SUTHERLAND DISTRICT COUNCIL
HOUSING & TECHNICAL SERVICES DEPT

PROPOSED HOUSING SITE
SUTHERLAND ROAD, DORNOCH

SITE INVESTIGATION
&
FOUNDATION RECOMMENDATIONS

SCOTT WILSON KIRKPATRICK & PARTNERS (SCOTLAND)
CONSULTING CIVIL & STRUCTURAL ENGINEERS
BANK OF SCOTLAND BUILDING
TULLOCH STREET
DINGWALL
IV15 9JZ

April 1987

PROPOSED HOUSING SITE
SUTHERLAND ROAD, DORNOCH

SITE INVESTIGATION

1. INTRODUCTION

On the 17 February 1987, Sutherland District Council invited Scott Wilson Kirkpatrick & Partners (Scotland) to carry out a site investigation at a site adjacent to the Cathedral Hall on Sutherland Road, Dornoch and to report on the type of foundations that would be required for a proposed housing development.

The proposed development is that shown on the District Council's Drawings Nos. H948, H804 and H863 for single storey, timber framed, two and three apartment, semi detached houses, along with the access roads.

2. SITE INVESTIGATION

Six trial pits were excavated by means of a JCB on Thursday 5 March 1987. A layout of the pits is shown in Figure 1. It was the intention that all pits be excavated to a depth of 3.00 metres below existing ground level, but problems were encountered with stability and some had to be terminated sooner.

A description of the materials found in each of the pits is given in the Trial Pit Records, Figures 2, 3 and 4.

Standpipes were inserted in Trial Pits 3 and 5.

Two representative samples, one from Pit 1 and one from Pit 4, were taken to the Highland Testing Services Ltd laboratory to determine their particle size distribution.

The results of the tests are shown in Figures 5, 6, 7 and 8.

3. GROUND CONDITIONS

The site is generally lying in a shallow hollow with ground levels lying between 6.00 metres and 8.00 metres at the edge of a raised beach area. The area is overlain by a layer of organic topsoil, varying in thickness between 0.75 metres and 1.40 metres, averaging just less than 1.00 metres.

Below the organic topsoil, in the area adjacent to Sutherland Road, lies a layer of loose to medium dense fine sand of varying thickness between 0.70 metres and 1.10 metres. This layer thins out and does not appear in the pits at the north of the site.

Below the layers of organic topsoil and fine sand lie layers of coarser yellowish and brown sand.

Water was encountered in the 4 lower lying pits, at depths of between 1.0 and 2.0 metres which impaired their stability. Water levels in the standpipes record an average depth of 0.20 and 1.60 metres for pits 3 and 5 respectively.

4. CONCLUSIONS

From the visual examination of the underlying layers of sand and from the laboratory classification, we are of the opinion that the area, once the organic topsoil had been removed and replaced, would be capable of supporting the proposed housing development and accordingly have drawn up recommendations for ensuring that this is achieved.

5. FOUNDATION RECOMMENDATIONS

We would recommend that the following be carried out in order that safe and adequate foundations are provided for:

a) Housing

(i) Excavate and completely remove the layer of organic topsoil and expose the layer of fine sand. This should be carried out over an area assuming a 45^{o} dispersal of load from the foundations down to the fine sand layer.

(ii) The area to be made up to appropriate correct levels by importing granular fill material and compacting it in place on top of the sand layers. A geotextile separator should be placed over the fine sand prior to filling, in order to assist compaction. A suitable specification is given below:

Imported fill material shall consist of crushed or uncrushed gravel, stone, rockfill, crushed concrete or slag or natural sand, or a combination of these. It shall be well graded with a maximum particle size of 100 mm and not more than 10% passing the 75 micron sieve. It shall be compacted in accordance with Table 6/2 of the Department of Transport's Specification for Road and Bridge Works, save that the first layer may be 400 mm thick.

The geotextile shall be "Lotrak 16/15" or similar approved laid in accordance with the manufacturer's instructions.

(iii) A raft foundation as shown in Figures 9, 10 and 11 should then be provided for the houses.

b) Access Roads and Car Parks

(i) The areas below the access roads and car parks should be cleared of any large vegetation and a geotextile separator placed directly onto the existing surface, provided the minimum 450 millimetre road pavement construction can be achieved.

(ii) The area should then be made up to the appropriate correct levels by importing granular fill material and compacting it in place on top of the geotextile separator.

The specification should be identical to that used for the area under the houses.

The width of area to be treated should be determined assuming a 45° dispersal of load from the road pavement through the infill material.

c) Landscape Areas

i) Areas outwith the houses and access roads should be made up to the correct levels using suitable filling material laid directly onto the existing ground. Topsoil to a minimum depth of 100 mm should then be provided.

The above specifications would provide adequate foundations for the individual parts, but some differential settlement of the access roads and car parks may be expected, due to compression of the topsoil. This can be mitigated by filling early and delaying final surfacing to the end of the job and providing strong drainage falls.

It may, however, be more appropriate to treat the whole site similarly, based on the specification for the housing areas, for the following reasons:

