KRONOSPAN Ltd.

CHIPBOARD DECOUPLING

REPORT ON GROUND INVESTIGATION

Contract: 41585v1

Date: January 2015

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REPORT ON GROUND INVESTIGATION

carried out at

CHIPBOARD DECOUPLING

Prepared for

KRONOSPAN LTD.
Chirk
Wrexham
LL14 5NT

Contract No: 41585v1

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EXECUTIVE SUMMARY

On the instructions of Kronospan Limited an investigation was carried out to determine design information for the installation of additional facilities at the existing chipboard decoupling plant.

The site is within the Kronospan manufacturing facility.

Site works comprised one cable percussion borehole and four concrete cores.

Allowable bearing capacities for a range of square foundation widths at about 3.00m in firm clay have been estimated as follows:

- 1.00m by 1.00m; 130kN/m^2
- 2.00m by 2.00m; 90kN/m^2

Strip foundations with widths in the range 0.50 to 1.00m at a depth of 3.00m may be designed to an allowable bearing capacity of 100kN/m^2.

The laboratory test results it is considered that a Design Sulphate Class may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

Waste Acceptance Criteria (WAC) testing has been undertaken on one sample of soil from between depths of 0.50 and 1.20m. The analytical results were below the relevant guideline values for inert waste. Final waste classification should be determined by the receiving landfill operator.

CONTENTS

1.0 INTRODUCTION

1.1 It is understood that the proposed development comprises an excavation about 3m deep to house the foundation base for a new chipboard decoupling lift table.

1.2 On the instructions of Kronospan a ground investigation was undertaken to determine ground conditions and geotechnical parameters for the design of the works.

1.3 It is recommended that a copy of this report be submitted to the relevant authorities to enable them to carry out their own site assessments and provide any comments.

1.4 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

1.5 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.

1.6 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated within the existing Kronospan production facility and may be approximately located by National Grid Reference SJ 287 382.

2.1.2 A site location plan is included in Appendix 1, Figure A1.1.

2.2 Geological Setting

2.2.1 Information on the published geology, provided on the British Geological Survey web based mapping (contains British Geological Survey materials © NERC 2015) indicates that drift deposits beneath the site comprise Glaciofluvial sand and Gravel.

2.2.2 The superficial deposits are underlain by the Pennine Lower Coal Measures Formation of Carboniferous age.

2.2.3 The site is within an existing commercial area and, although not indicated as present on the site from the geological maps, the possibility that Made Ground exists on site cannot be discounted.

3.0 SITE WORK

3.1 The site work was carried out on 28th October 2014. The locations of the exploratory hole was determined by the Client based on the proposed development layout., The site work was carried out on the basis of the practices set out in BS 10175:2011, ref. 7.2, BS 5930:2010 ref. 7.3 and ISO 1997:2007, ref 7.4.

3.2 Site work comprised one cable percussion borehole referenced BH01.

3.3 The position of the borehole is shown on Figure A1.2 in Appendix 1.

3.4 The depths of the borehole, descriptions of strata encountered and comments on groundwater conditions are given in the borehole records in Appendix 2.

3.5 Representative disturbed samples were taken at the depths shown on the borehole records and dispatched to the laboratory. Standard penetration tests, ref. 7.9, were carried out in the boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.

3.6 Samples were collected for environmental purposes in amber glass jars and kept in a cool box.

3.7 Concrete cores were obtained through the concrete floor slab at four locations in the vicinity of the chipboard finishing line.

3.8 The ground levels at the borehole location was not determined.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

4.1.1 All soil samples were prepared in accordance with BS1377: Part One: 1990 ref. 7.9 and representative sub-samples were taken for testing. The following tests were carried out:

- 2 No. Moisture contents
- 2 No. Plasticity indices
- 4 No. Particle size distribution by wet sieving
- 2 No. pH value and soluble sulphate content
- 4 No. Compressive strength of concrete cores

4.1.2 The results of the testing are given in Appendix 3, Test Reports 41585-1 and 14-23626.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Materials

5.1.1 Concrete was encountered from ground level to 0.25m.

5.1.2 Beneath surface concrete made ground, comprising very gravelly sand, was encountered to a depth of 1.50m. This material may represent made ground.

5.1.3 Natural drift strata were encountered at a depth of 1.50m comprising a variable sequence of clay and very sandy gravel to 4.80m.

5.1.4 Clay was encountered between 2.50 and 4.00m. Laboratory testing classified the material as intermediate plasticity with a plastic limit of 24% and a plastic index of 15. A natural moisture content of 27% was also measured.

5.1.5 Silt was encountered from 4.80m to 13.50m. Laboratory testing classified the material as low plasticity silt with a plastic limit of 24% and a plastic index of 8. A natural moisture content of 27% was also measured.

5.1.6 Sand was encountered at the base of the silt. BH01 was terminated within sand at a depth of 15.00m.

5.1.7 SPT 'N' values are plotted against depth in Figure A1.3.

5.1.8 One SPT 'N' value at 1.20m recorded 50 blows for 235mm penetration. This may either represent very dense material or an obstruction.

5.1.9 One SPT 'N' value at 2.00m in gravel recorded value of 16 indicating medium dense material.

5.1.10 One SPT 'N' value at 3.00m in clay recorded value of 8. This value is generally consistent with the logging description of firm.

5.1.11 Five SPT 'N' values in silt, between depths of 5.10m and 13.40m, recorded values in the range 8 to 13 indicating loose and medium dense material.

5.1.12 One SPT 'N' value at 14.50m in sand recorded value of 23 indicating medium dense material.

5.2 Concrete Cores

5.2.1 Concrete cores were obtained from four locations.

5.2.2 Cores were crushed in the laboratory to determine compressive strength.

5.2.3 Cores varied in length from 115 to 210mm.

5.2.4 Compressive strengths in the range 29.6 to 39.8N/mm^2 were determined.

5.3 Groundwater

5.3.1 Groundwater was encountered at 2.00m during boring. Groundwater was sealed at about 4.80.

5.3.2 Small amounts of water were added to assist drilling between about 4.80 and 15.00m.

6.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

6.1 Proposed Development

6.1.1 It is understood that the proposed development comprises an excavation about 3m deep to house the foundation base for a new chipboard decoupling lift table.

