COMPUTER AIDED VISUAL IMPACT ANALYSIS

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A thesis submitted for the
degree of Doctor of Philosophy.

Volume 2.

Department of Architecture and Building Science
University of Strathclyde, Glasgow.

September, 1983

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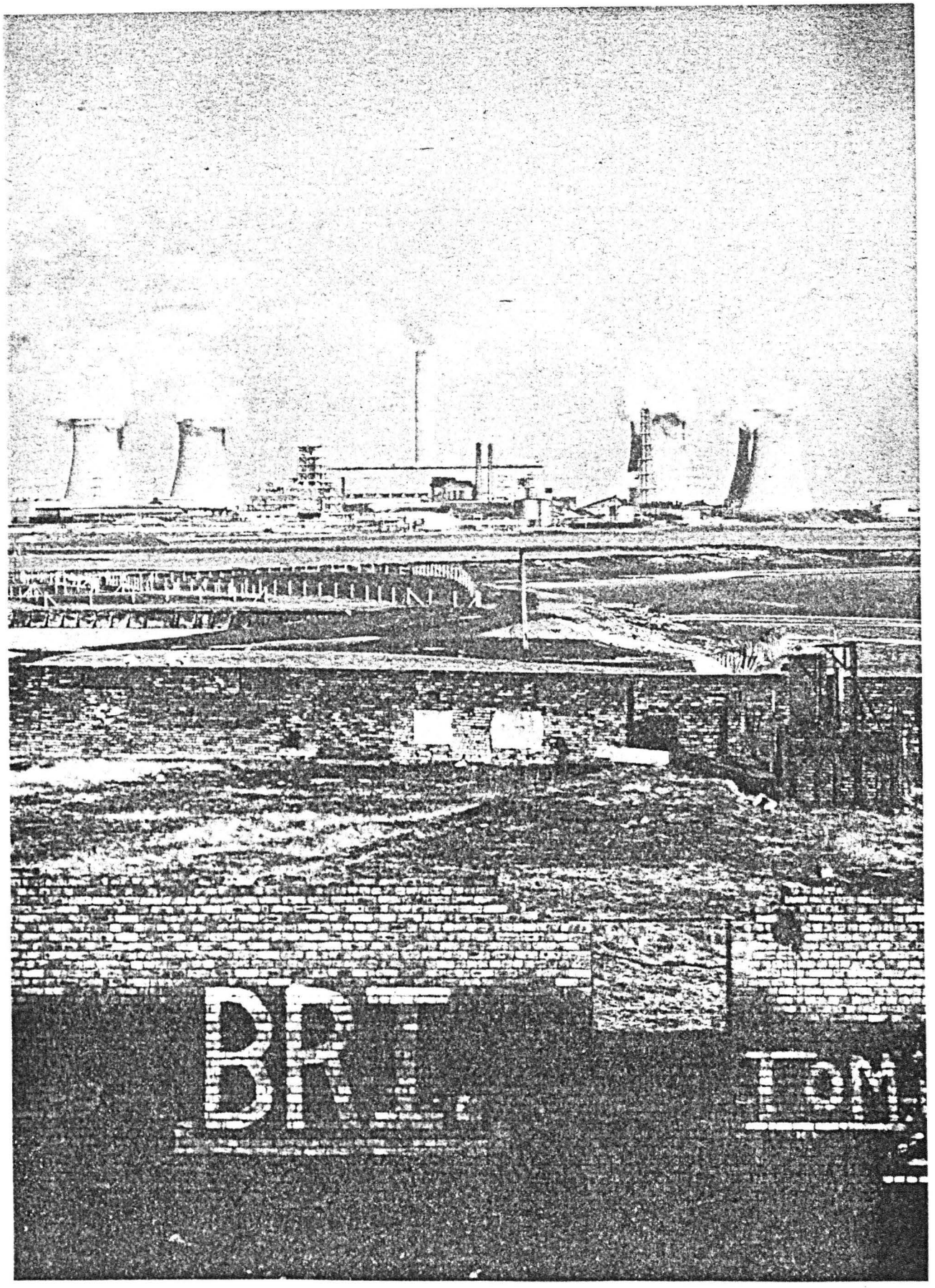
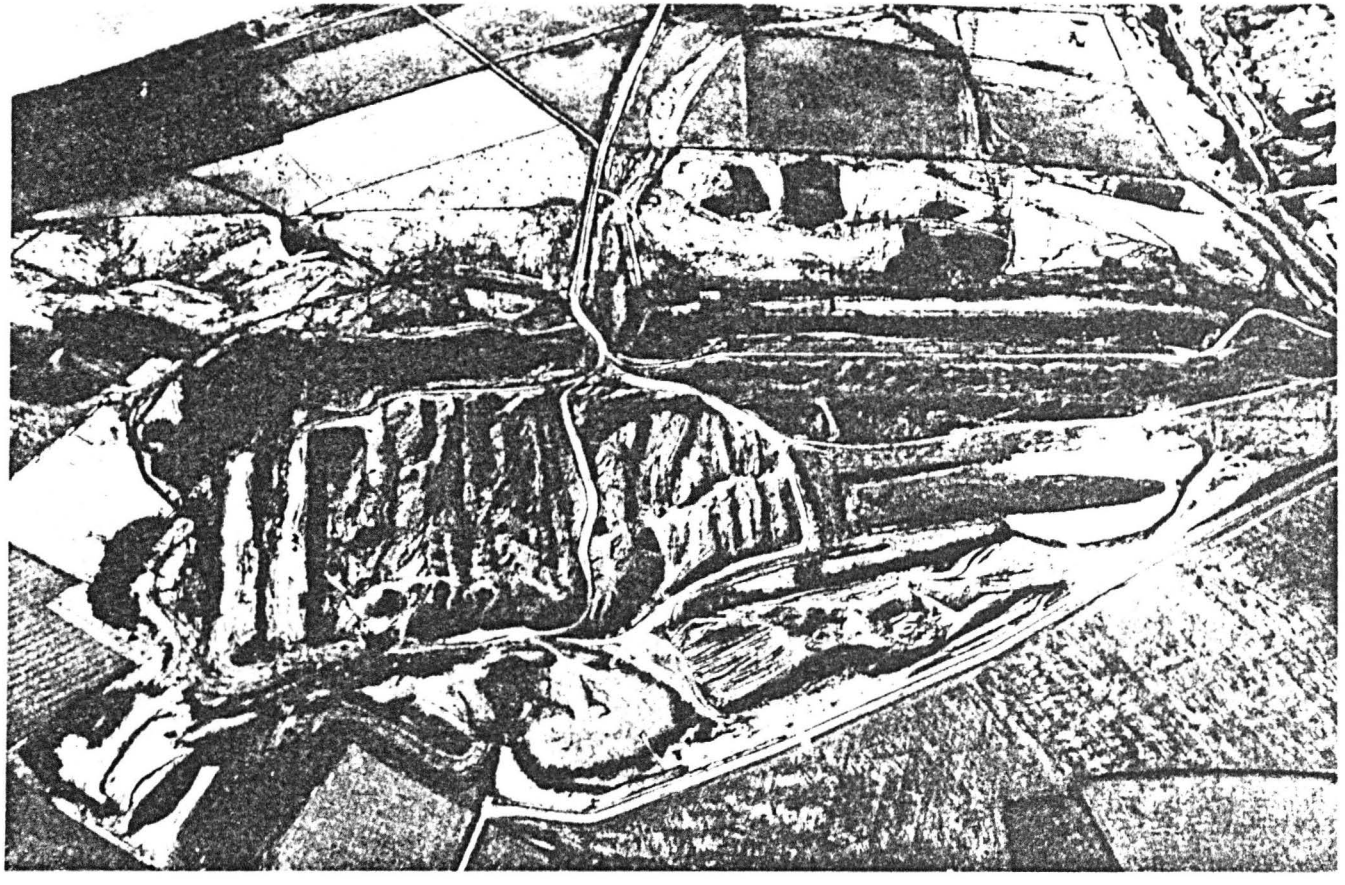
GRAPHICS