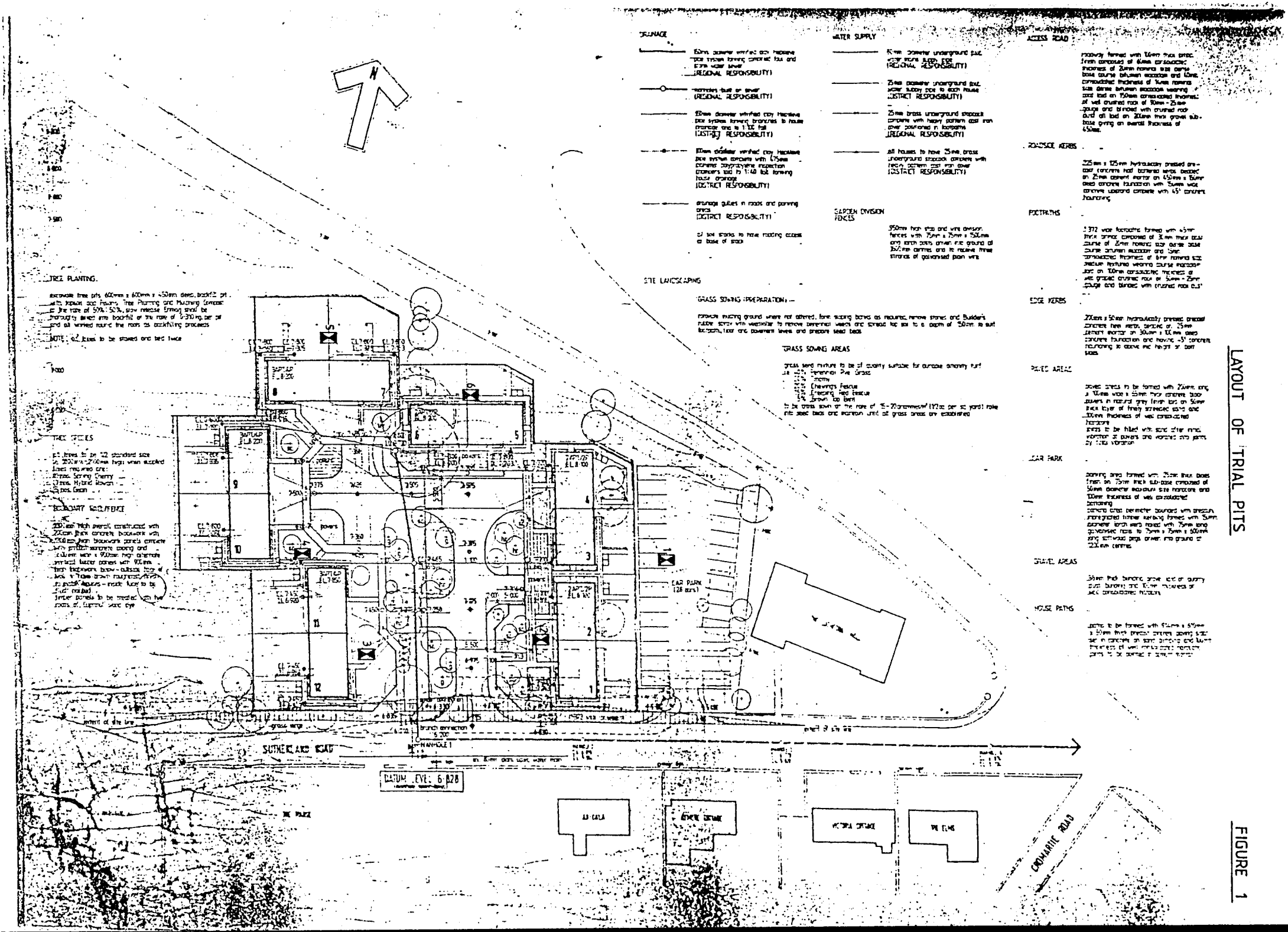
(1) Control of filling operations would be much easier to monitor.

(2) Alterations to layout in the future could easily be accomplished.

(3) Differential settlements would be minimised.

(4) The cost of treating the whole area may turn out to be competitive with that for doing separate parts. Although more material would have to be removed and replaced, the operation would be much simpler and may result in a cheaper cost.

Further consideration should also be given to carrying out the work of removal and infilling as a separate contract in advance of any building work. This could then be accomplished as either a long term or short term contract, depending on finances available.


DRAINAGE
WATER SUPPLY
ACCESS ROAD
KERB & CHANNEL
FOOTPATHS
EDGE KERBS
PAVED AREAS
CAR PARK
GRAVEL AREAS
HOUSE PATHS
SITE LANDSCAPING
GRASS SOWING PREPARATION
GRASS SOWING AREAS
TREE PLANTING.
TREE SPECIES
BOUNDARY SHELTERFENCE
SUTHERLAND ROAD
CAR PARK (28 cars)
DATUM RVL 6.828
CROMARTIE ROAD
LAYOUT OF TRIAL PITS
FIGURE 1

Method of excavation	JCB Excavator	Location		Date commenced	Record of
Dimensions of trial pit (m)	2.0 x 1.0	Ground level (m O D)	6.30	5/3/87	TRIAL PIT 1

Samples and in situ tests Depth (m)	Type	Water depth (m)	Date and depth (m)	Description of strata	O D level (m O D)	Legend
			0.75	Loose black topsoil overlying 150 mm loose white fine sand	5.53	
			1.40	Very wet and foul smelling fibrous organic soil	4.90	
SAMPLE A				Loose saturated blue/grey fine sand with occasional large round cobbles	4.00	
			2.30	End of Trial Pit		

Remarks: Pit had to be abandoned at 2.30 as side kept falling in and soil in base was completely saturated.

Method of excavation	JCB Excavator	Location		Date commenced	Record of
Dimensions of trial pit (m)	2.0 x 1.0	Ground level (m O D)	6.24	5/3/87	TRIAL PIT 2

Samples and in situ tests Depth (m)	Type	Water depth (m)	Date and depth (m)	Description of strata	O D level (m O D)	Legend
			0.75	Loose black topsoil	5.49	
			1.30	Loose saturated yellowish coarse sand	4.94	
			2.40	Loose saturated blue/grey fine sand with occasional large round cobbles	3.84	
			3.00	Loose saturated brown coarse sand	3.24	
				End of Trial Pit		

Remarks: Side of pit kept falling in.
Water entering around the 5.20 m level.

TRIAL PIT RECORDS

Scale 1 : 50

For explanation of symbols and abbreviations see Key Sheet

Lab Ref No 87504

Proposed Housing Site
Sutherland Road, Dornoch

Fig 2

Method of excavation	JCB Excavator	Location	Date commenced	Record of
Dimensions of trial pit (m)	2.0 x 1.0	Ground level (m O D) 6.07	5/3/87	TRIAL PIT 3

Samples and in situ tests: Depth (m)	Type	Water depth (m)	Date and depth (m)	Description of strata	O D level (m O D)	Legend
			1.00	400 mm loose black topsoil overlying 200 mm loose white fine sand overlying fibrous black organic soil	5.07	
			1.60	Medium dense wet blue/grey fine sand with occasional medium cobbles	4.47	
			2.50	Medium dense saturated brown medium/coarse sand	3.57	
				End of Trial Pit		

Remarks:
1. Hole had to be abandoned at 3.57 m as sides kept falling in.
2. Water started entering around the 4.47 m level.
3. Stand pipe installed.

