Concrete Investigation for CCLLP of Swimming Pool

Report No. 7116

Prepared by: Infrastruct Asset Management Services Limited

Prepared for: Chamberlain Consulting LLP

Site Survey Date: 21st-23rd August 2018

INFRASTRUCT
Asset Management Services Limited

Document Control

Document: Report on the findings of concrete investigations carried out at St. Georges Leisure Centre, Tower Hamlets.

Client: Chamberlain Consulting LLP

Job No. 7116

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Document Checking

Primary Author Markus Denton-Masih
Infrastruct AMS Ltd

Approved by Markus Denton-Masih
Infrastruct AMS Ltd

Issue	Date	Status
1	2nd October 2018	Rev 0

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Contents

1.0 Introduction

1.1 Infrastruct Asset Management Services was instructed by Chamberlain Consulting LLP to carry out concrete investigations to the structure of St. Georges Swimming Pool.

1.2 The test engineers who completed the work on the site visit were:

1. Markus Denton-Masih — Senior Test Engineer
2. Martin Rodney — Test Technician

The findings of the testing works are detailed in Sections 2.0 & 3.0 of this report.

1.3 The following tests described in Table 1 below were carried out.

Table 1 Tests carried out at St. Georges Swimming Pool

	Test Type	Equipment Used	Relevant Standard / Guidance
1			
2			
3	Breakouts	Electrically powered hammer drill	In house guidance.
4	Dust Sampling for Chloride Content	Cordless Hammer Drill	BRE Digest 444

1.4 Test locations were identified as shown below. St. Georges Leisure centre is on 4 levels, with the pool at ground level and the entrance and reception on the lower ground level. The drawings differ in the identification of the floor level. We will refer to the pool level as the ground floor. Locations marked with blue are test locations where further lab result data is provided. Locations marked with red are test locations undertaken in the soffit. Locations marked in purple are visual observations, where a 'V' and number designation indicates further notes are provided.

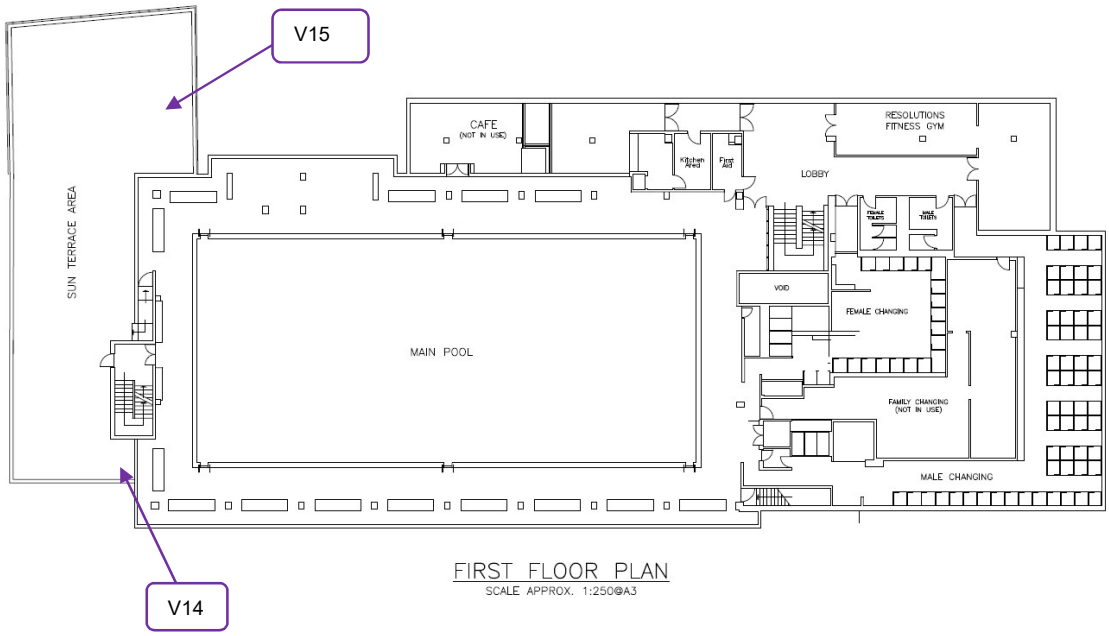


Fig.1 Ground floor plan at pool level.