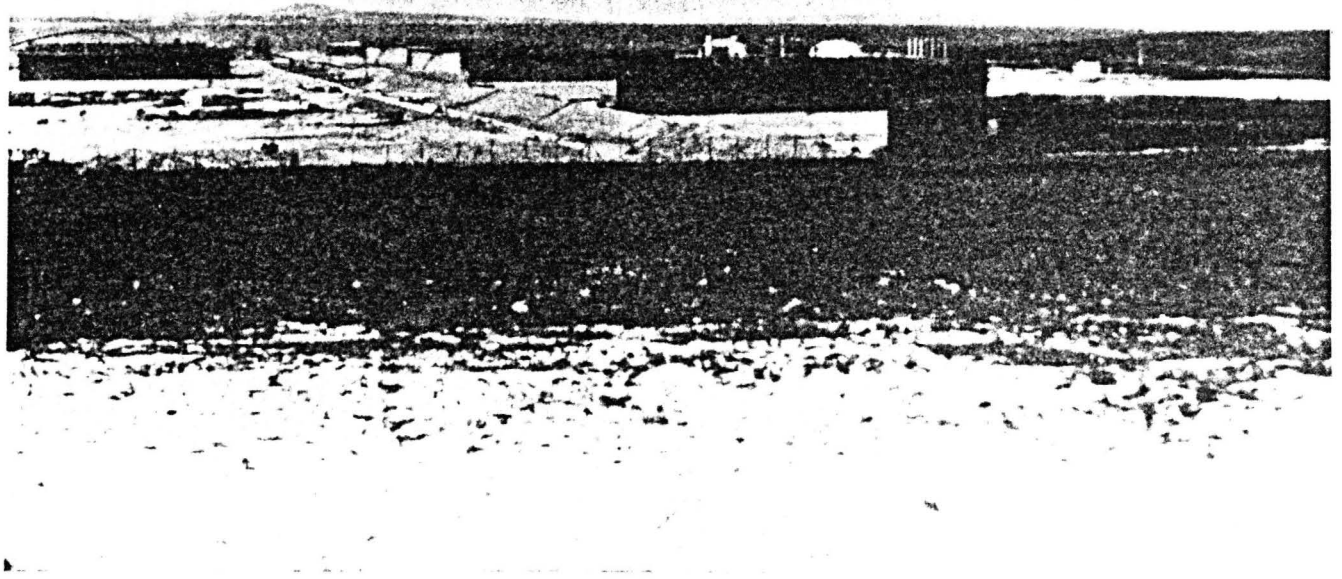
CHAPTER 1



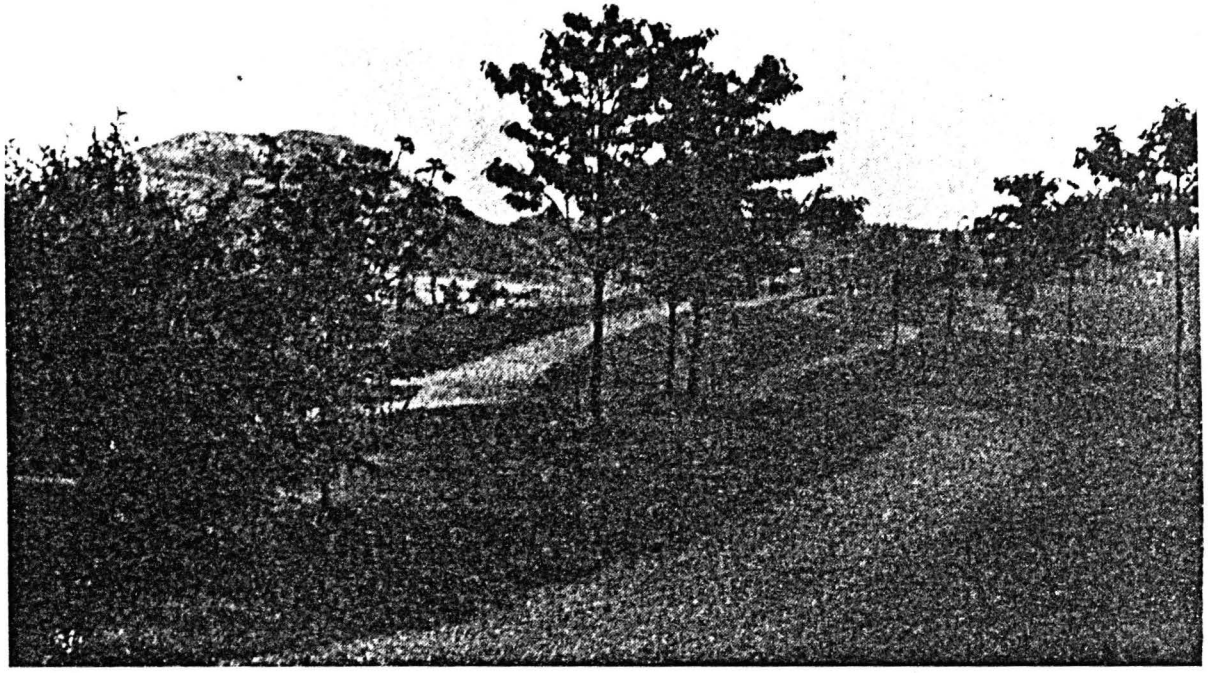
(G1) The Visual Environment of Industry. (ARCH77) p348