Method of excavation	JCB Excavator	Location	Date commenced	Record of
Dimensions of trial pit (m)	2.0 x 1.0	Ground level (m O D) 6.24	5/3/87	TRIAL PIT 4

Samples and in situ tests: Depth (m)	Type	Water depth (m)	Date and depth (m)	Description of strata	O D level (m O D)	Legend
			1.00	Loose black topsoil	5.24	
			1.70	Medium dense wet white fine sand (becoming saturated towards bottom)	4.54	
SAMPLE B			2.60	Medium dense saturated brown medium/coarse sand	3.64	
				End of Trial Pit		

Remarks:
1. Pit had to be abandoned at 3.64 m level as sides kept falling in.
2. Water started entering hole around the 4.30 m level.

TRIAL PIT RECORDS

Scale 1 : 50

For explanation of symbols and abbreviations see Key Sheet

Lab Ref No 87504

Proposed Housing Site
Sutherland Road, Dornoch

Fig 3

Method of excavation	JCB Excavator	Location	Date commenced	Record of
Dimensions of trial pit (m)	2.0 x 1.0	Ground level (m O D) 7.39	5/3/87	TRIAL PIT 5

Samples and in situ tests: Depth (m)	Type	Water depth (m)	Date and depth (m)	Description of strata	O D level (m O D)	Legend
			0.85	Loose black topsoil	6.54	
			2.40	Loose to medium dense dry yellowish fine/medium sand with occasional large round cobbles	4.99	
			3.00	Medium dense dry yellowish medium/coarse sand	4.39	
				End of Trial Pit		

Remarks:
1. Sides of pit stood up well and remained dry.
2. Stand pipe inserted.

Method of excavation	JCB Excavator	Location	Date commenced	Record of
Dimensions of trial pit (m)	2.0 x 1.0	Ground level (m O D) 7.35	5/3/87	TRIAL PIT 6

Samples and in situ tests: Depth (m)	Type	Water depth (m)	Date and depth (m)	Description of strata	O D level (m O D)	Legend
			0.85	Loose black topsoil	6.50	
			2.40	Loose dry yellowish fine/medium sand with occasional large round cobbles	4.95	
			3.00	Medium dense dry yellowish coarse sand/fine gravel	4.35	
				End of Trial Pit		

Remarks: Sides of pit remained reasonably intact and dry.

TRIAL PIT RECORDS

Scale 1 : 50

For explanation of symbols and abbreviations see Key Sheet

Lab Ref No 87504

Proposed Housing Site
Sutherland Road, Dornoch

Fig 4

Figure 5

HIGHLAND TESTING SERVICES LTD.
(Inverness)

MATERIALS TESTING ENGINEERS
AND CONSULTING TECHNOLOGISTS

42a SEAFIELD ROAD
LONGMAN INDUSTRIAL ESTATE
INVERNESS
Telephone (0463) 225844

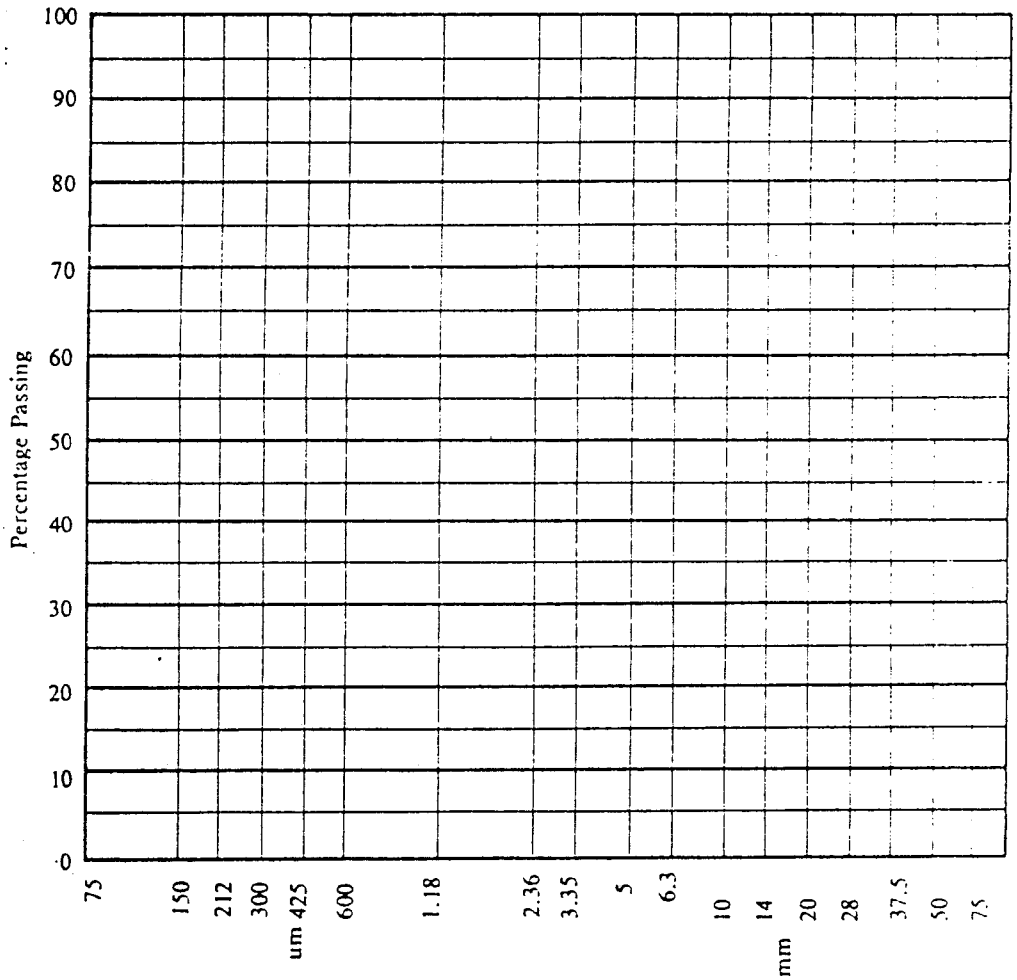
AGGREGATE GRADING ANALYSIS

SAMPLE NO. A
SAMPLE REF. 5231

CLIENT. Scott, Wilson, Kirkpatrick Ltd
CONTRACT. Housing Scheme, Dornoch
LOCATION.....
DATE RECEIVED. 5.3.87

MATERIAL. Sand (grey)
SUPPLIER.....
SOURCE.....
B.S. APPLICABLE.....