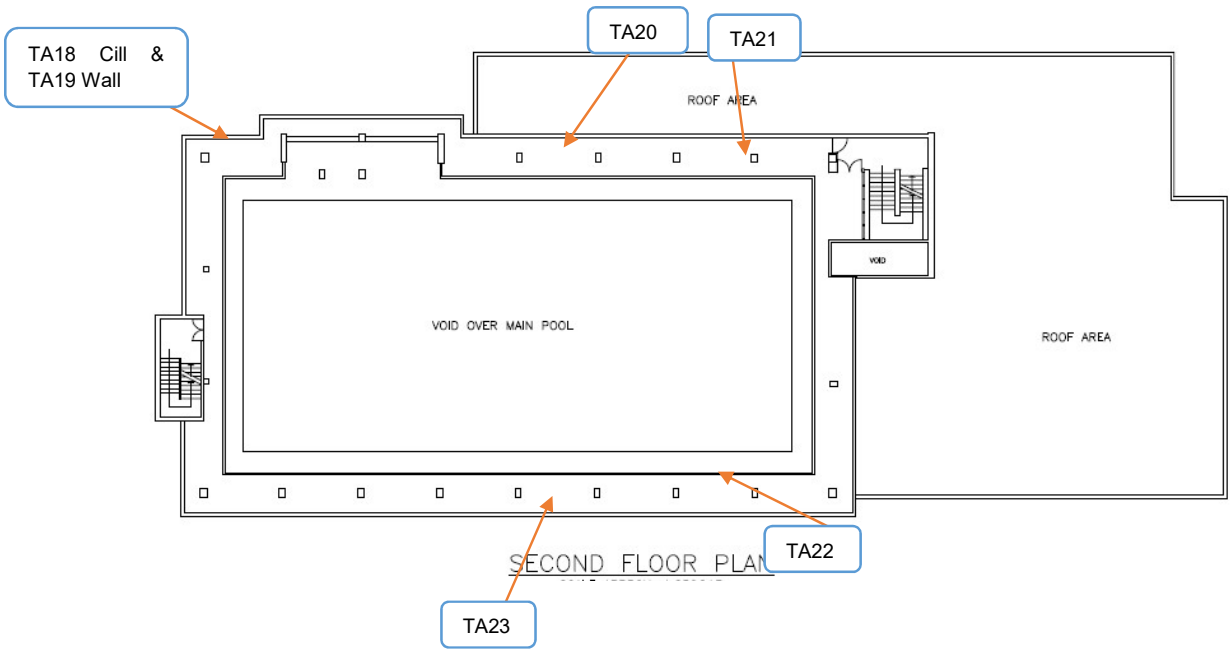


Fig.2 1st Floor plan and test locations

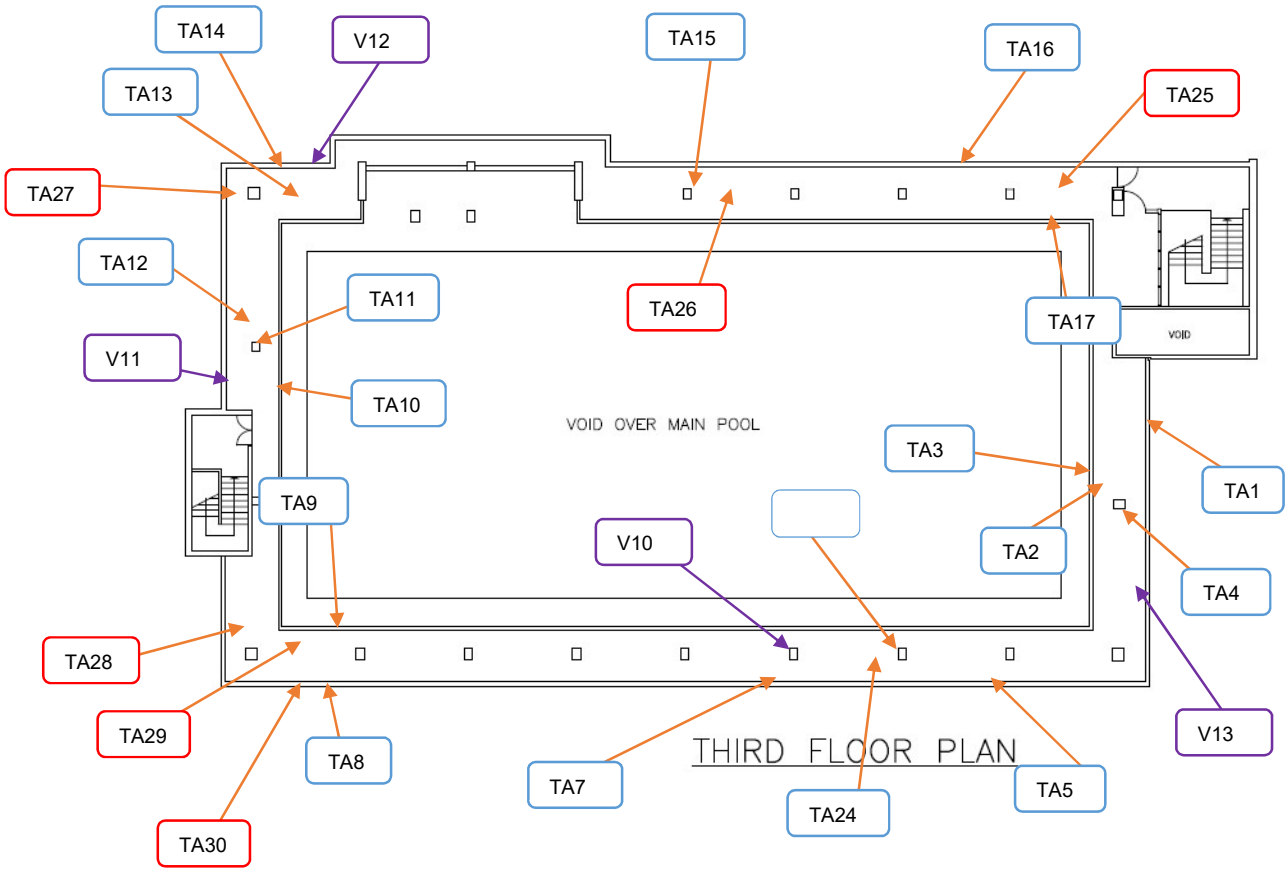


Fig.3 2nd Floor test locations

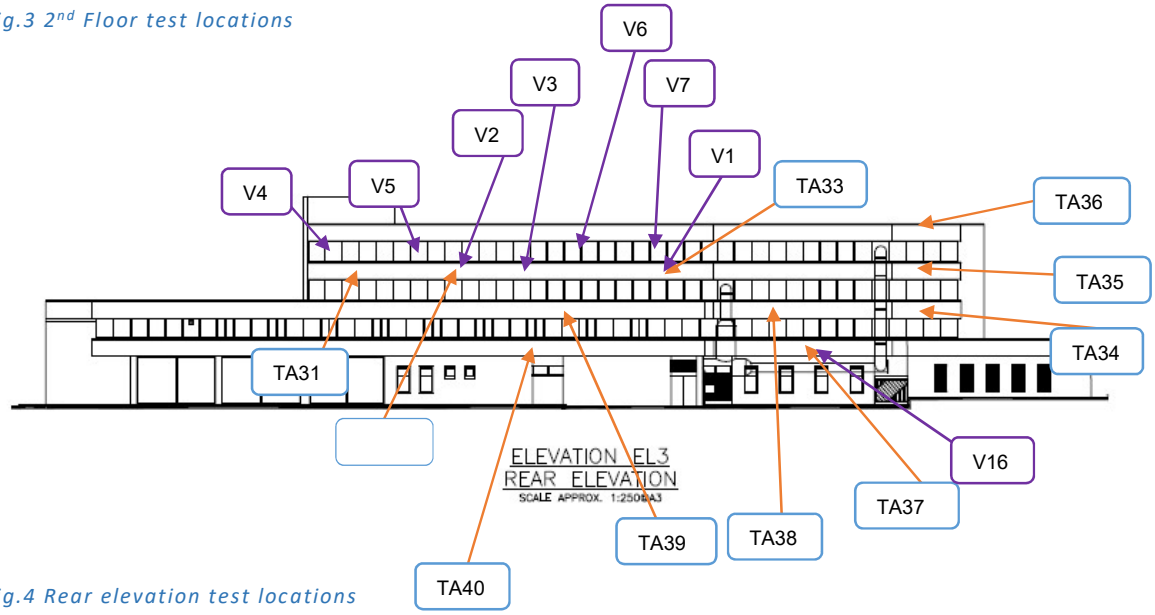


Fig.4 Rear elevation test locations

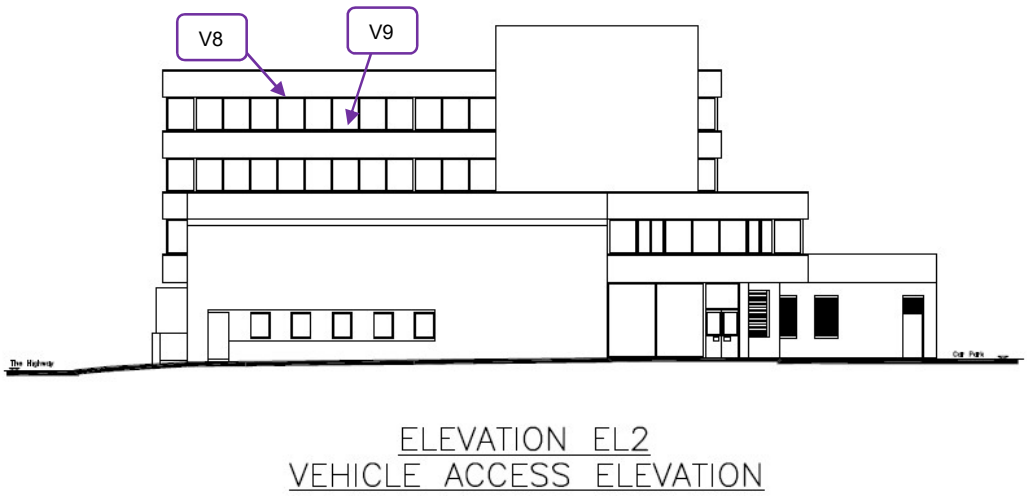


Fig.5 East Elevation – Vehicle access

2.0 Findings of the Inspection

The findings of the inspection and testing completed on 23rd August 2018 are provided in the sub-sections below and show the following information:

- A photo of the test location where applicable
- Compressive strength results for all cores
- Chloride and carbonation results where applicable.