6.2 Foundation Design

6.2.1 Strata about the base of the pit comprised firm clay.

6.2.2 Allowable bearing capacities for a range of square foundation widths at about 3.00m in firm clay have been estimated as follows:

- 1.00m by 1.00m; 130kN/m^2
- 2.00m by 2.00m; 90kN/m^2

6.2.3 Strip foundations with widths in the range 0.50 to 1.00m at a depth of 3.00m may be designed to an allowable bearing capacity of 100kN/m^2.

6.2.4 These values would provide a suitable factor of safety against shear failure. Total settlements would not be expected to exceed about 25mm.

6.3 Excavations

6.3.1 On the basis of observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to less than 1.00m should stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations which appear unstable, and those in excess of 1.20m deep, in accordance with Health and Safety Regulations.

6.3.2 Groundwater should be expected in excavations to depths below about 2.00m. Groundwater control measures and excavation support will therefore be required.

6.4 Chemical Attack on Buried Concrete

6.4.1 The site has been classified in accordance with BRE Special Digest 1, ref. 7.15, as brownfield without the presence of pyrite. It is recommended that the guidelines given in BRE Special Digest 1, ref. 7.15, be adopted.

6.4.2 The results of chemical tests indicate sulphate concentrations in the soil of 13 and 48mg/l as 2:1 water/soil extract, with pH values of 8.5 and 9.3.

6.4.3 It is recommended that for conventional shallow foundations the groundwater should be regarded as mobile.

6.4.4 On the basis of the laboratory test results it is considered that a Design Sulphate Class for this material may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

6.5 Waste Disposal

6.5.1 Waste Acceptance Criteria (WAC) testing has been undertaken on one sample of soil from between depths of 0.50 and 1.20m.

6.5.2 The analytical results were below the relevant guideline values for inert waste.

6.5.3 Final waste classification should be determined by the receiving landfill operator.

7.0 REFERENCES

7.1 CLR 4, 'Sampling strategies for contaminated land'. Report by The Centre for Research into the Built Environment, the Nottingham Trent University, DoE, 1994.

7.2 British Standards Institute: BS 10175 'Code of practice for the investigation of potentially contaminated sites', BSI 2011.

7.3 BS 5930:1999+A2:2010 '*Code of practice for site investigations*', British Standards Institute, 2010.

7.4 ISO 1997, Part 2:2007, 'Eurocode 7 – Geotechnical Design – Part 2, Ground Investigation and Design'

7.5 ISO 22476 – 3:2005, 'Geotechnical Investigation and Testing – Field Testing' Part 3, Standard Penetration Test.

7.6 ISO 22476 – 2:2005, 'Geotechnical Investigation and Testing – Field Testing' Part 2, Dynamic Probing.

7.7 ISO 22475-1:2006, 'Geotechnical Investigation and Testing – Sampling Methods and Groundwater Measurements' Part 1: Technical Principles for Execution.

7.8 ISO 14688 Part 1:2002 and Part 2:2004, 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

7.9 British Standard 1377:1990, Part 9, 'Methods of Test for Soils for Civil Engineering Purposes'.

7.10 Rodin S, Corbett B O, Sherwood D E and Thorburn S. 'Penetration Testing in the United Kingdom. State of the Art Report. European Symposium on Penetration Testing'. Stockholm, 1974.

7.11 Stroud, M.A. 'The Standard Penetration Test in Insensitive Clays and Soft Rocks', Proceedings of European Symposium on Penetration Testing, Stockholm, 1974.

7.12 Stroud, M.A. and Butler, F.G. 1975 'The Standard Penetration Test and Engineering Properties of Glacial Materials', Symposium of Engineering Behaviour of Glacial Materials, Birmingham University.

7.13 Thorburn, S. 'Tentative Correction Chart for the Standard Penetration Test in non-cohesive soils', Soil Engineering and Public Works Review, 58, 1963.

7.14 Design Guidance for Road Pavement Foundations, Interim Advice Note 173/06, February 2006

7.15 Building Research Establishment, Special Digest 1, 'Concrete in Aggressive Ground', 2005.

7.16 Berezantsev, V.G., "Load bearing capacity and deformation of piled foundations". Proceedings of the 5th International Conference on Soil Mechanics, Paris, **2**, 11-12, 1961

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APPENDIX 1

DRAWINGS

PROJECT: 41585 Chipboard Decoupling, Kronospan
FIGURE No. A1.1. **SCALE: nts**
TITLE: Site Location Plan
IAN FARMER ASSOCIATES Geotechnical & Environmental Specialists

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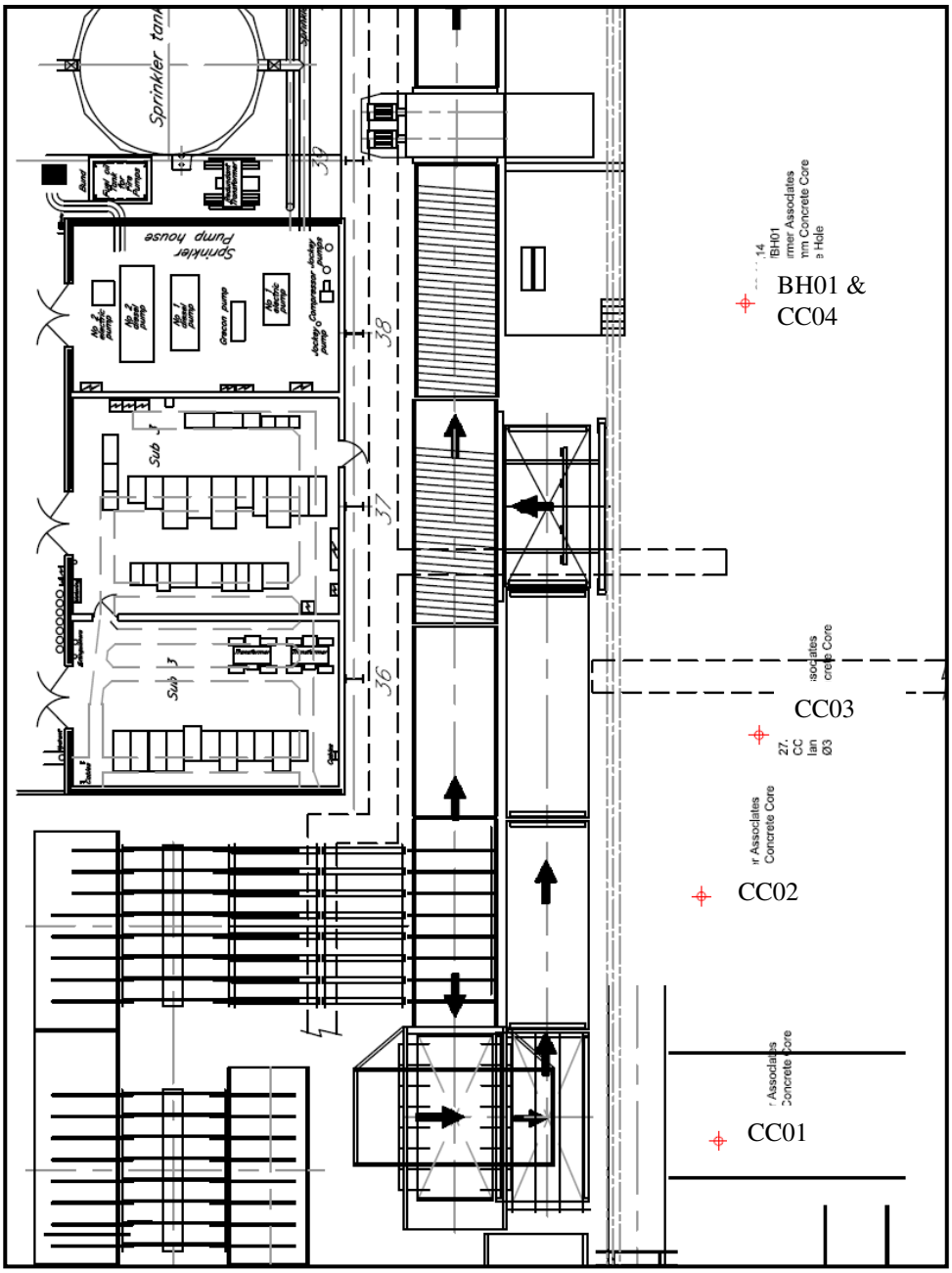