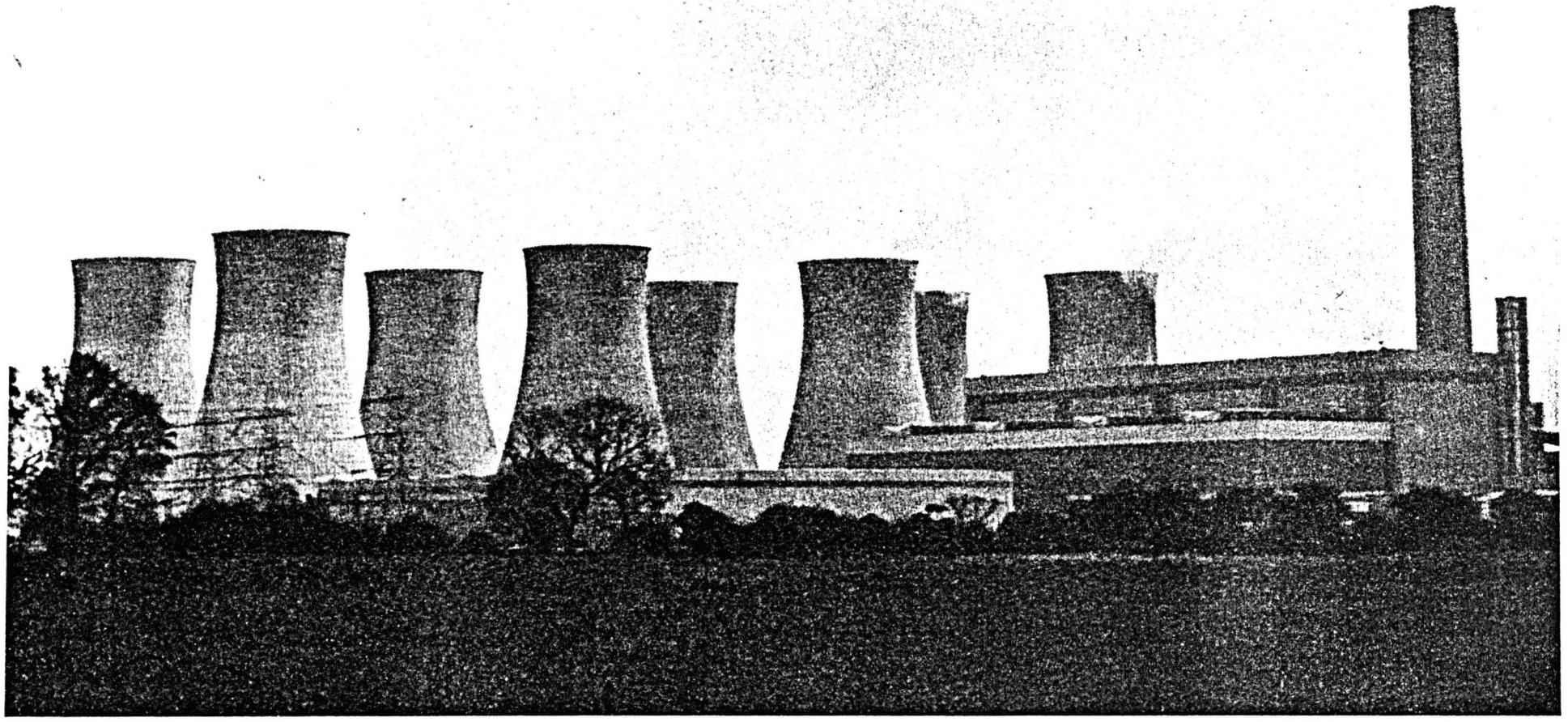
(G2) Open Cast Coal Mining (LOVE79) p258.