2.1 Summary of cover and carbonation results internally

A summary of the cover and carbonation depth results is shown in table 2 below for all internal test locations. Cover is given in millimetres and bar size is shown in parentheses. The carbonation depths vary but the deepest penetration of carbonation is found at TA22. Lowest cover is noted at TA25.

Table 2

Ref.	Location	Element	Carb depth (mm)	Cover horiz.	Cover vert.
TA1	2nd Floor Gallery	Ext. Wall	30		
TA2	2nd Floor Gallery	Flr	14	Mesh?	57
TA3	2nd Floor Gallery	Parapet Wall	12	37(20)	31(12)
TA4	2nd Floor Gallery	Column	3	63	59(28)
TA5	2nd Floor Gallery	Ext. Wall	7		
TA6	2nd Floor Gallery	Column	4	61	69
TA7	2nd Floor Gallery	Ext. Wall	4		
TA8	2nd Floor Gallery	Ext. Wall	0		
TA9	2nd Floor Gallery	Parapet Wall	2	31(20)	37(32)
TA10	2nd Floor Gallery	Parapet Wall	28	51(20)	56(40)
TA11	2nd Floor Gallery	Column	14	74	58(40)
TA12	2nd Floor Gallery	Floor	18	68(32)	65(25)
TA13	2nd Floor Gallery	Floor	9	63	77

Table 2 Cont…

TA14	2nd Floor Gallery	Ext. Wall	2	62	45(12)
TA15	2nd Floor Gallery	Column	2	54(16)	52(32)
TA16	2nd Floor Gallery	Ext. Wall	8		
TA17	2nd Floor Gallery	Parapet Wall	34	31(14)	41(22)
TA18	1st Floor Gallery	Ext. Wall Cill	0		
TA19	1st Floor Gallery	Ext. Wall	7		
TA20	1st Floor Gallery	Floor	8	21	63
TA21	1st Floor Gallery	Column	0	50(14)	54(32)
TA22	1st Floor Gallery	Parapet Wall	>55	49(32)	54(40)
TA23	1st Floor Gallery	Floor	3	76	69
TA24	2nd Floor Gallery	Floor	12		
TA25	2nd Floor Gallery	Ceiling Upper soffit	3	3 (spalled)	
TA26	2nd Floor Gallery	Ceiling Upper soffit	16		
TA27	2nd Floor Gallery	ceiling Lower soffit	3		
TA28	2nd Floor Gallery	ceiling Lower soffit	0		
TA29	2nd Floor Gallery	Internal wall roof	2	34	41
TA30	2nd Floor Gallery	External wall roof	2	12	

2.2 Summary of chemical results internally

Table 3 below summarises the chloride and sulphate results taken internally. The highest chlorides values are found at TA2 and TA23 (in red), however, according to DG444 these points fall into a risk category of negligible to low potential of corrosion. The sulphate results also point to a low potential risk of sulphate attack, though no real guidelines are given on bulk results.

Table 3

			% Chloride by Mass of Cement		% Sulphate by mass of Cement	
Ref.	Location	Element	5-30mm	30-55mm	5-30mm	30-55mm
TA1	2nd Floor Gallery	Ext. Wall			0.29	0.29
TA2	2nd Floor Gallery	Flr	0.27	0.18		
TA3	2nd Floor Gallery	Parapet Wall	0.11	0.11		
TA4	2nd Floor Gallery	Column	0.11	0.07		
TA5	2nd Floor Gallery	Ext. Wall	0.09	0.05		
TA6	2nd Floor Gallery	Column			0.55	0.27
TA7	2nd Floor Gallery	Ext. Wall	0.05	0.05		
TA8	2nd Floor Gallery	Ext. Wall	0.12	0.06		
TA9	2nd Floor Gallery	Parapet Wall	0.07	0.02		
TA10	2nd Floor Gallery	Parapet Wall	0.09	<0.02		
TA11	2nd Floor Gallery	Column	0.11	0.09		
TA12	2nd Floor Gallery	Floor			0.50	0.53
TA13	2nd Floor Gallery	Floor	0.15	0.18		
TA14	2nd Floor Gallery	Ext. Wall	0.09	0.08		
TA15	2nd Floor Gallery	Column			0.50	0.52
TA16	2nd Floor Gallery	Ext. Wall	0.05	0.05		

Table 3 Cont….