PROJECT: 41585 Chipboard Decoupling, Kronospan

FIGURE No. A1.2 **SCALE: nts**

TITLE: Exploratory Hole Location Plan

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in ISO 1997, 7.4 and BS 5930, ref 7.3.

A2.1.2 Light Cable Percussion Boring

For routine soil exploration to depths in excess of 3m, the light cable percussion rig is generally employed for boring through soils and weak rocks, refs 7.3, 7.4. It consists of a powered winch and tripod frame, with running wheels that are permanently attached so that the rig may be towed behind a suitable vehicle. The rig is towed into position and set up using its own winching system.

The locations of services are checked to make sure the borehole is not situated unacceptably near any services. Regardless of the proximity of services, a CAT scan is undertaken at the borehole location and a trial hole dug to 1.20m by hand.

Boreholes are advanced in soil by the percussive action of the cable tool. The force of the cylindrical tool as it is dropped a short distance cuts a plug of cohesive soil that is removed by the tool.

In non-cohesive soils, the borehole is advanced by a 'shell', otherwise known as a 'bailer' or 'sand pump', which incorporates a clack valve. Material is transferred into the shell and retained by the clack valve. The water level in a borehole is maintained above that in the surrounding granular soil to allow for temporary reductions in the head of water as the shell is withdrawn from the borehole. Water should flow from the borehole into the surrounding soil at all times to prevent 'piping' and loosening the soil at the base of the hole. The casing is always advanced with the borehole in granular soil so that material is drawn from the base rather than the borehole sides.

Obstructions to boring are overcome by fitting a serrated chiselling ring to the base of the percussion tool. For large obstructions, a heavy chisel with a hardened cutting edge may have to be used.

Disturbed samples are taken in polythene bags, jars or tubs that are sealed against air or water loss.

Undisturbed samples are generally taken in cohesive materials at changes in strata and at one metre intervals to 5 metres then at 1.5 metre intervals to the full depths of the borehole. The general purpose open-tube sampler is suitable for firm to stiff clays, but is often used to retrieve disturbed samples of weak rocks, soft or hard clay and also clayey sand or silts. This has been adopted for routine use, and usually consists of a 100mm internal diameter tube (U100), which is capable of taking soil samples up to 450mm in length. The undisturbed samples are sealed at each end using micro-crystalline wax to prevent drying.

Standard penetration tests are generally carried out in non-cohesive soils but also in stiff clays and soft rocks at frequencies similar to that of undisturbed sampling.

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by ISO 1997, ref 7.4, BS 1377, Part 9, 1990 ref 7.9.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 63.5kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the 'N' value.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT.**

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.

- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.

- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

A2.3 SAMPLES

U	represents undisturbed 100mm diameter sample, the number of blows to obtain the sample also recorded.
U fail	indicates undisturbed sample not recovered
HV	represents Hand Vane test with equivalent undrained shear strength in kN/m^2.
PP	represents Pocket Penetrometer test with equivalent undrained shear strength in kN/m^2.
CBR	represents California Bearing Ratio test
B	represents large bulk disturbed samples
D	represents small disturbed sample
A	represents amber jar contamination sample
V	represents vial contamination sample
W	represents water sample
$\underline{\nabla}$	represents water strike
$\underline{\blacktriangledown}$	represents level to which water rose

A2.4 DESCRIPTION OF SOILS

A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref 7.8, supplemented by section 6 of BS 5930, ref. 7.3 have been used in the soil descriptions contained within this report.

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Site	Borehole Number
Chipboard Decoupling. Kronospan	BH01

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 15.00m		Kronospan Limited	41585
	Location	**Dates** 28/10/2014-28/11/2014	**Engineer**	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.25)	MADE GROUND: CONCRETE.		
0.20-1.20	B4					0.25	Brown, grey, very gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse, including mudstone, sandstone and slate, with a high cobble content of mudstone and sandstone. (Possible made ground)		
0.40	E1								
0.50-0.70	B2								
0.50-0.70	E3								
0.70-1.20	B5								
0.70-1.20	E6					(1.25)			
1.20-1.59	SPT(C) 50/235	1.20	DRY	11,6/10,10,22,8					
1.20-1.50	B7								
1.20-1.65	D8					1.50	Medium dense brown, grey, clayey very sandy subangular fine to coarse GRAVEL including mudstone, sandstone and slate.		
2.00-2.45	D10			Water strike(1) at 2.00m, sealed at 4.80m.		(1.00)			▽1
2.00-2.50	B9								
2.00-2.45	SPT(C) N=16	1.70	DRY	2,3/5,6,3,2		2.50	Firm, brown, grey, slightly gravelly, silty, CLAY. Gravel is angular to subangular, fine to coarse locally tending to gravel with some matrix of sandy clay.		
3.00-3.45	SPT N=8	3.00	WET	1,1/2,2,2,2					
3.00-3.45	D12								
3.00-3.50	B11					(1.50)			
4.00-4.45	U N/R	4.00	3.00	100 blows		4.00	Brown slightly clayey very sandy angular and subangular fine to coarse GRAVEL including mudstone.		
4.00-4.50	B13								
						(0.80)			
						4.80	Firm, grey, clayey SILT.		
5.10-5.55	SPT N=15	4.70	2.00	2,2/3,3,4,5					
5.10-5.50	B14								
5.10-5.50	D15								
6.50-6.95	U N/R	6.00	2.00	20 blows					
6.50-7.00	B16								
8.00-8.45	SPT N=8	8.00	4.00	1,2/3,1,2,2					