B.S. Sieve Size	Cumulative Percentages Passing		
Metric			Spec.
75mm			
63mm			
50 mm			
37.5 mm			
28 mm			
20 mm			
14 mm			
10 mm			
6.3 mm			
5 mm			
3.35 mm			
2.36 mm			
1.18 mm			
600 µm	100.0		
425	99.6		
300	97.8		
212	90.3		
150	66.8		
75	13.8		



REMARKS

DATE.....

SIGNED. D. S. Bama MATERIALS ENGINEER

42a SEAFIELD ROAD
LONGMAN INDUSTRIAL ESTATE
INVERNESS
Telephone (0463) 225844

HIGHLAND TESTING SERVICES LTD.

PARTICLE SIZE DISTRIBUTION

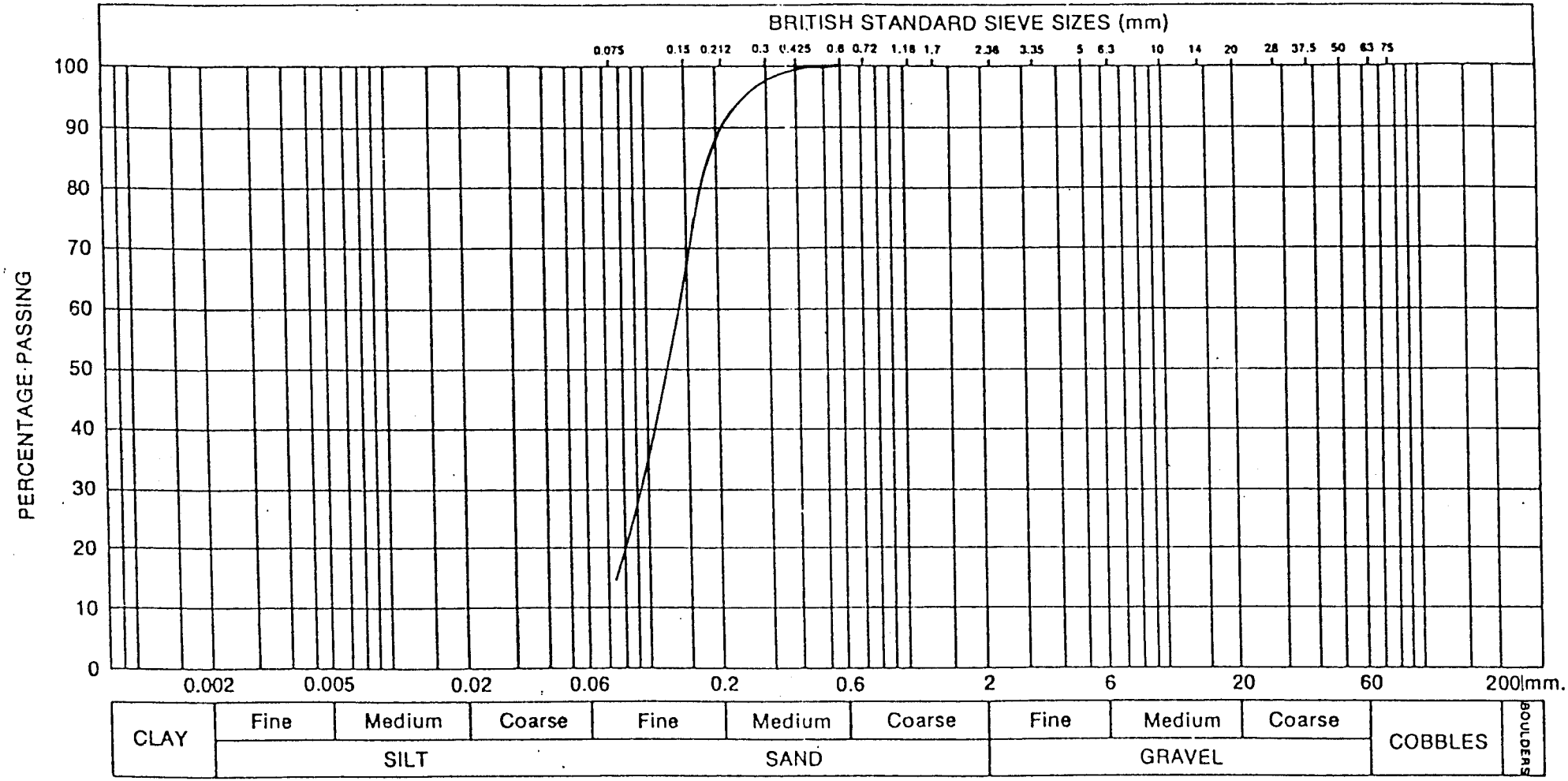


Figure 6

BOREHOLE
TRIAL HOLE NO. _____ SAMPLE NO. A DEPTH _____ m. DESCRIPTION GREY SAND

Sample Ref.		
5231	DATE 5/3/87	SCHEME Housing Scheme, Dornoch. LOCATION DATE SAMPLED

Client :-
Scott, Wilson, Kirkpatrick

Figure 7

HIGHLAND TESTING SERVICES LTD.
(Inverness)