TA17	2nd Floor Gallery	Parapet Wall			0.42	0.36
TA18	1st Floor Gallery	Ext. Wall Cill	0.05	0.05		
TA19	1st Floor Gallery	Ext. Wall			0.43	0.25
TA20	1st Floor Gallery	Floor			0.34	0.54
TA21	1st Floor Gallery	Column	0.11	0.12		
TA22	1st Floor Gallery	Parapet Wall	0.23	0.05		
TA23	1st Floor Gallery	Floor	0.27	0.17		
TA24	2nd Floor Gallery	Floor	0.22	0.23		
TA25	2nd Floor Gallery	Ceiling Upper soffit			0.17	0.19
TA26	2nd Floor Gallery	Ceiling Upper soffit	0.07	0.16		
TA27	2nd Floor Gallery	ceiling Lower soffit			0.37	0.36
TA28	2nd Floor Gallery	ceiling Lower soffit	0.09	0.02		
TA29	2nd Floor Gallery	Internal wall roof	0.07	0.05		
TA30	2nd Floor Gallery	External wall roof			0.46	0.45

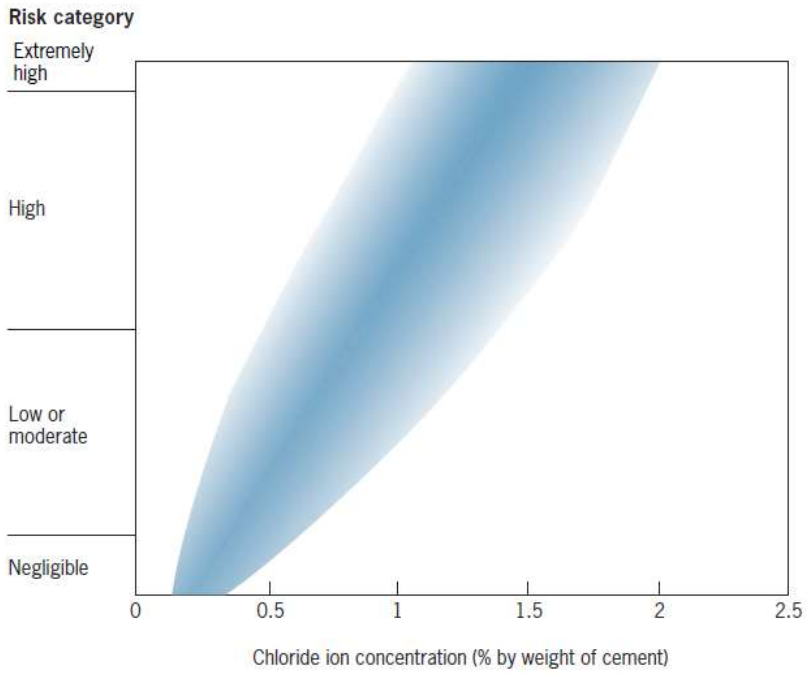


Fig.6 Risk classification chart for chlorides from DG444 Part 2

2.3 Summary of external results

Table 4 below shows us all a summary of all the external results. Location references tie into fig.4. Again, we see that there are no chloride results with a concerning risk of corrosion, when qualified against DG444. All test locations were from spandrel elements – where the concrete face was covered by mosaic tiles. Because of this we see no evidence of carbonation and very little chloride ingress.

Table 4

						% Chloride by Mass of Cement	
Ref.	Location	Element	Carb depth (mm)	Cover horiz.	Cover vert.	5-30mm	30-55mm
TA31	Above Window	Spandrel	0	54(18)		0.05	0.06
TA32	Above Window	Spandrel	0	59(28)		0.07	0.05
TA33	Above Window	Spandrel	0	46(40)		0.07	0.07
TA34	Above Window	Spandrel	0		63	0.05	<0.02
TA35	Above Window	Spandrel	0	63	52(28)	<0.02	<0.02
TA36	Above Window	Spandrel	0		61(32)	0.05	0.05
TA37	Below Window	Spandrel	0	48(36)	46(20)	0.07	0.07
TA38	Below Window	Spandrel	0	61(25)	53(25)	0.05	0.02
TA39	Above Window	Spandrel	0		48(14)	0.05	0.05
TA40	Above Window	Spandrel	0		60(40)	0.05	0.05

2.4 Visual observations

Whilst investigating the structural condition of the building, several locations were noted to have deteriorated in some way. These locations are marked on the drawings in fig.1 to fig.5 with purple indicators. Each point has an explanatory note and some also include a photo. These are laid out below.