Remarks
Samples marked as E comprise of 1 x amber jar and 1 x vial.
Borehole backfilled on completion.
Chiselling from 1.60m to 1.80m for 0.75 hours. Water added from 4.80m to 15.00m. Excavating from 0.00m to 1.20m for 1.00 hour.

Scale (approx)	Logged By
1:40	DD

Figure No. 41585.BH01

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Site	Borehole Number
Chipboard Decoupling. Kronospan	BH01

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 15.00m		Kronospan Limited	41585
	Location	**Dates** 28/10/2014-28/11/2014	**Engineer**	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
8.00-8.45 8.00-8.50	D18 B17						At 8.00m: becoming very soft.		
						(8.60)			
9.50-9.95 9.50-9.95 9.50-10.00	SPT N=9 D20 B19	9.00	4.00	1,2/2,2,2,3					
11.00-11.45 11.00-11.45 11.00-11.50	SPT N=8 D22 B21	11.00	7.00	1,2/2,2,1,3					
12.70-13.15 12.70-13.15 12.70-13.20	SPT N=12 D24 B23	12.30	6.00	1,2/3,3,3,3					
13.40-14.50	B25					13.40	Medium dense, dark, brown, grey, very gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse, with a low cobble content.		
						(1.60)			
14.50-14.95 14.50-15.00	SPT N=23 D26	14.50	5.00	3,4/6,6,5,6					
						15.00	Complete at 15.00m		

Remarks
Samples marked as E comprise of 1 x amber jar and 1 x vial.
Borehole backfilled on completion.

Scale (approx)	Logged By
1:40	DD

Figure No. 41585.BH01

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APPENDIX 3

LABORATORY TESTS

APPENDIX 3

GENERAL NOTES ON LABORATORY TESTS ON SOILS

A3.1 GENERAL

A3.1.1 Where applicable all tests are carried out in accordance with the relevant British Standard. The laboratory test procedures are as below:

Test Name	Procedures BS1377:1990 Part:Clause
Moisture Content	2:3
Liquid Limit	2:4
Plastic Limit and Plastic Index	2:5
Particle Size Distribution	9.2
Sedimentation	9.4
Mass Loss on Ignition	3.4
Sulphate content	3:5
pH Value	3:9
Compaction Test	4:3
California Bearing Ratio	4:7
Consolidation	5:3
Bulk Density	7:2*
Laboratory Vane Tests	7:3*
Triaxial Compression	
Total Stress Single-Stage	7:8
Total Stress Multi-Stage	7:9
Desiccation	Note 1*

Note 1 - BRE Information paper IP4 issued February 1993
* Tests are not included in UKAS accreditation

A3.1.2 Where an external laboratory carried out testing, their report, including test methods is included in this Appendix.

A3.1.3 A summary sheet of laboratory test results undertaken by Ian Farmer Laboratories is included, however where copies of the individual test results are required these will be provided on request.

A3.1.4 Any discussion in this report is based on the values and results obtained from the appropriate tests. Due allowance should be made, when considering any result in isolation, of the possible inaccuracy of any such individual result. Details of the accuracy of results are included in this section, where applicable.

A3.2 MOISTURE CONTENT

A3.2.1 Unless stated to the contrary, the moisture content of a soil sample was determined by the standard oven drying method, BS 1377, Part 1, Test 3. The result is reported to an accuracy of ±0.5%

A3.3 ATTERBERG LIMITS

A3.3.1 The Liquid Limit, **LL**, is the moisture content at which the soil passes from the liquid to plastic state. Unless stated to the contrary, the Liquid Limit was determined using the four point, cone penetrometer method, Test 4. The value is reported to the nearest whole number, to an accuracy of ±0.5%.

A3.3.2 The Plastic Limit, **PL**, is the moisture content at which soil passes from the plastic to solid state and becomes too dry to remain in a plastic condition. The Plastic Limit was determined using the method described in Test 5. The value is reported to the nearest whole number, to an accuracy of ±0.5%.

A3.3.3 The Plasticity Index, **PI**, is the numerical difference between the liquid and plastic limits, corresponding to the range of moisture contents over which a soil is in a plastic state. The determination of the Plasticity Index is covered by Test 5.

A3.4 SOIL CLASSIFICATION

A3.4.1 Classification of soils is usually undertaken by means of the Plasticity Classification Chart, sometimes called the A-Line Chart. This is graphical plot of PI against LL with the A-Line defined as PI = 0.73(LL - 20).

A3.4.2 This line is defined from experimental evidence and does not represent a well defined boundary between soil types, but forms a useful reference datum. When the values of LL and PI for inorganic clays are plotted on the chart they generally lie just above the A-Line in a narrow band parallel to it, while silts and organic clays plot below this line.

A3.4.3 Clays and silts are divided into five zones of plasticity:

Low Plasticity (L)	LL less than 35
Intermediate Plasticity (I)	LL between 35 and 50
High Plasticity (H)	LL between 50 and 70
Very High Plasticity (V)	LL between 70 and 90
Extremely High Plasticity (E)	LL greater than 90

A3.4.4 In general, clays of high plasticity are likely to have a lower permeability, are more compressible and consolidate over a longer period of time under load than clays of low plasticity. Clays of high plasticity are more difficult to compact as fill material.

A3.5 CHEMICAL TESTS

A3.5.1 The total sulphate content of soil was determined using the gravimetric method detailed in BS1377: Part 3:1990, Test 5. The results are recorded to an accuracy of ±0.1%.

A3.5.2 The water soluble sulphate content of soil was determined using the gravimetric method detailed in BS1377: Part 3: 1990, Test 5. The results are recorded to an accuracy of ±0.1g/l.

