvre (C2257) test results

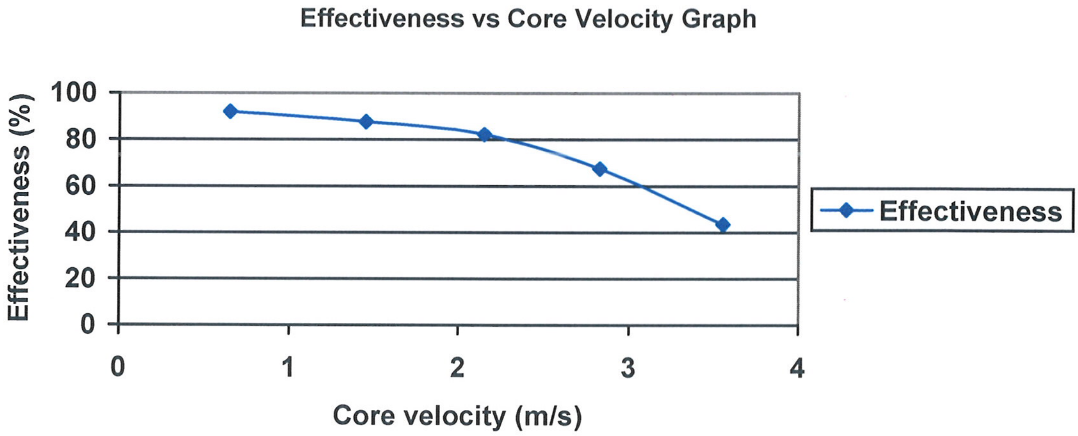
Date: 15 Apr. '15 Time: 12.00pm

Table 3 Louvre Test Results – Sand Penetration

Test No	Air flow rate, q_v (m^3/s)	Total mass injected, (kg)	Total mass rejected, (kg)	Core velocity, (m/s)	Louvre effectiveness (%)
1	0.592	1.00	0.918	0.64	91.9
2	1.323	1.00	0.875	1.45	87.6
3	1.962	2.00	1.642	2.15	82.1
4	2.578	2.00	1.348	2.82	67.4
5	3.240	2.00	1.085	3.55	43.4

Figure 4 is a graph showing effectiveness of the louvre with simulated wind affect.

Figure 4 Effectiveness of Louvre with Simulated Wind Effect



7. Controlled Dismantle

7.1 Variations Observed

(Refer to the drawing in Appendix B - variation numbers are labelled thereon.)

There were no variations from the drawing provided.

Appendix A

Photographs

The photographs are presented in numerical order.

DLP C2257/2516 Sample under test

DLP C2257/2516 Sample under test

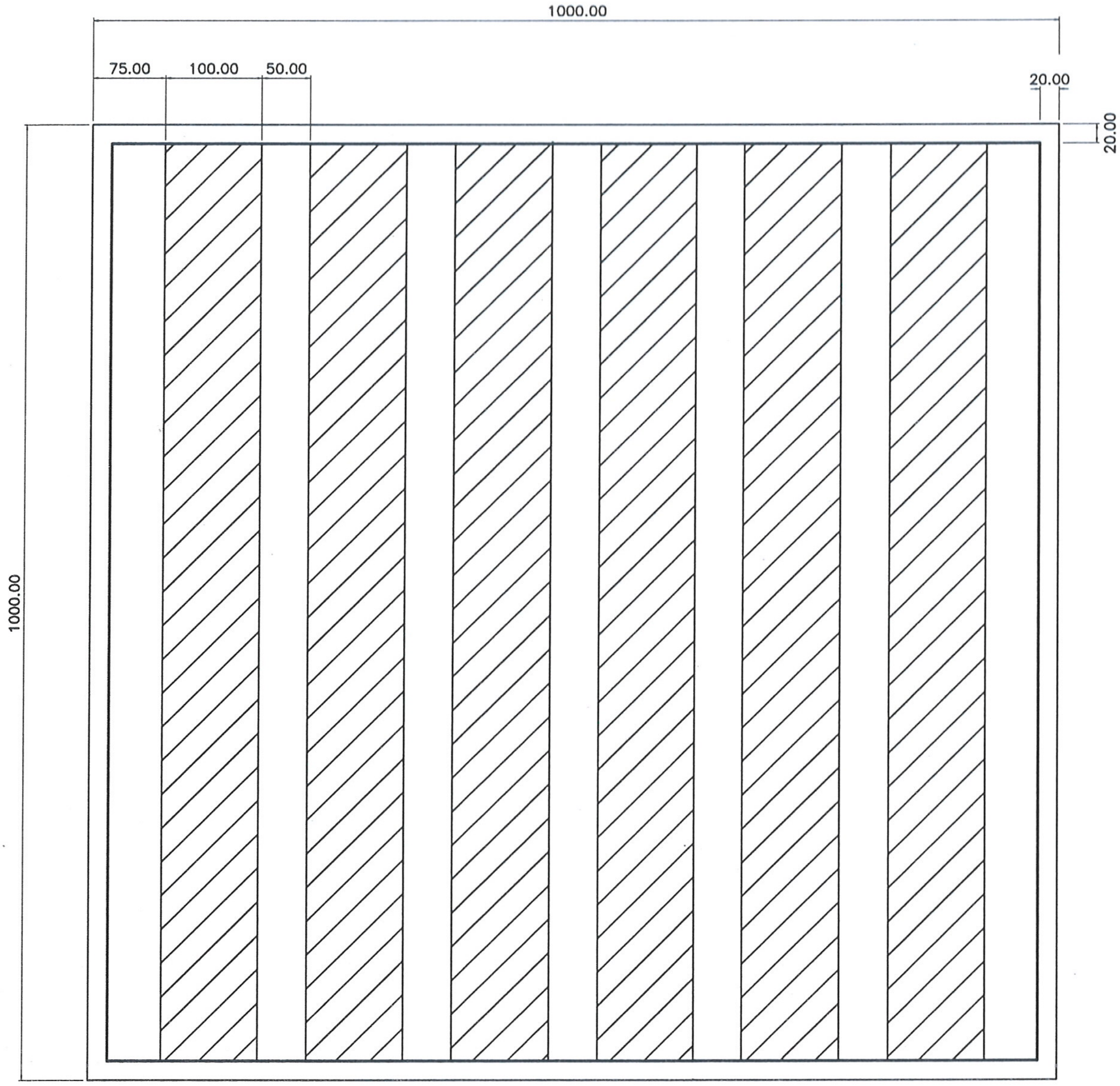
Appendix B

Drawings

The following un-paginated sheet is a copy of Faisal Jassim Industries drawing numbered:

- DWG - 01

FRONT



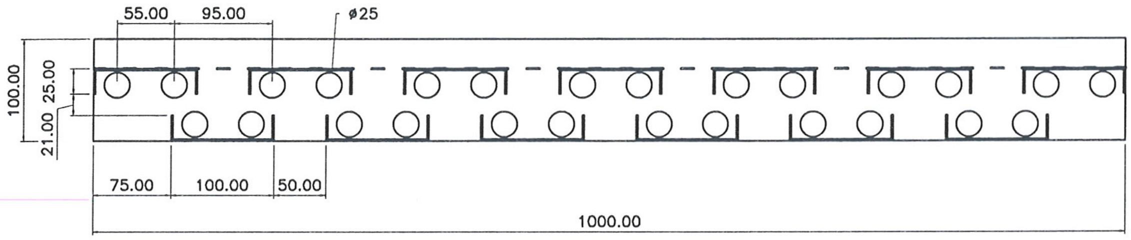


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Table 4 Document Status

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