MATERIALS TESTING ENGINEERS
AND CONSULTING TECHNOLOGISTS

42a SEAFIELD ROAD
LONGMAN INDUSTRIAL ESTATE
INVERNESS
Telephone (0463) 225844

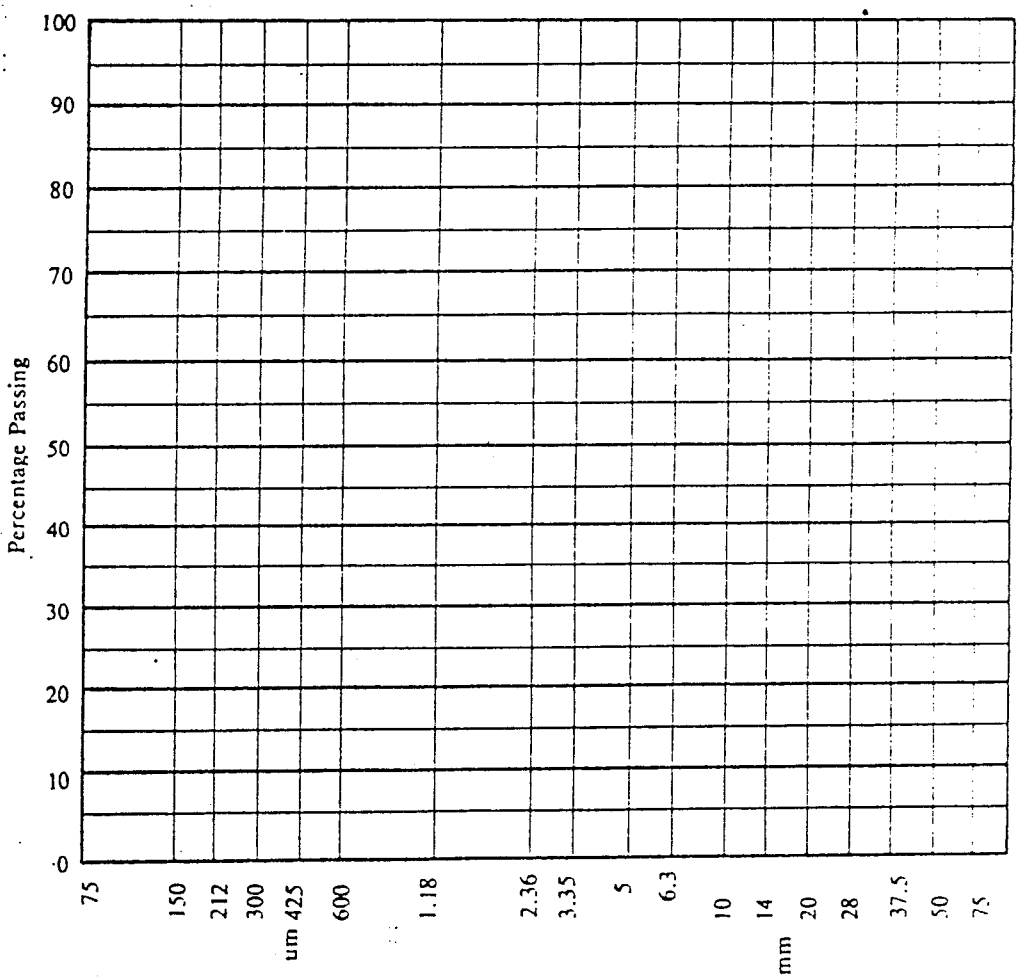
AGGREGATE GRADING ANALYSIS

SAMPLE NO. B
SAMPLE REF. 5231

CLIENT. Scott, Wilson, Kirkpatrick Ltd
CONTRACT. Housing Scheme, Dornoch
LOCATION.....
DATE RECEIVED. 5.3.87

MATERIAL. Sand (brown)
SUPPLIER.....
SOURCE.....
B.S. APPLICABLE.....

B.S. Sieve Size	Cumulative Percentages Passing		
Metric			Spec.
75mm			
63mm			
50 mm			
37.5 mm			
28 mm			
20 mm	100.0		
14 mm	97.8		
10 mm	96.2		
6.3 mm	93.7		
5 mm	93.5		
3.35 mm	92.9		
2.36 mm	92.3		
1.18 mm	90.6		
600 µm	77.9		
425	60.8		
300	36.4		
212	13.6		
150	4.3		
75	0.8		



REMARKS

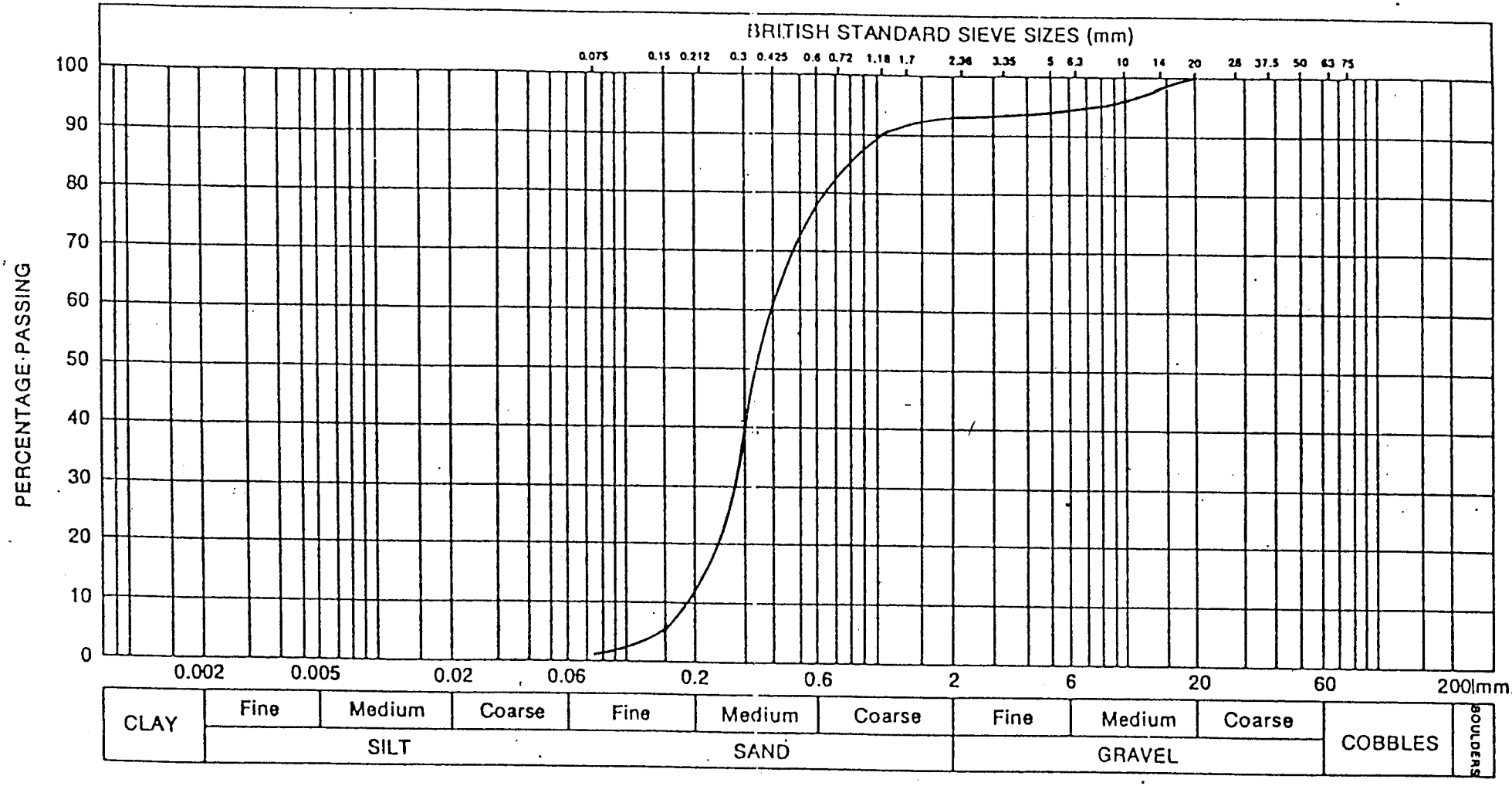
DATE.....