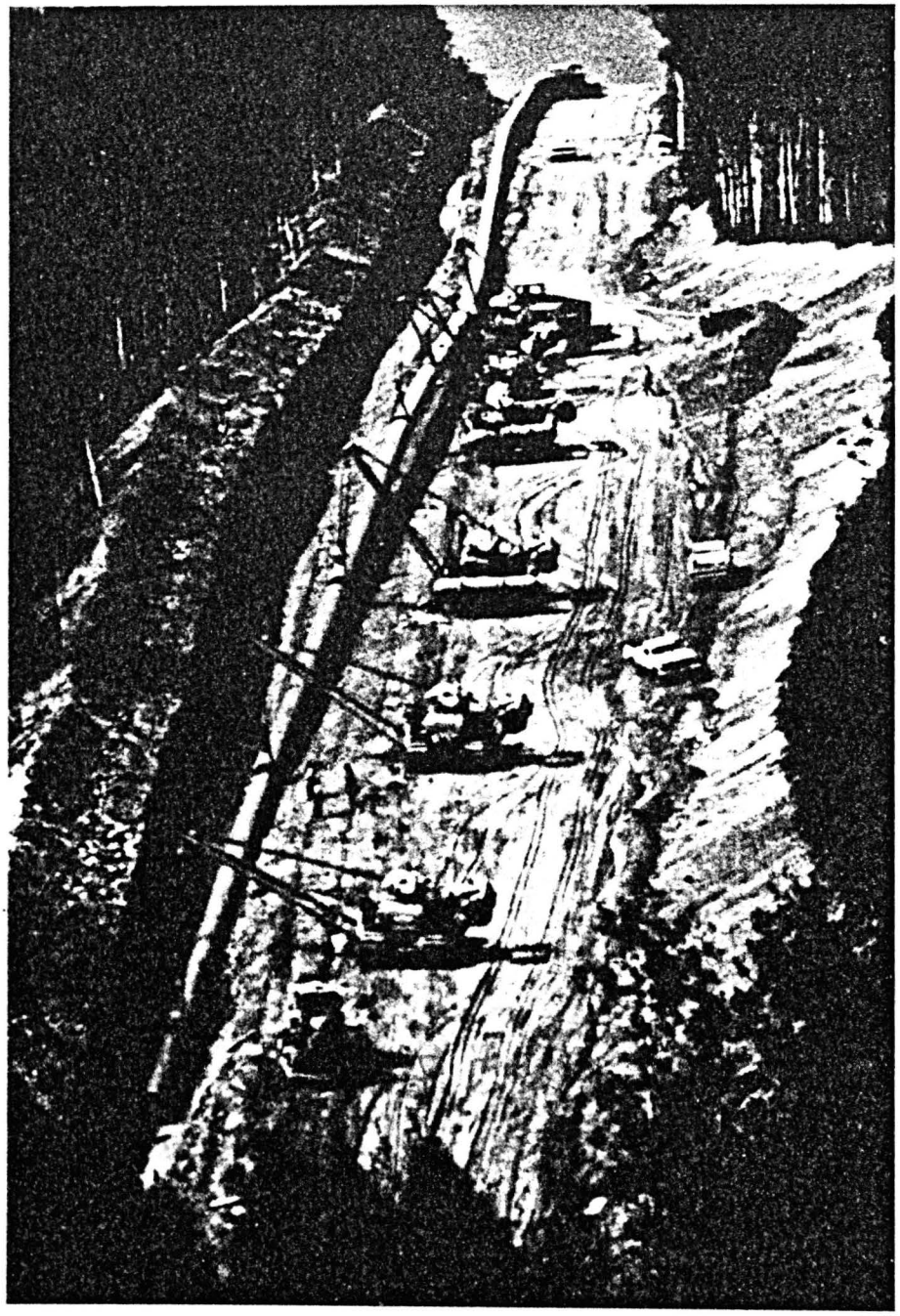
(G3) Oil Terminal, Flotta, Orkney.



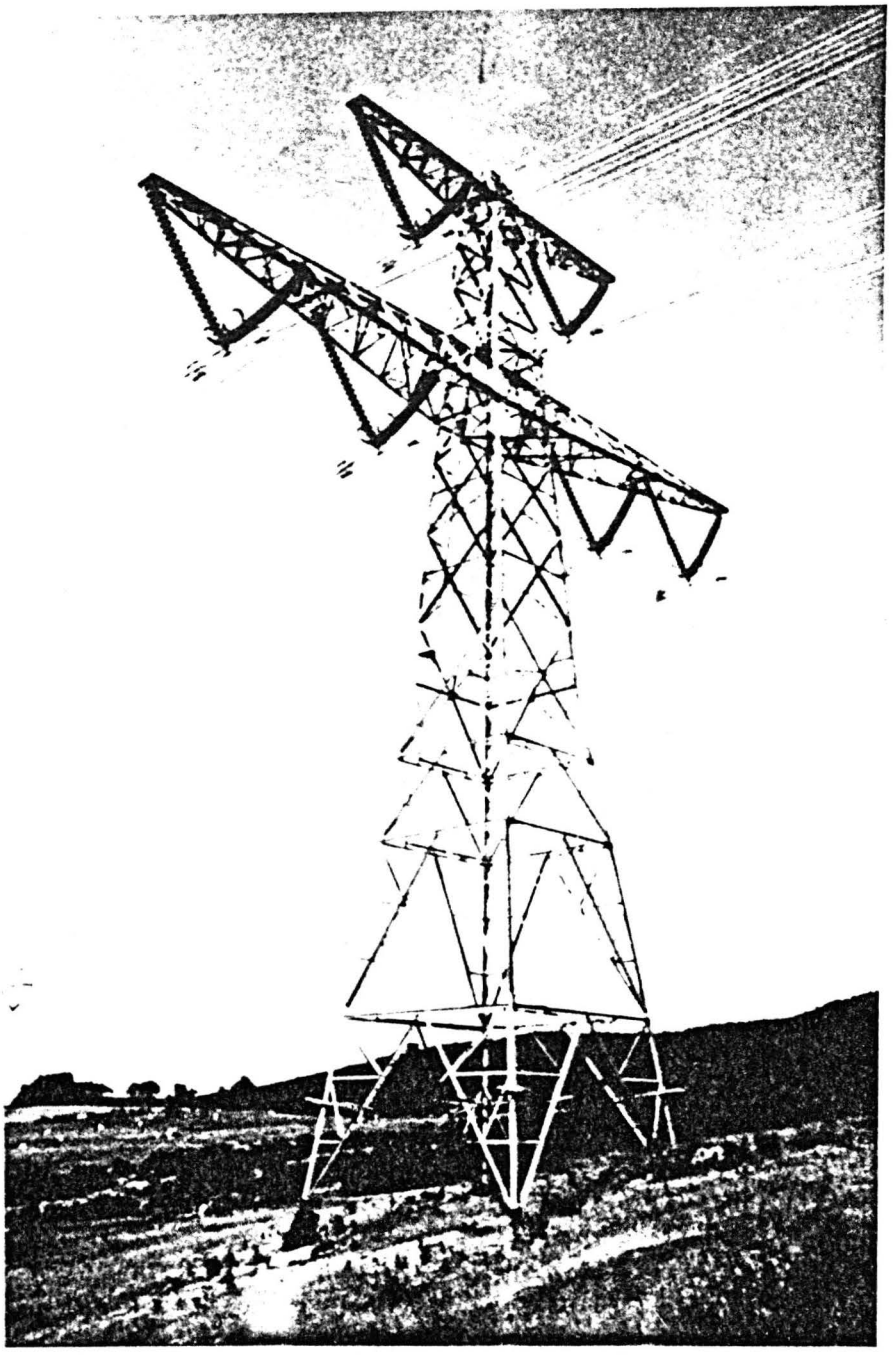
(G4) Reinstated industrial wasteland and quarry. (LOVE79) p264.