2.4.1 V1

Salt deposits from run-off by TA33

2.4.2 V2

Salt deposits from run-off by TA32

2.4.3 V3

Salt deposits from run-off

2.4.4 V4

Seals around window deteriorating and sill waterproofing failed

2.4.5 V5

Seals around window deteriorating and evidence of pooling water on sill over breaks in waterproofing

2.4.6 V6

Seals around window deteriorating

2.4.7 V7

Seals around window deteriorating

2.4.8 V8

Delaminating tiles along soffit of window

2.4.9 V9

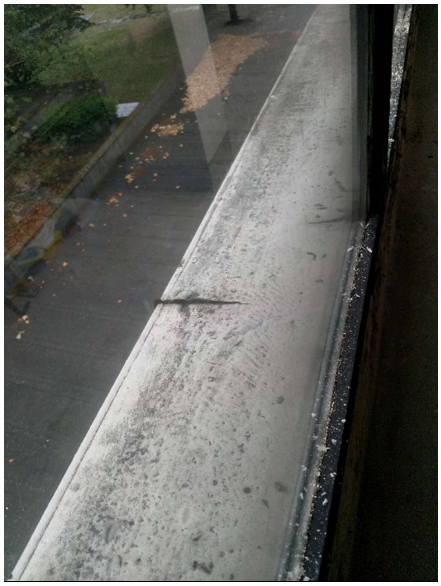
Same as rear elevation – evidence of water run-off and water pooling on sill with failed sill waterproofing

2.4.10 V10

Breakout from previous investigating has not been made good and the steel has been exposed to moisture – note the dried salts on the column. 55mm cover to links which are dual 10mm bars. 80mm cover to main vertical steel, which is 25mm in dia.

Concrete spalling in ceiling slab above column. Corrosion of low-cover steel most likely cause

2.4.11 V11



Waterproofing has failed on sill

2.4.12 V12

Waterproofing has failed on sill. Double glazing unit has blown – condensation in between panes.

2.4.13 V13

Concrete ceiling slab spalling at edge due to low cover to steel.

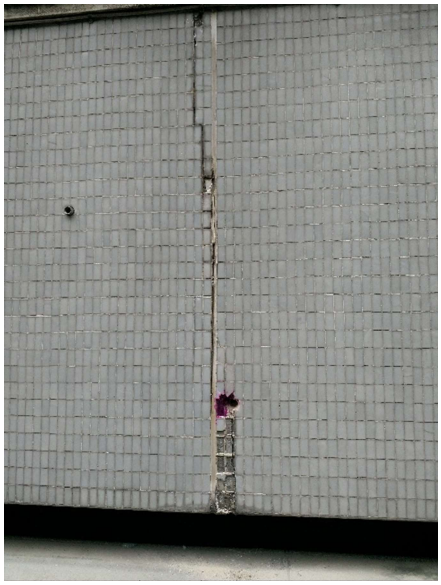
2.4.14 V14

Roof drain is blocked in corner of roof

2.4.15 V15

Roof gulley needs cleaning to remove debris in drains

2.4.16 V16



Tiles spalling and cracking by joint in spandrel

3.0 Summary

In summary the chemical results do not highlight any areas of the structure that are at a heightened risk or corrosion or sulphate attack. There were a couple of locations noted where tiles had spalled a little, or the grout had cracked. The most severe locations where this had occurred appeared to have been at V16, noted previously and at the front elevation of the building, shown in Photo 1 below. Here we can see that the tiles in the window soffit have spalled away and fallen onto the public footpath below. The tiles spalling at V16 are a lower risk as this section is over a fenced off staff car parking area.

Photo 1 – front elevation

It was noted that there were several locations where the concrete ceiling slab at level 2 exhibited spalling due to low cover to the steel reinforcing. Additionally, it was evident that water ingress at windows on level 2 has been an issue.

Appendix A Chemical results

Kiwa CMT Testing

Client:
Infrastruct Asset Management Services Limited
Bedford I Kan
38 Mill Street
Bedford
MK40 3HD

Report Number: 75068/58304

Site: St George Leisure Centre

Date: 5th September 2018

Trust
Quality
Progress

UKAS
TESTING
0529

Kiwa CMT Testing

Client:

Infrastruct Asset Management Services Limited
Bedford I Kan
38 Mill Street
Bedford
MK40 3HD

Date:	05/09/2018	**Originator:**	Markus Denton-Masih
Order Ref:	Sample Schedule	**Our Ref:**	58304/CH
Site:	St George Leisure Centre		

Document Control

Document Prepared By: **Brandon Fairweather** **Chemistry Administrator**		
Document Authorised By: **Mike Barham** **Departmental Manager**		
Issue Number and Date	**Issue 1**	**05/09/2018**

1. Samples

1.1. The samples were delivered by the client to Kiwa CMT Testing on 28/08/2018

Sample References	Sample Description
TA1 – TA40	80No. samples of concrete dust, 2No increments per location, each sample weighing approximately 2 – 20g.