A3.5.3 The sulphate content of groundwater was determined using the gravimetric method detailed in BS1377: Part 3: 1990, Test 5. The results are record to an accuracy of ±0.1g/l.

A3.5.4 The pH value was determined electrometrically using the procedures given in BS 1377: Part 3: 1990, Test 9. The results are recorded to an accuracy of ±0.1 pH units.

A3.5.5 The total sulphur content of soil was determined using the ignition in oxygen method detailed in TRL Report 447, Test 4B.

A3.5.6 The organic content of soil was determined in accordance with the chemical method detailed in BS1377: Part 3:1990 Clause 3. The sample was prepared in accordance with Clause 3.4.2.

A3.5.7 The organic content of soil was determined in accordance with the loss on ignition method detailed in BS1377: Part 3:1990 Clause 4. The sample was prepared in accordance with Clause 4.3.2.

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Warrington
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WA1 4RT

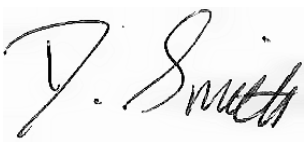
F.A.O. Mr A Latimer

TEST REPORT - 41585

Site :	Chipboard Decoupling. Kronospan
Job Number :	41585
Originating Client :	Kronospan
Originating Reference :	Not Given
Date Sampled :	
Date Scheduled :	16/12/2014
Date Testing Started :	18/12/14
Date Testing Finished :	7/1/15

Remarks :

- First Report for above Job Number
- Samples will be disposed of 28 days after the report is issued unless otherwise agreed
- This report may contain results from tests which are not included within the scope of the UKAS accreditation. Please see final sheet for details.

Authorised By:  Daniel Smith

Position : Laboratory Supervisor Date : 8/1/15

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AGS ASSOCIATION OF GEOTECHNICAL & GEOENVIRONMENTAL SPECIALISTS

UKAS TESTING
1464

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Laboratory Test Report - 41585

Site : Chipboard Decoupling. Kronospan

Client : Kronospan

Job Number 41585

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Moisture Content %						
BH01	3.00	D16	Sieved	27	79	33	39	24	15	0.60	CI	Brown, slightly silty, slightly clayey, sandy, GRAVEL
BH01	5.10	D20	Natural	27	100	27	32	24	8	0.38	ML	Brown silt

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3.2 Determination of moisture content 4.3 Determination of the liquid limit 5.3 Determination of the plastic limit and plasticity index

IAN FARMER ASSOCIATES

Laboratory Test Report - 41585

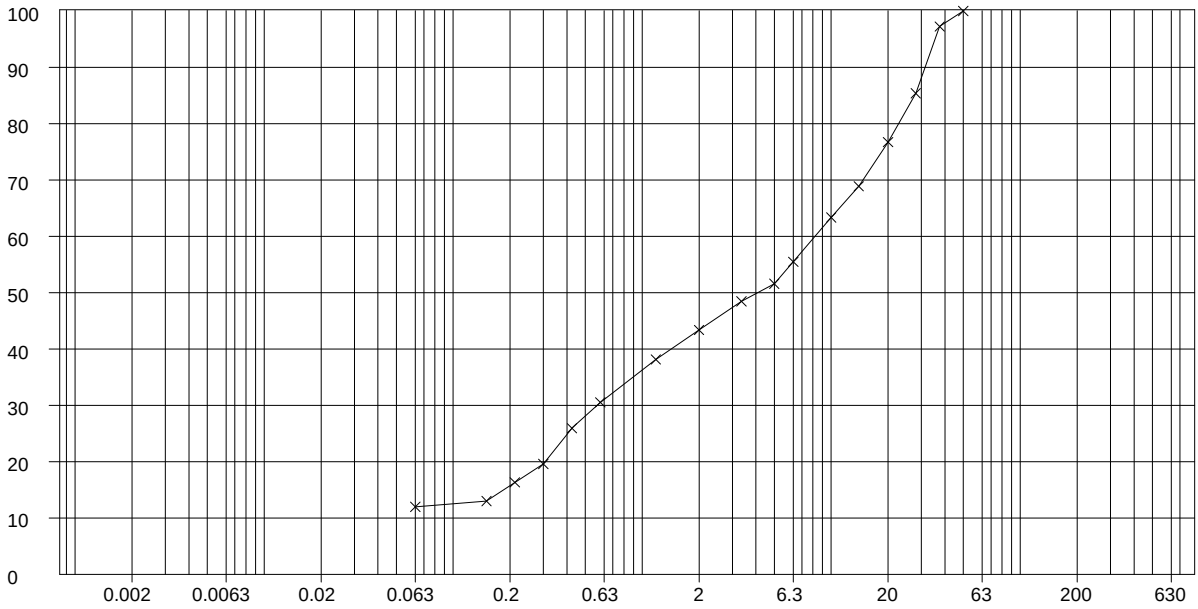
Site : Chipboard Decoupling. Kronospan

Client : Kronospan

Job Number 41585

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH01	2.00	B15	N/A	Brown slightly clayey, slightly silty, sandy, GRAVEL



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	97
28 mm	85
20 mm	77
14 mm	69
10 mm	63
6.3 mm	55
5 mm	52
3.35 mm	48
2 mm	43
1.18 mm	38
600 µm	31
425 µm	26
300 µm	20
212 µm	16
150 µm	13
63 µm	12

Grading Analysis	
D85	27.6 mm
D60	8.4 mm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	57%
Sand	31%
Silt/Clay	12%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 41585