SIGNED D. S. Barr MATERIALS ENGINEER

42a SEAFIELD ROAD
LONGMAN INDUSTRIAL ESTATE
INVERNESS
Telephone (0463) 225844

HIGHLAND TESTING SERVICES LTD.

PARTICLE SIZE DISTRIBUTION



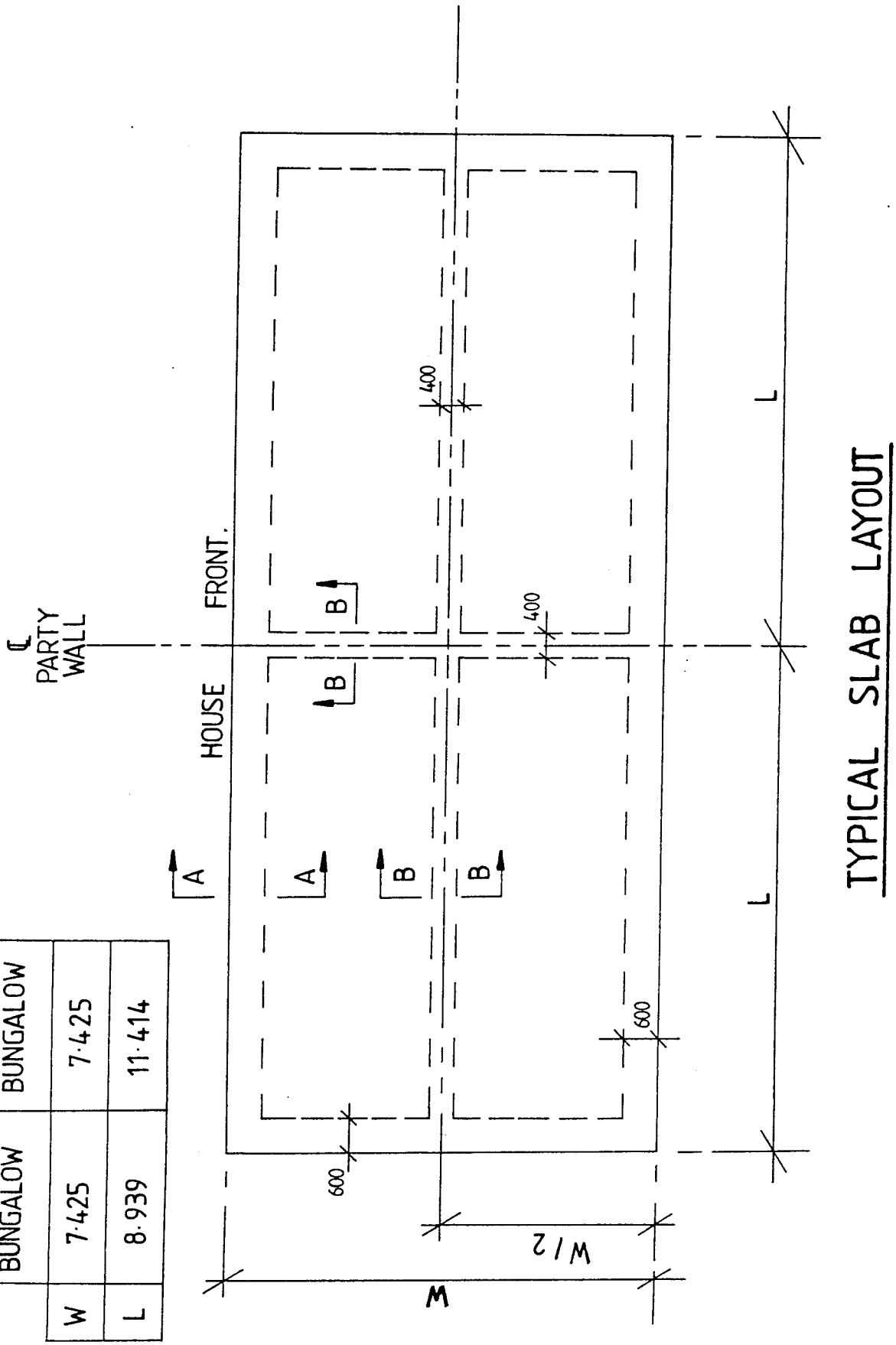
BOREHOLE
TRIAL HOLE NO. _____ SAMPLE NO. B DEPTH _____ m. DESCRIPTION BROWN SAND

Sample Ref.			
5231	DATE 5/3/87	SCHEME Housing Scheme, Dornoch. LOCATION DATE SAMPLED	Client :- Scott, Wilson, Kirkpatrick

Figure 8

SCOTT WILSON KIRKPATRICK & PARTNERS Chartered Engineers	SKETCH	Job No 87504	Sheet No FIGURE 9	Revision
	Revision / Suffix / Date			

Date	Initials	Checked	Job
MAR'87	DJB		PROPOSED HOUSING SCHEME SUTHERLAND ROAD DORNOCH.