2. Analysis:

2.1. The sample(s) were submitted for the following analysis

Sample References	Testing Requirements
All samples	See sample schedule

2.2. The below are the testing methods use in the analysis

Testing	Testing Method	UKAS
Chloride ion content	BS 1881 : Part 124 : 2015	Yes
Cement content	BS 1881 : Part 124 : 2015	Yes
Total sulphate content	BS 1881 : Part 124 : 2015	Yes

2.3.

Comments:
The test method used for the lime (CaO) determinations deviates from **BS 1881 : Part 124 : 2015** only in terms of the indicator used.

3. Results:

3.1. Detailed chemical results for the analysis can be found in Appendix 1, of this report

Kiwa CMT Testing

Sample Schedule

Site: St Georges Leisure Centre

	Dust Depths	
Ref	5-30	30-55
1	S	S
2	C	C
3	C	C
4	C	C
5	C	C
6	S	S
7	C	C
8	C	C
9	C	C
10	C	C
11	C	C
12	S	S
13	C	C
14	C	C
15	S	S
16	C	C
17	S	S
18	C	C
19	S	S
20	S	S
21	C	C
22	C	C
23	C	C
24	C	C
25	S	S
26	C	C
27	S	S
28	C	C
29	C	C
30	S	S
31	C	C
32	C	C
33	C	C
34	C	C
35	C + CC	C
36	C	C
37	C	C
38	C	C
39	C	C
40	C	C

C = Chlorides
S = Sulphates
CC = Cement Content

Appendix 1:

Certificates of Chemical Analysis

Kiwa CMT Testing

DETAILED ANALYTICAL RESULTS - CHLORIDES

Client	Infrastruct Asset Management	**Job No.**	58304
Contact	Markus denton-Masih	**Site**	St George Leisure Centre
Order Ref	Sample Schedule	**Date Received**	28/08/2018
Date Analysed	03/08/2018	**Date Reported**	05/09/2018
Test Methods	BS 1881 : Part 124 : 2015	**Sample Description**	Concrete Dust

Sample Reference		%Chloride by mass of sample	%Chloride by mass of cement	Determined % Cement Content
TA2	5-30	0.085	0.27	30.9
	30-55	0.057	0.18	30.9
TA3	5-30	0.035	0.11	30.9
	30-55	0.035	0.11	30.9
TA4	5-30	0.035	0.11	30.9
	30-55	0.021	0.07	30.9
TA5	5-30	0.028	0.09	30.9
	30-55	0.014	0.05	30.9
TA7	5-30	0.016	0.05	30.9
	30-55	0.016	0.05	30.9
TA8	5-30	0.037	0.12	30.9
	30-55	0.019	0.06	30.9
TA9	5-30	0.021	0.07	30.9
	30-55	0.008	0.02	30.9
TA10	5-30	0.028	0.09	30.9
	30-55	<0.003	<0.02	30.9
TA11	5-30	0.035	0.11	31.9
	30-55	0.030	0.09	32.9
TA13	5-30	0.046	0.15	30.9
	30-55	0.055	0.18	30.9
TA14	5-30	0.028	0.09	30.9
	30-55	0.025	0.08	30.9
TA16	5-30	0.016	0.05	30.9
	30-55	0.016	0.05	30.9
TA18	5-30	0.015	0.05	30.9
	30-55	0.015	0.05	30.9
TA21	5-30	0.036	0.11	30.9
	30-55	0.038	0.12	30.9
TA22	5-30	0.071	0.23	30.9
	30-55	0.014	0.05	30.9
TA23	5-30	0.084	0.27	30.9
	30-55	0.054	0.17	30.9
TA24	5-30	0.067	0.22	30.9
	30-55	0.072	0.23	30.9
TA26	5-30	0.021	0.07	30.9
	30-55	0.050	0.16	30.9
TA28	5-30	0.028	0.09	30.9
	30-55	0.008	0.02	30.9

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DETAILED ANALYTICAL RESULTS - CHLORIDES

Client	Infrastruct Asset Management	**Job No.**	58304
Contact	Markus denton-Masih	**Site**	St George Leisure Centre
Order Ref	Sample Schedule	**Date Received**	28/08/2018
Date Analysed	03/08/2018	**Date Reported**	05/09/2018
Test Methods	BS 1881 : Part 124 : 2015	**Sample Description**	Concrete Dust

Sample Reference		%Chloride by mass of sample	%Chloride by mass of cement	Determined % Cement Content
TA29	5-30	0.021	0.07	30.9
	30-55	0.014	0.05	30.9
TA31	5-30	0.014	0.05	30.9
	30-55	0.019	0.06	30.9
TA32	5-30	0.021	0.07	30.9
	30-55	0.014	0.05	30.9
TA33	5-30	0.021	0.07	30.9
	30-55	0.021	0.07	30.9
TA34	5-30	0.014	0.05	30.9
	30-55	<0.003	<0.02	30.9
TA35	5-30	<0.003	<0.02	30.9
	30-55	<0.003	<0.02	30.9
TA36	5-30	0.014	0.05	30.9
	30-55	0.014	0.05	30.9
TA37	5-30	0.021	0.07	30.9
	30-55	0.021	0.07	30.9
TA38	5-30	0.014	0.05	30.9
	30-55	0.007	0.02	30.9
TA39	5-30	0.014	0.05	30.9
	30-55	0.014	0.05	30.9
TA40	5-30	0.014	0.05	30.9
	30-55	0.014	0.05	30.9

Comments

1No. cement content was determined and has been used in the calculations above.