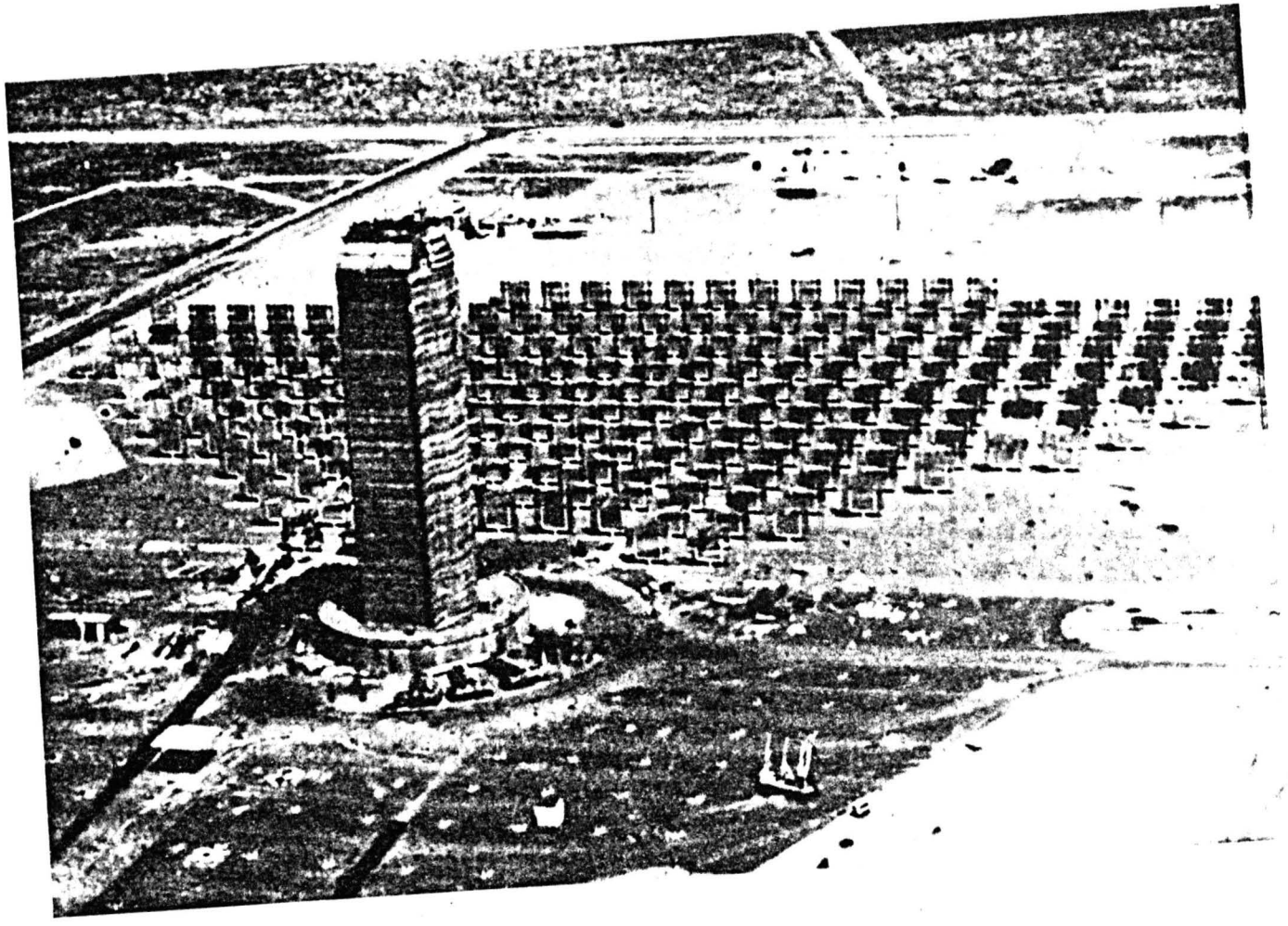
(G5) Eggborough Power Station, CEGB. England.



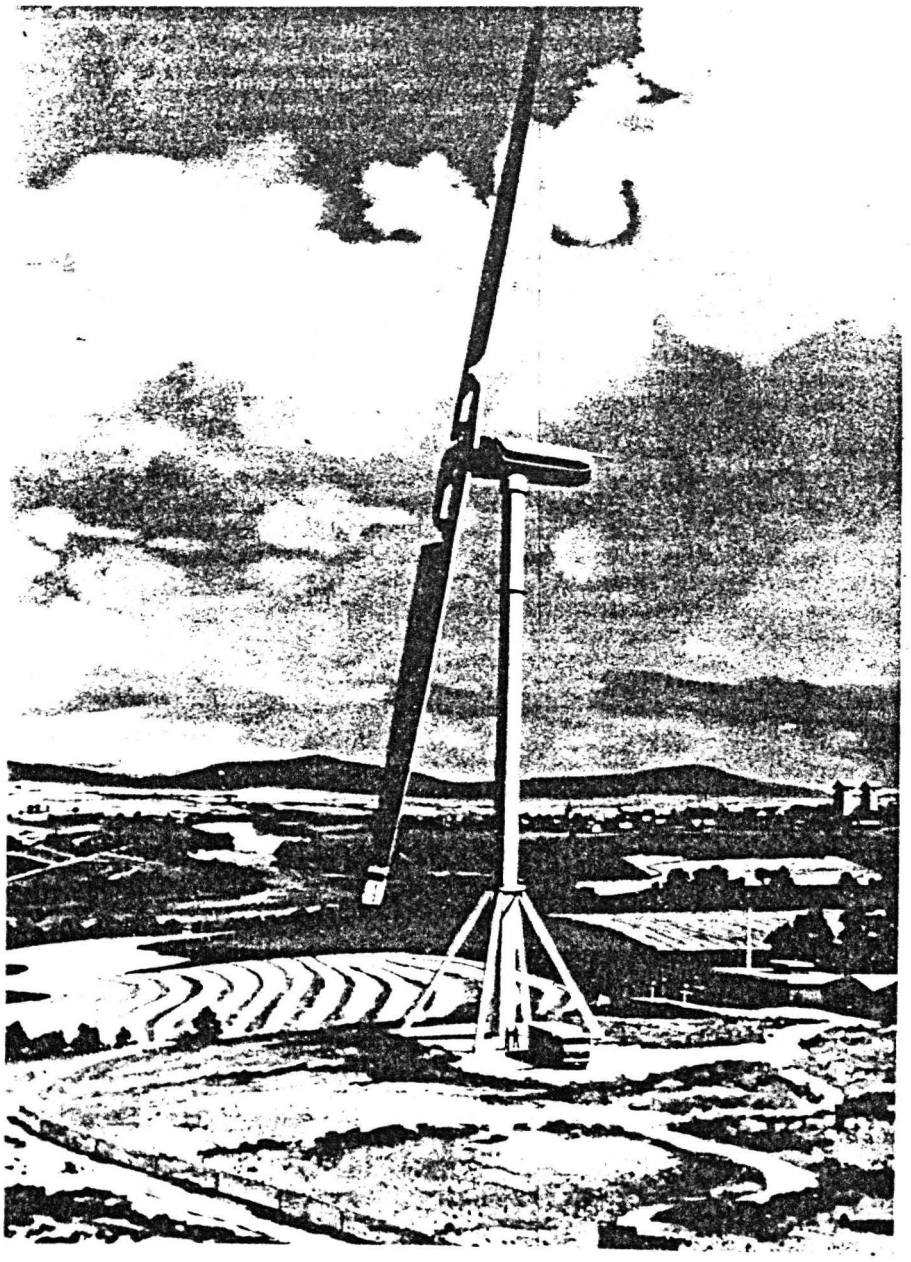
(G6) The linear incision of pipeline corridors across the landscape.