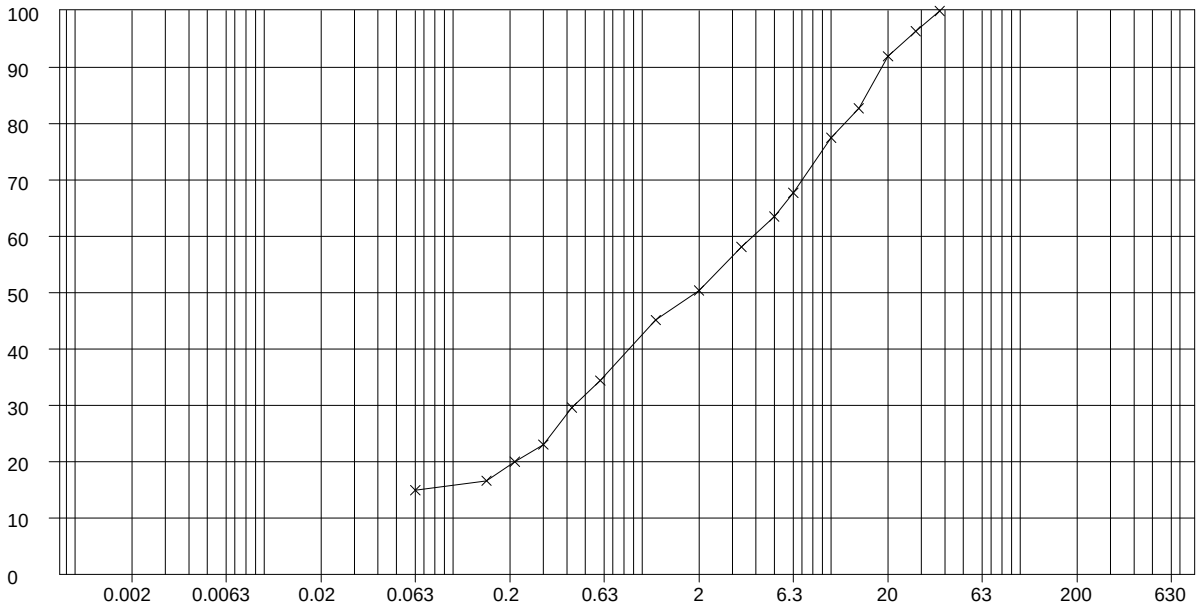
Site : Chipboard Decoupling. Kronospan

Client : Kronospan

Job Number 41585

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH01	3.00	B18	N/A	Brown, slightly silty, slightly clayey, sandy, GRAVEL



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve / Particle Size	% Passing
50 mm	100
37.5 mm	100
28 mm	96
20 mm	92
14 mm	83
10 mm	78
6.3 mm	68
5 mm	64
3.35 mm	58
2 mm	50
1.18 mm	45
600 µm	34
425 µm	30
300 µm	23
212 µm	20
150 µm	17
63 µm	15

Grading Analysis	
D85	15.5 mm
D60	3.9 mm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	50%
Sand	35%
Silt/Clay	15%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

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Laboratory Test Report - 41585

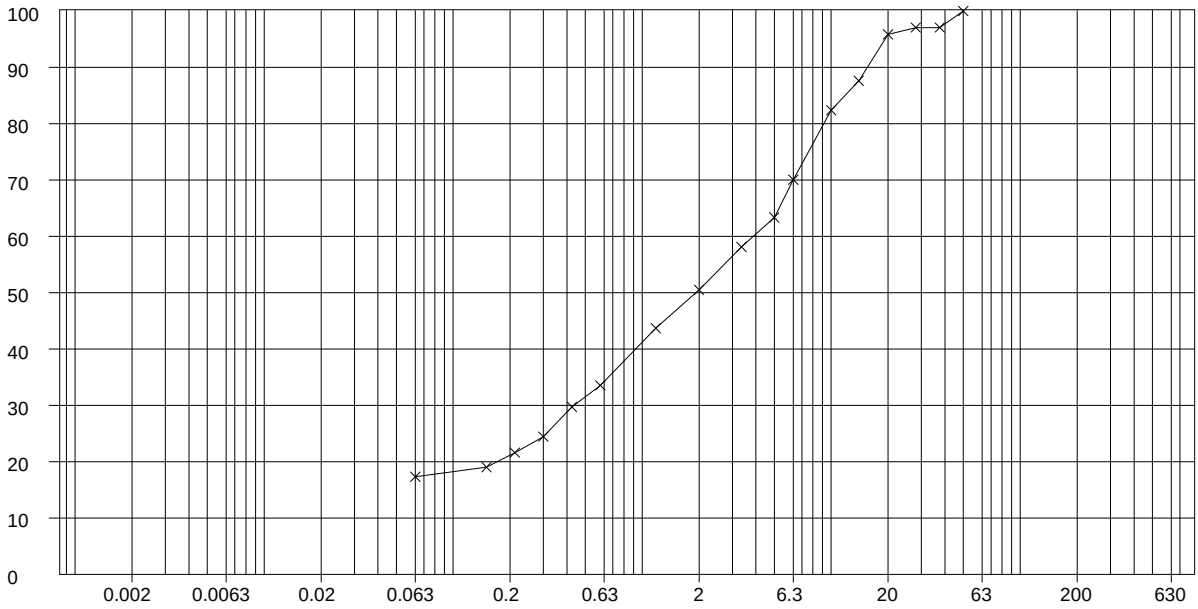
Site : Chipboard Decoupling. Kronospan

Client : Kronospan

Job Number 41585

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH01	4.00	B19	N/A	Brown slightly silty, slightly clayey, sandy, GRAVEL



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	97
28 mm	97
20 mm	96
14 mm	88
10 mm	82
6.3 mm	70
5 mm	63
3.35 mm	58
2 mm	51
1.18 mm	44
600 µm	34
425 µm	30
300 µm	24
212 µm	22
150 µm	19
63 µm	17

Grading Analysis	
D85	12.0 mm
D60	3.9 mm
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	49%
Sand	33%
Silt/Clay	18%