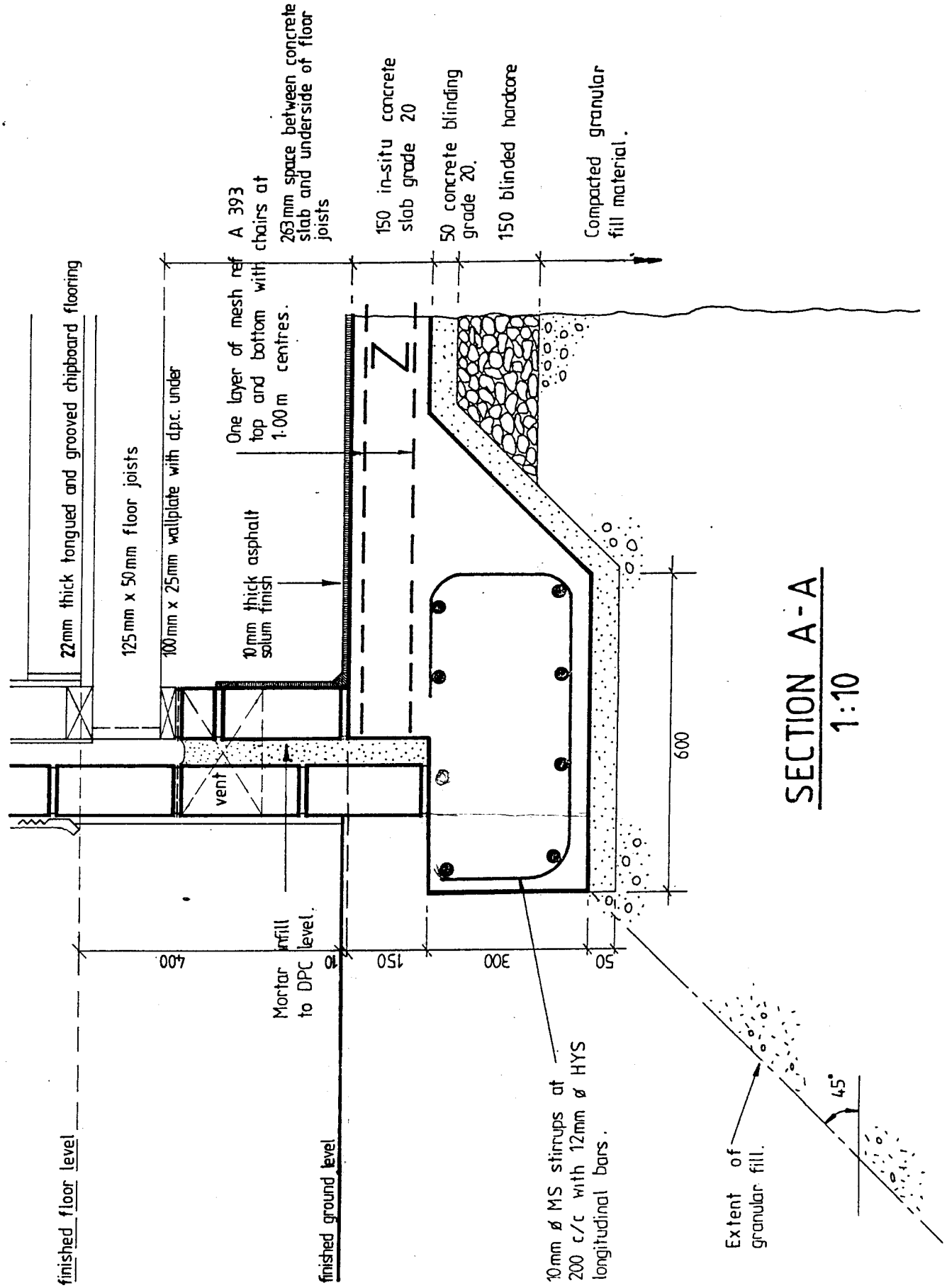
TYPICAL SLAB LAYOUT

DIMENSIONS OF SLABS.			
	2 APT BUNGALOW	3 APT BUNGALOW	
W	7·425	7·425	
L	8·939	11·414	

Form 672

SCOTT WILSON KIRKPATRICK & PARTNERS Chartered Engineers	SKETCH	Job No 87504	Sheet No FIGURE 10	Revision
	Revision / Suffix / Date			

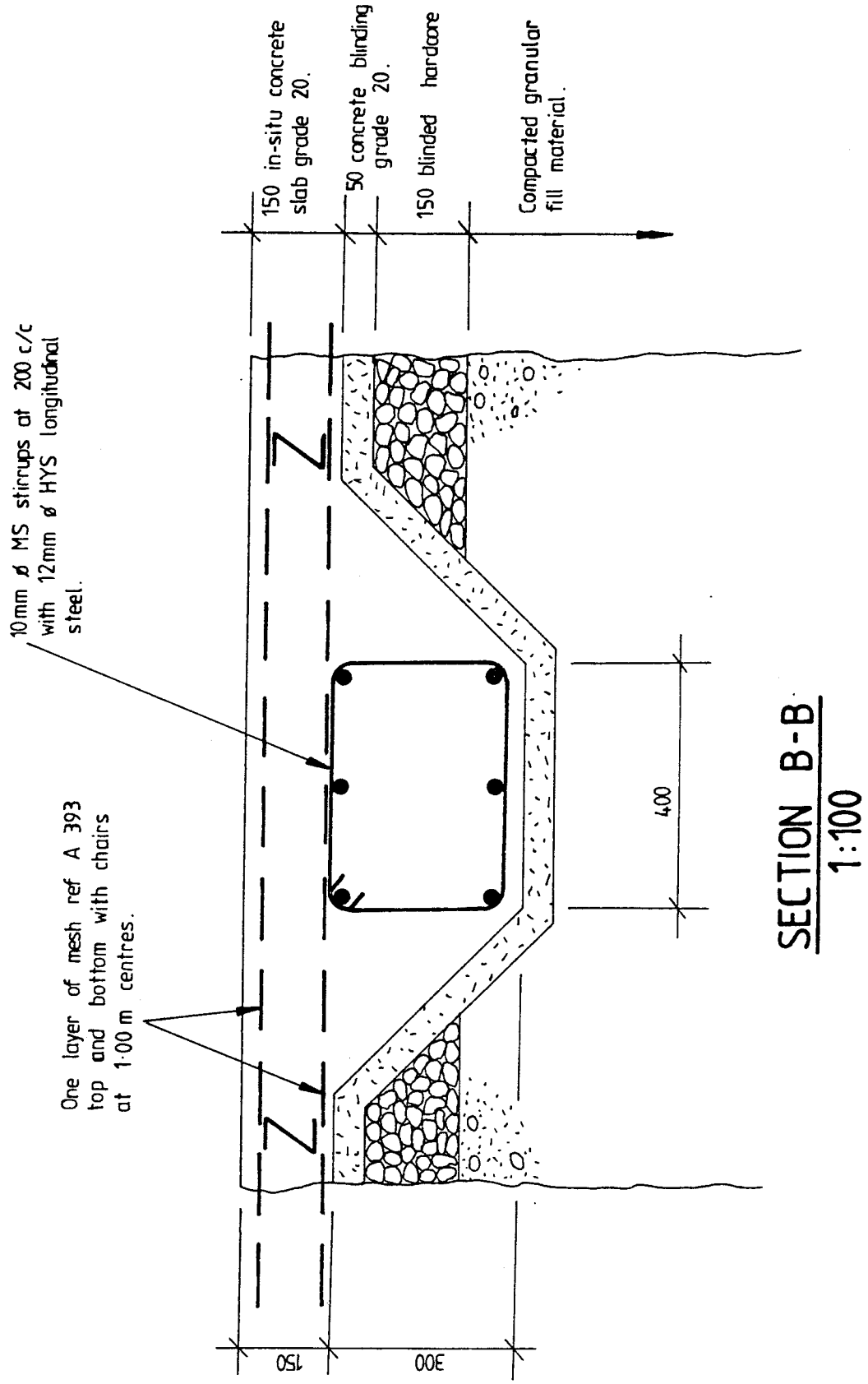
Date	Initials	Checked	Job
MAR'87	DJB		PROPOSED HOUSING SCHEME SUTHERLAND ROAD DORNOCH.