(G7) Electricity pylons - high visual attention especially when seen against the sky.

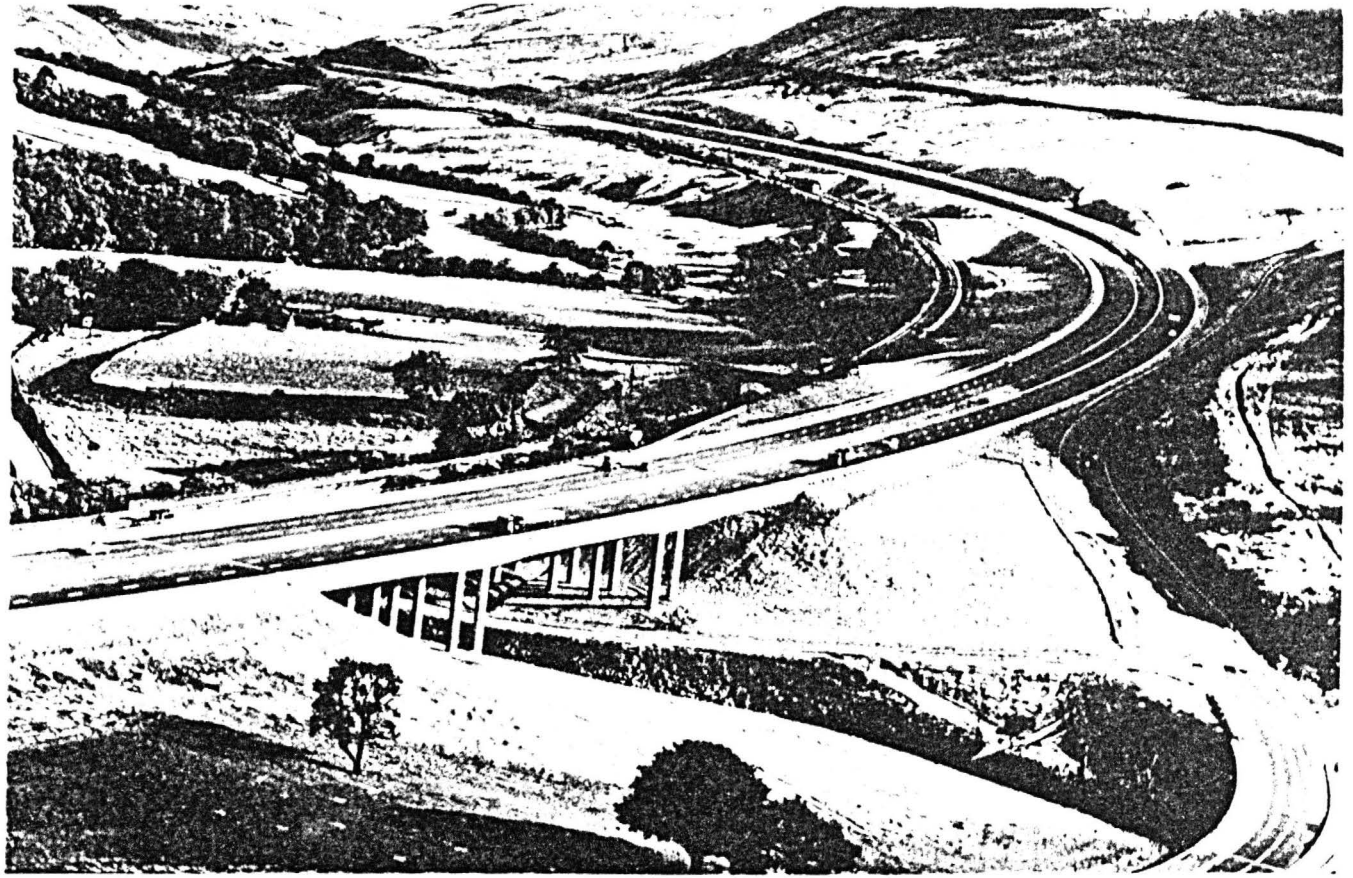


(G8) Solar collectors.