Signed : B Fairweather
Environmental Technician

Approved : M. Barham
Chief Chemist

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DETAILED ANALYTICAL RESULTS - CONCRETE

Cement Content in accordance with BS 1881 : Part 124 : 2015

Client	Infrastruct Asset Management Services Ltd	**Job No.**	58304
Contact	Makus Denton-Masih	**Site**	St George Leisure Centre
Order Ref	Sample Schedule	**Date Received**	28/08/2018
Sample Description	Concrete Dust	**Date Analysed**	04 - 05/09/2018
Test Methods	BS 1881 : Part 124 : 2015	**Date Reported**	05/09/2018

Analyte:	**Units:**	**35 (5-30)**
Lime CaO	%	19.96
Silica SiO_2	%	7.94
Insoluble Residue	%	54.88
Loss on Ignition	%	12.33
Cement Content (Based on)	%	30.9 Lime
	Kg/m^3 (+/- 25 Kg/m^3)	705

Assumptions made in calculating the above figures:

1) The cement is a basic Portland containing 64.5% CaO and 20.2% soluble silica.
2) There was no significant contribution to the lime or silica from the aggregate.
3) The oven dry density of the concrete is 2280 Kg/m_3.

Signed : B Fairweather
Environmental Technician

Approved : M. Barham
Chief Chemist

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DETAILED ANALYTICAL RESULTS - SULPHATES

Client	Infrastruct Assest Management Services	**Job No.**	58304
Contact	Markus Denton - Masih	**Site**	St George Leisure Centre
Order Ref	Sample Schedule	**Date Received**	28/08/2018
Date Analysed	03 - 04/09/2018	**Date Reported**	05/09/2018
Sample Description	Concrete Dust		

Analyte:		**As:**	**TP1 5-30**	**TP1 30-55**	**TP6 5-30**	**TP6 30-55**
% Total (acid soluble) sulphate by mass of sample	%	SO_3	0.29	0.29	0.55	0.27

Analyte:		**As:**	**TP12 5-30**	**TP12 30-55**	**TP15 5-30**	**TP15 30-55**
% Total (acid soluble) sulphate by mass of sample	%	SO_3	0.50	0.53	0.5	0.52

Analyte:		**As:**	**TP17 5-30**	**TP17 30-55**	**TP19 5-30**	**TP19 30-55**
% Total (acid soluble) sulphate by mass of sample	%	SO_3	0.42	0.36	0.43	0.25

Comments:

Concrete Society Technical Report 32 (2nd Ed. Sept 2014) indicates the maximum level of sulphate (as SO_3) derived from concrete, is likely to be of the order of 4% BY MASS OF CEMENT although this could be higher.

The result quoted above should be multiplied by a factor of 1.2 in order to be expressed as SO_4

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation

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Kiwa CMT Testing

DETAILED ANALYTICAL RESULTS - SULPHATES

Client	Infrastruct Assest Management Services	**Job No.**	58304
Contact	Markus Denton - Masih	**Site**	St George Leisure Centre
Order Ref	Sample Schedule	**Date Received**	28/08/2018
Date Analysed	03 - 04/09/2018	**Date Reported**	05/09/2018
Sample Description	Concrete Dust		

Analyte:		**As:**	**TP20 5-30**	**TP20 30-55**	**TP25 5-30**	**TP25 30-55**
% Total (acid soluble) sulphate by mass of sample	%	SO_3	0.34	0.54	0.17	0.19

Analyte:		**As:**	**TP27 5-30**	**TP27 30-55**	**TP30 5-30**	**TP30 30-55**
% Total (acid soluble) sulphate by mass of sample	%	SO_3	0.37	0.36	0.46	0.45

Comments:

Concrete Society Technical Report 32 (2nd Ed. Sept 2014) indicates the maximum level of sulphate (as SO_3) derived from concrete, is likely to be of the order of 4% BY MASS OF CEMENT although this could be higher.

The result quoted above should be multiplied by a factor of 1.2 in order to be expressed as SO_4

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation

Signed : B Fairweather
Environmental Technician

Approved : M. Barham
Chief Chemist

Further interpretation or advice is a chargeable service and may be obtained by contacting the above signatory.

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