Form 672

SCOTT WILSON KIRKPATRICK & PARTNERS Chartered Engineers	SKETCH	Job No 87504	Sheet No FIGURE 11	Revision
	Revision / Suffix			
	Date			

Date	Initials	Checked	Job
MAR'87	DJB		PROPOSED HOUSING SCHEME SUTHERLAND ROAD DORNOCH.

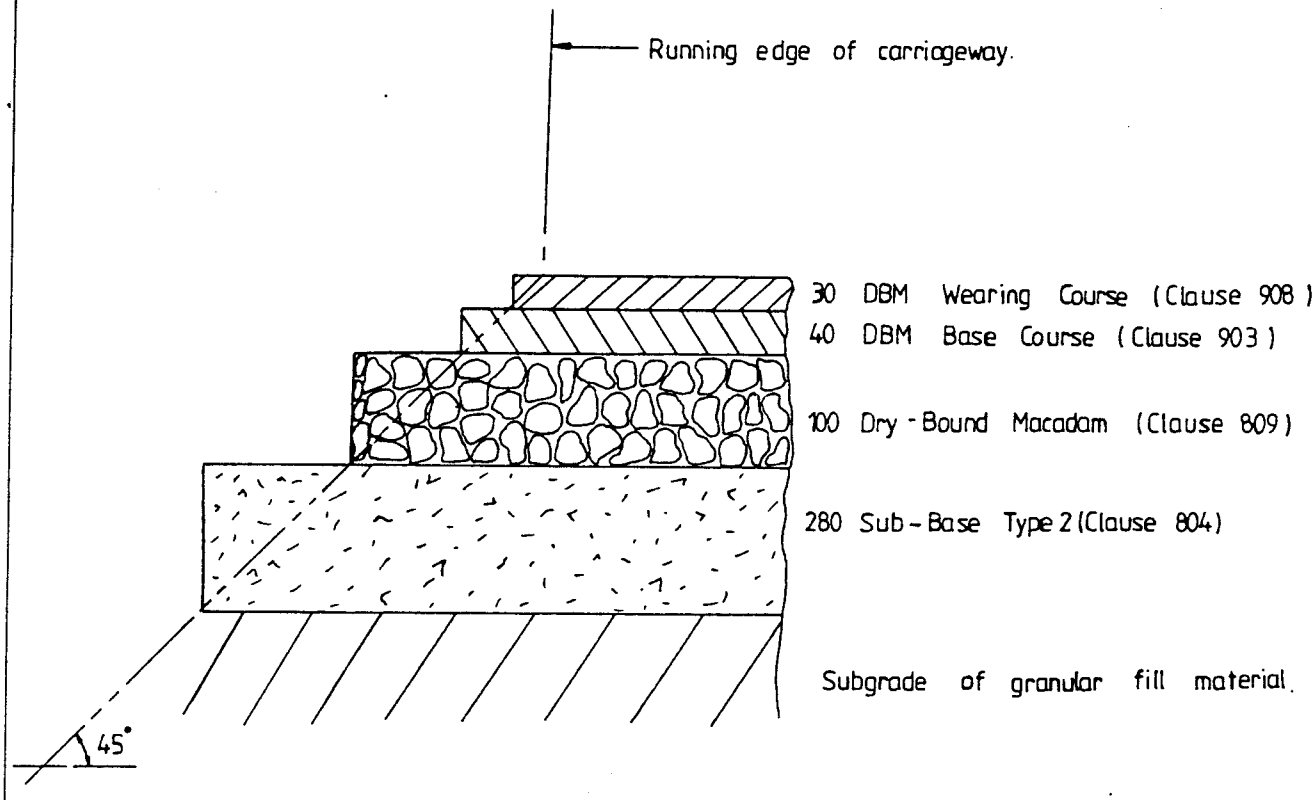


SECTION B-B
1:100

Form 672

SCOTT WILSON KIRKPATRICK & PARTNERS Chartered Engineers	SKETCH	Job No 87504	Sheet No FIGURE 12	Revisio
	Revision / Suffix / Date			

Date	Initials	Checked	Job
MAR'87	DJB		PROPOSED HOUSING SCHEME SUTHERLAND ROAD DORNOCH.



ACCESS ROAD PAVEMENT

RECOMMENDED CONSTRUCTION

NOTES

1. All materials, laying and compaction to be in accordance with the DOT "Specification for Road and Bridge Works."
2. DBM Wearing Course to have 10mm aggregate.
   DBM Base Course to have 20mm aggregate.