A PROPOSED 2·5 MEGAWATT AEROGENERATOR

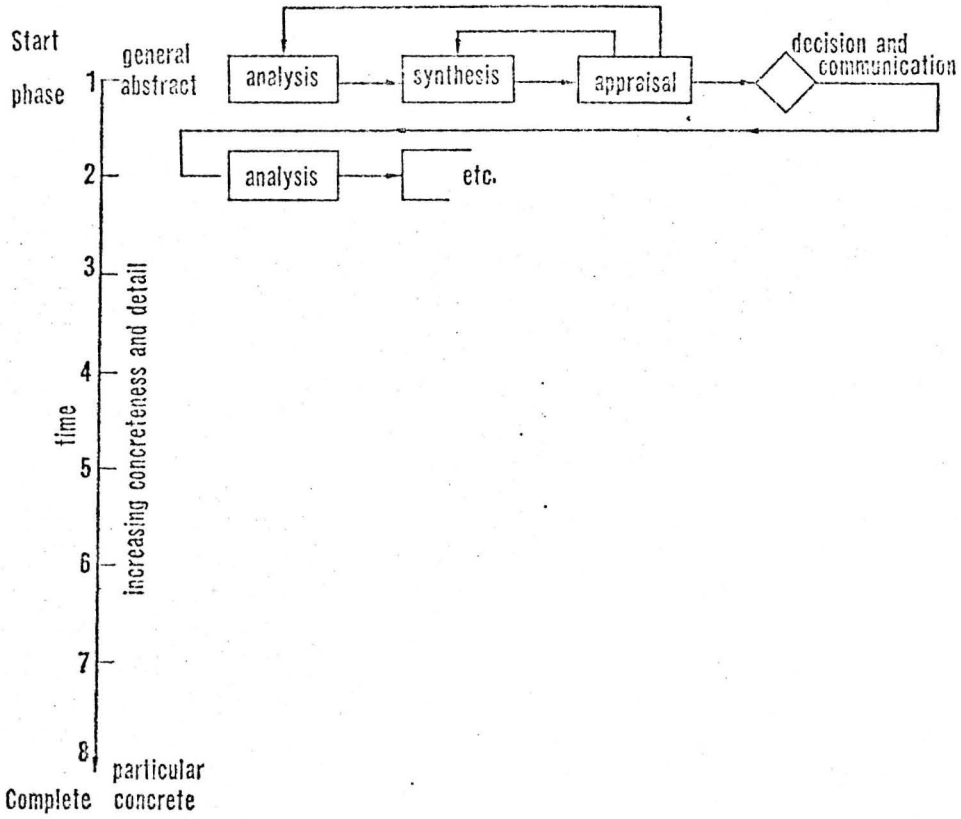
(G9) Wind turbine generator. (WATT79).



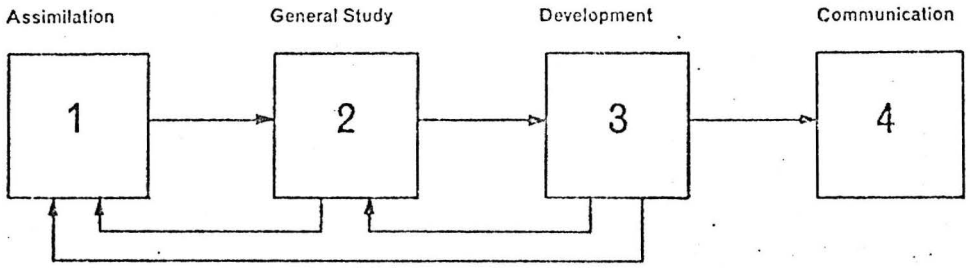
(G10) Motorway systems and the landscape (LOVE73) p171.

(G11) Recreation and the environment
Peak National Park (LOVE73) p157 and p158.

CHAPTER 2



(G12) Markus/Maver model of the design process. (MARK72) p22.



Phase 1 assimilation

The accumulation and ordering of general information and information specifically related to the problem in hand.

Phase 2 general study

The investigation of the nature of the problem.

The investigation of possible solutions or means of solution.

Phase 3 development

The development and refinement of one or more of the tentative solutions isolated during phase 2.

Phase 4 communication

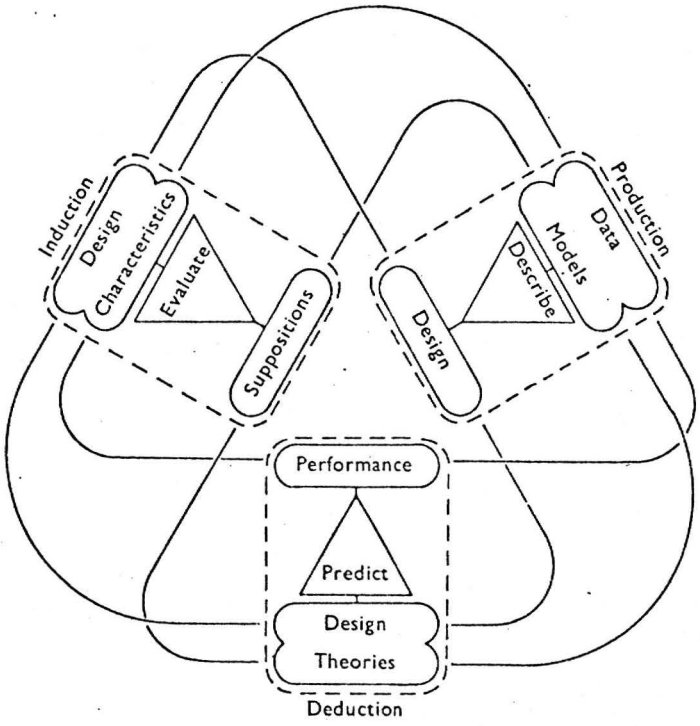
The communication of one or more solutions to people inside or outside the design team.

(G13) RIBA model of the design process. (LAWS80) p24 (ROYA80) p346.