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

IAN FARMER ASSOCIATES

Laboratory Test Report - 41585

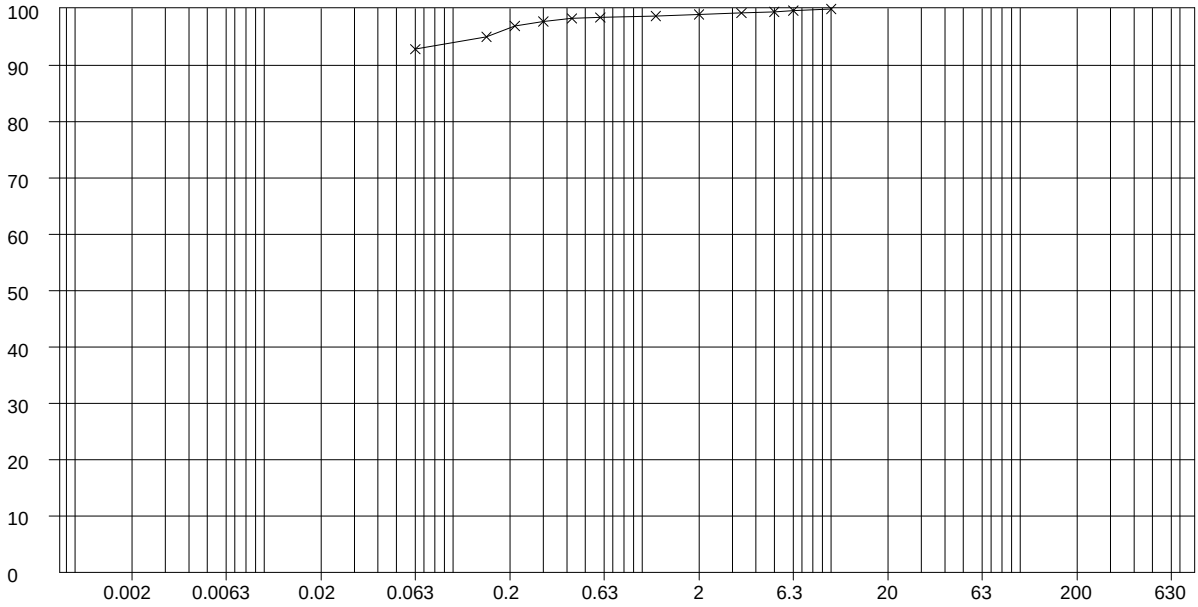
Site : Chipboard Decoupling. Kronospan

Client : Kronospan

Job Number 41585

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Pipette/ Hydrometer	Description
BH01	5.10	B21	N/A	Brown silt



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Grading Analysis	
D85	-
D60	-
D10	-
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	0%
Gravel	1%
Sand	6%
Silt/Clay	93%

Sieve / Particle Size	% Passing
200 mm	100
150 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	99
2 mm	99
1.18 mm	99
600 µm	99
425 µm	98
300 µm	98
212 µm	97
150 µm	95
63 µm	93

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 7.4.5 Particle size tests

Preparation Details : Sample washed with no dispersant used, Oven Dried at 105 - 110℃

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Test Report : **41585**

Site : Chipboard Decoupling. Kronospan
Job Number : 41585
Originating Client : Kronospan

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

The following tests contained within this report are not UKAS Accredited.

Date of Issued : 8/1/15

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TEST CERTIFICATE
Determination of Compressive Strength of Concrete Cores
Tested in Accordance with BS EN 12504-1 : 2009

Contract / Site :	Kronospan	Report Number :	41585
Client :	Ian Farmer Associates	Job Number :	41585
Address :	17 Rivington Court Hardwick Grange Warrington Cheshire WA1 4RT	Sample Number:	CC02
		Date Recieved :	8-Dec-14
		Tested By :	G. Robinson

INFORMATION PROVIDED BY PRODUCER (N)

Core Identification :	CC02
Date of Drilling / Coring :	Not Given

TESTING DATA

Specimen Storage prior to Test:	Water Saturated	Maximum Length (mm) :	210
Date of Tested :	17-Dec-14	Minimum Length (mm) :	205
Average Core Diameter (mm) :	103	Length after Preperation (mm)	103
and Position	Random	Length/Diameter Ratio:	1 : 1.0
Presence of Cracks :	None	Class of Voids (%)	2
Soaking Time Before Test (hrs)	>72	Distribution of Materials :	Random
Size of Reinforcement (mm)	N/A	Compaction of Concrete :	Good
Spacing of Reinforcement (mm)	N/A	Age of Specimen (days)	Not Given
and Position from Top (mm)	N/A	Appearance of Concrete :	Normal

Method of Preperation (Sulphur mixture capping method)	BS EN 12390-3 : 2009 clause A4
Surface Condition of Speciment at Test :	Saturated surface dry
Aggregate Description and Size :	5-12mm subrounded gravel

Maximum Load at Failure (kN) :	282.0	Type of Failure :	Normal
Density of Specimen - BS EN 12390-7:2009 Clause 5.5 (kg/m^3) Density is by water displacement		Water Saturated	**2250**
Compressive Strength (N/mm^2)			**33.8**

Checked By : _____ D.Smith Date Checked: 18/12/2014
(signature)
Laboratory Supervisor

1464

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TEST CERTIFICATE
Determination of Compressive Strength of Concrete Cores
Tested in Accordance with BS EN 12504-1 : 2009

Contract / Site :	Kronospan	Report Number :	41585
Client :	Ian Farmer Associates	Job Number :	41585
Address :	17 Rivington Court Hardwick Grange Warrington Cheshire WA1 4RT	Sample Number:	CC03
		Date Recieved :	8-Dec-14
		Tested By :	G. Robinson

INFORMATION PROVIDED BY PRODUCER (N)

Core Identification :	CC03
Date of Drilling / Coring :	Not Given

TESTING DATA

Specimen Storage prior to Test:	Water Saturated	Maximum Length (mm) :	180
Date of Tested :	17-Dec-14	Minimum Length (mm) :	165
Average Core Diameter (mm) :	103	Length after Preperation (mm)	103
and Position	Random	Length/Diameter Ratio:	1 : 1.0
Presence of Cracks :	None	Class of Voids (%)	1
Soaking Time Before Test (hrs)	>72	Distribution of Materials :	Random
Size of Reinforcement (mm)	6,10,10	Compaction of Concrete :	Good
Spacing of Reinforcement (mm)	N/A	Age of Specimen (days)	Not Given
and Position from Top (mm)	28,30	Appearance of Concrete :	Normal

Method of Preperation (Sulphur mixture capping method)	BS EN 12390-3 : 2009 clause A4
Surface Condition of Speciment at Test :	Saturated surface dry

Aggregate Description and Size : 5-8mm subrounded gravel

Maximum Load at Failure (kN) : 247.0 Type of Failure : Normal

Density of Specimen - BS EN 12390-7:2009 Clause 5.5 (kg/m^3) Water Saturated **2270**
Density is by water displacement

Compressive Strength (N/mm^2) **29.6**

Checked By : D Smith (signature) D.Smith Date Checked: 18/12/2014
Laboratory Supervisor

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TEST CERTIFICATE

Determination of Compressive Strength of Concrete Cores
Tested in Accordance with BS EN 12504-1 : 2009

Contract / Site :	Kronospan	Report Number :	41585
Client :	Ian Farmer Associates	Job Number :	41585
Address :	17 Rivington Court Hardwick Grange Warrington Cheshire WA1 4RT	Sample Number:	CC04
		Date Recieved :	8-Dec-14
		Tested By :	G. Robinson

INFORMATION PROVIDED BY PRODUCER (N)

Core Identification :	CC04
Date of Drilling / Coring :	Not Given

TESTING DATA

Specimen Storage prior to Test:	Water Saturated	Maximum Length (mm) :	120
Date of Tested :	17-Dec-14	Minimum Length (mm) :	115
Average Core Diameter (mm) :	102	Length after Preperation (mm)	103
and Position	Random	Length/Diameter Ratio:	1 : 1.0
Presence of Cracks :	None	Class of Voids (%)	2
Soaking Time Before Test (hrs)	>72	Distribution of Materials :	Random
Size of Reinforcement (mm)	N/A	Compaction of Concrete :	Good
Spacing of Reinforcement (mm)	N/A	Age of Specimen (days)	Not Given
and Position from Top (mm)	N/A	Appearance of Concrete :	Normal

Method of Preperation (Sulphur mixture capping method)	BS EN 12390-3 : 2009 clause A4
Surface Condition of Speciment at Test :	Saturated surface dry

Aggregate Description and Size : 5-12mm subrounded gravel

Maximum Load at Failure (kN) : 281.0 Type of Failure : Normal

Density of Specimen - BS EN 12390-7:2009 Clause 5.5 (kg/m^3) Water Saturated **2210**
Density is by water displacement

Compressive Strength (N/mm^2) **34.4**

Checked By : _____ D.Smith Date Checked: 18/12/2014
(signature)
Laboratory Supervisor

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TEST CERTIFICATE
Determination of Compressive Strength of Concrete Cores
Tested in Accordance with BS EN 12504-1 : 2009

Contract / Site :	Kronospan	Report Number :	41585
Client :	Ian Farmer Associates	Job Number :	41585
Address :	17 Rivington Court Hardwick Grange Warrington Cheshire WA1 4RT	Sample Number:	CC01
		Date Recieved :	8-Dec-14
		Tested By :	G. Robinson

INFORMATION PROVIDED BY PRODUCER (N)

Core Identification :	CC01
Date of Drilling / Coring :	Not Given

TESTING DATA

Specimen Storage prior to Test:	Water Saturated	Maximum Length (mm) :	200
Date of Tested :	17-Dec-14	Minimum Length (mm) :	190
Average Core Diameter (mm) :	103	Length after Preperation (mm)	103
and Position	Random	Length/Diameter Ratio:	1 : 1.0
Presence of Cracks :	None	Class of Voids (%)	1
Soaking Time Before Test (hrs)	>72	Distribution of Materials :	Random
Size of Reinforcement (mm)	8	Compaction of Concrete :	Good
Spacing of Reinforcement (mm)	N/A	Age of Specimen (days)	Not Given
and Position from Top (mm)	69,80	Appearance of Concrete :	Normal

Method of Preperation (Sulphur mixture capping method)	BS EN 12390-3 : 2009 clause A4
Surface Condition of Speciment at Test :	Saturated surface dry
Aggregate Description and Size :	5-10mm angular gravel

Maximum Load at Failure (kN) :	332.0	Type of Failure :	Normal

Density of Specimen - BS EN 12390-7:2009 Clause 5.5 (kg/m^3) Water Saturated **2320**
Density is by water displacement

Compressive Strength (N/mm^2) **39.8**

Checked By : D Smith D.Smith Date Checked: 18/12/2014
(signature)
Laboratory Supervisor

1464

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 14-23626

05-Jan-15

Client	Ian Farmer Associates 14 Faraday Close District 15 Pattinson North Industrial Est Washington Tyne & Wear NE38 8QJ
Our Reference	14-23626
Client Reference	41585
Contract Title	Kronospan
Description	2 Soil samples.
Date Received	19-Dec-14
Date Started	19-Dec-14
Date Completed	05-Jan-15
Test Procedures	Identified by prefix DETSn (details on request).
Notes	Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 14-23626
Client Ref 41585
Contract Title Kronospan

			Lab No	748916	748917
			Sample ID	BH01	BH01
			Depth	1.20	2.00
			Other ID		
			Sample Type	SOIL	SOIL
			Sampling Date	n/s	n/s
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Inorganics					
pH	DETSC 2008#			9.3	8.5
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	48	13

Information in Support of the Analytical Results

Our Ref 14-23626
Client Ref 41585
Contract Kronospan

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
748916	BH01 1.20 SOIL		PT 1L	Sample date not supplied	
748917	BH01 2.00 SOIL		PT 1L	Sample date not supplied	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

APPENDIX 4

DESIGN CONSIDERATIONS

APPENDIX 4

GEOTECHNICAL DESIGN CONSIDERATIONS

A4.1 ASSESSMENT OF GRANULAR SOIL CONDITION

A4.1.1 SPT 'N' values reported on the borehole logs are as measured in the field with no corrections applied.

A4.1.2 However for general design in sands the 'N' values should be normalised to 60% by the following equation:-

A4.1.3 N60 = Er/60.N where:-

N is the blow count and

Er is the energy ratio of the specific test equipment

A4.1.4 Further corrections for rod length and overburden pressure in sands may be applied in accordance with BS EN ISO 22476-3, ref 9.6.

A4.2 ASSESSMENT OF COHESIVE SOIL CONDITION

A4.2.1 In accordance with BS EN ISO 22475-1, ref. 7.7, and BS5930, ref.7.3, the thick walled U100 sample is considered as a Class B sampling technique and will only produce Class 3 to 5 quality samples in accordance with EN 1997-2:2007, ref.7.4.

A4.2.2 Laboratory strength and consolidation testing should only be carried out on Class 1 quality samples, which can be obtained from a Class A sampling technique, ref. 9.5. This is due to possible disturbance during sampling, giving a weaker strength in testing.

A4.2.3 Therefore laboratory test values for c_u and m_v obtained from thick walled U100 samples should only be used as guidance and not used as absolute values for the shear strength and compressibility properties of the clay and only used to provide guidance to descriptive strength on the borehole records.

A4.2.4 Work undertaken by Stroud, ref. 7.11 determined a relationship between SPT 'N' values, plasticity undrained shear strength and compressibility of many over-consolidated clays. Further work by Stroud and Butler, ref.7.12, in which data was analysed from sites covering a wide range of glacial deposits, confirmed there to be a correlation between the 'N' value plasticity undrained shear strength and compressibility.

A4.2.5 The relationship was of the form:

$$Cu = f_1 \times N$$

and

$$mv = 1/(f_2 \times N)$$

Where c_u = Un-drained shear strength

m_v = Coefficient of compressibility

f_1 and f_2 = Factors

A4.2.6 It was determined by Stroud that f_1 varied between 4kPa for material of high plasticity and 6kPa for material of low plasticity. Similarly f_2 varied between 400kPa and 600kPa.