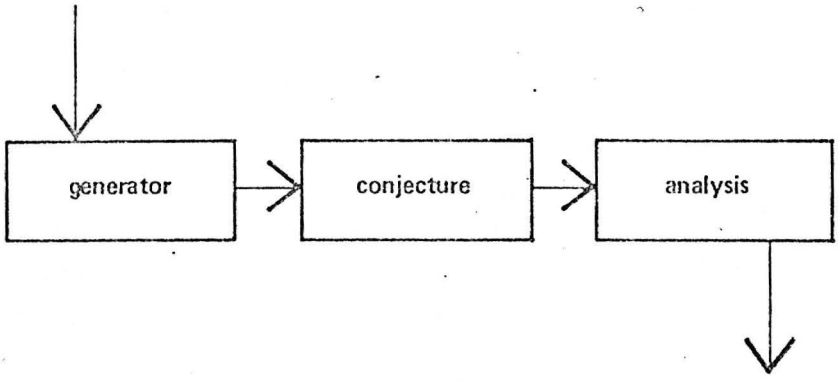
Outline plan of work

Stage	Purpose of work and Decisions to be reached	Tasks to be done	People directly involved	Usual Terminology
A. Inception	To prepare general outline of requirements and plan future action.	Set up client organisation for briefing. Consider requirements, appoint architect.	All client interests, architect.	**Briefing**
B. Feasibility	To provide the client with an appreisal and recommendation in order that he may determine the form in which the project is to proceed, ensuring that it is feasible, functionally, technically and financially.	Carry out studies of user requirements, site conditions, planning, design, and cost, etc., as necessary to reach decisions.	Clients' representatives, architects, engineers, and QS according to nature of project.	
C. Outline Proposals	To determine general approach to layout, design and construction in order to obtain authoritative approval of the client on the outline proposals and accompanying report.	Develop the brief further. Carry out studies on user requirements, technical problems, planning, design and costs, as necessary to reach decisions.	All client interests, architects, engineers, QS and specialists as required.	**Sketch Plans**
D. Scheme Design	To complete the brief and decide on particular proposals, including planning arrangement appearance, constructional method, outline specification, and cost, and to obtain all approvals.	Final development of the brief, full design of the project by architect, preliminary design by engineers, preparation of cost plan and full explanatory report. Submission of proposals for all approvals.	All client interests, architects, engineers, QS and specialists and all statutory and other approving authorities.	
Brief should not be modified after this point.				
E. Detail Design	To obtain final decision on every matter related to design, specification, construction and cost.	Full design of every part and component of the building by collaboration of all concerned. Complete cost checking of designs.	Architects, QS, engineers and specialists, contractor (if appointed).	**Working Drawings**
Any further change in location, size, shape, or cost after this time will result in abortive work.				
F. Production Information	To prepare production information and make final detailed decisions to carry out work.	Preparation of final production information i.e. drawings, schedules and specifications.	Architects, engineers and specialists, contractor (if appointed).	
G. Bills of Quantities	To prepare and complete all information and arrangements for obtaining tender.	Preparation of Bills of Quantities and tender documents.	Architects, QS, contractor (if appointed).	
H. Tender Action	Action as recommended in NJCC *Code of Procedure for Single Stage Selective Tendering* 1977.*	Action as recommended in NJCC *Code of Procedure for Single Stage Selective Tendering* 1977.*	Architects, QS, engineers, contractor, client.	
J. Project Planning	To enable the contractor to programme the work in accordance with contract conditions; brief site inspectorate; and make arrangements to commence work on site.	Action in accordance with *The Management of Building Contracts** and Diagram 9.	Contractor, sub-contractors.	**Site Operations**
K. Operations on Site	To follow plans through to practical completion of the building.	Action in accordance with *The Management of Building Contracts** and Diagram 10.	Architects, engineers, contractors, sub-contractors, QS, client.	
L. Completion	To hand over the building to the client for occupation, remedy any defects, settle the final account, and complete all work in accordance with the contract.	Action in accordance with *The Management of Building Contracts** and Diagram 11.	Architects, engineers, contractor, QS, client.	
M. Feed-Back	To analyse the management, construction and performance of the project	Analysis of job records. Inspections of completed building. Studies of building in use.	Architect engineers, QS contractor, client.	

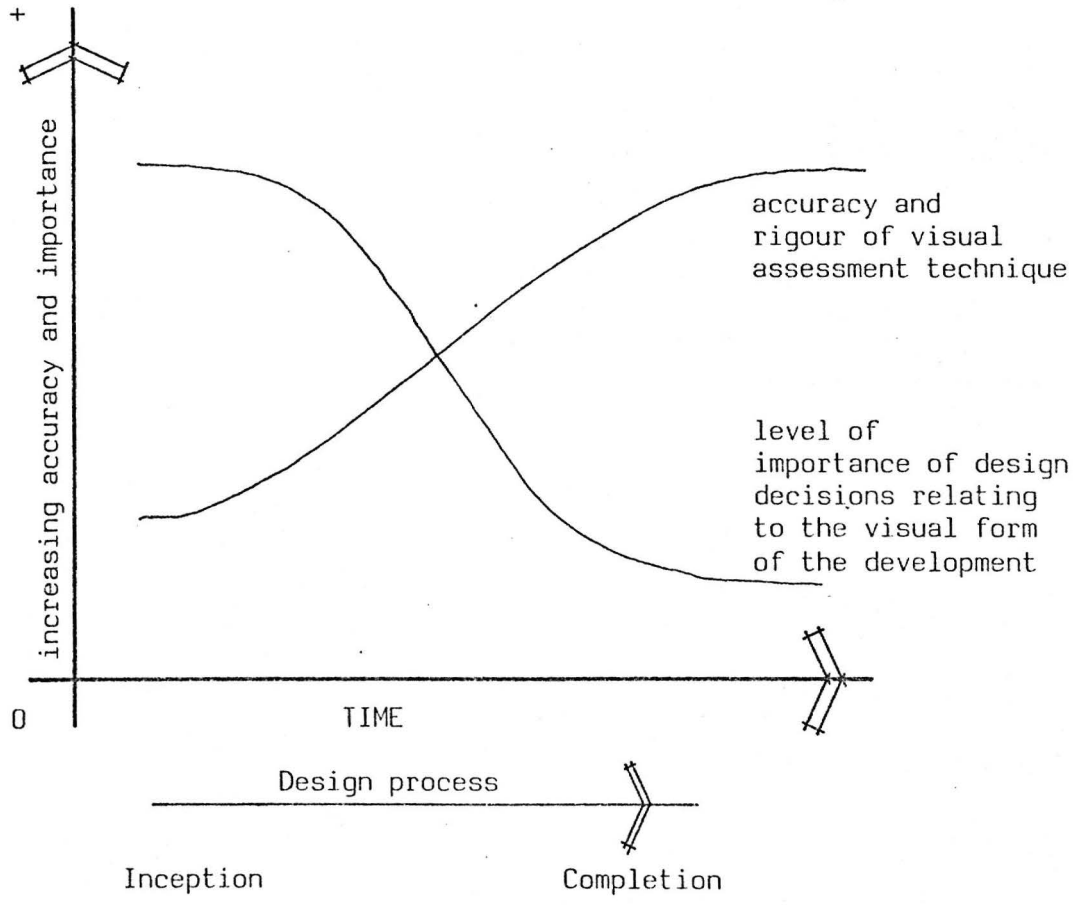
(G14) RIBA outline plan of work. (ROYA80) p351.



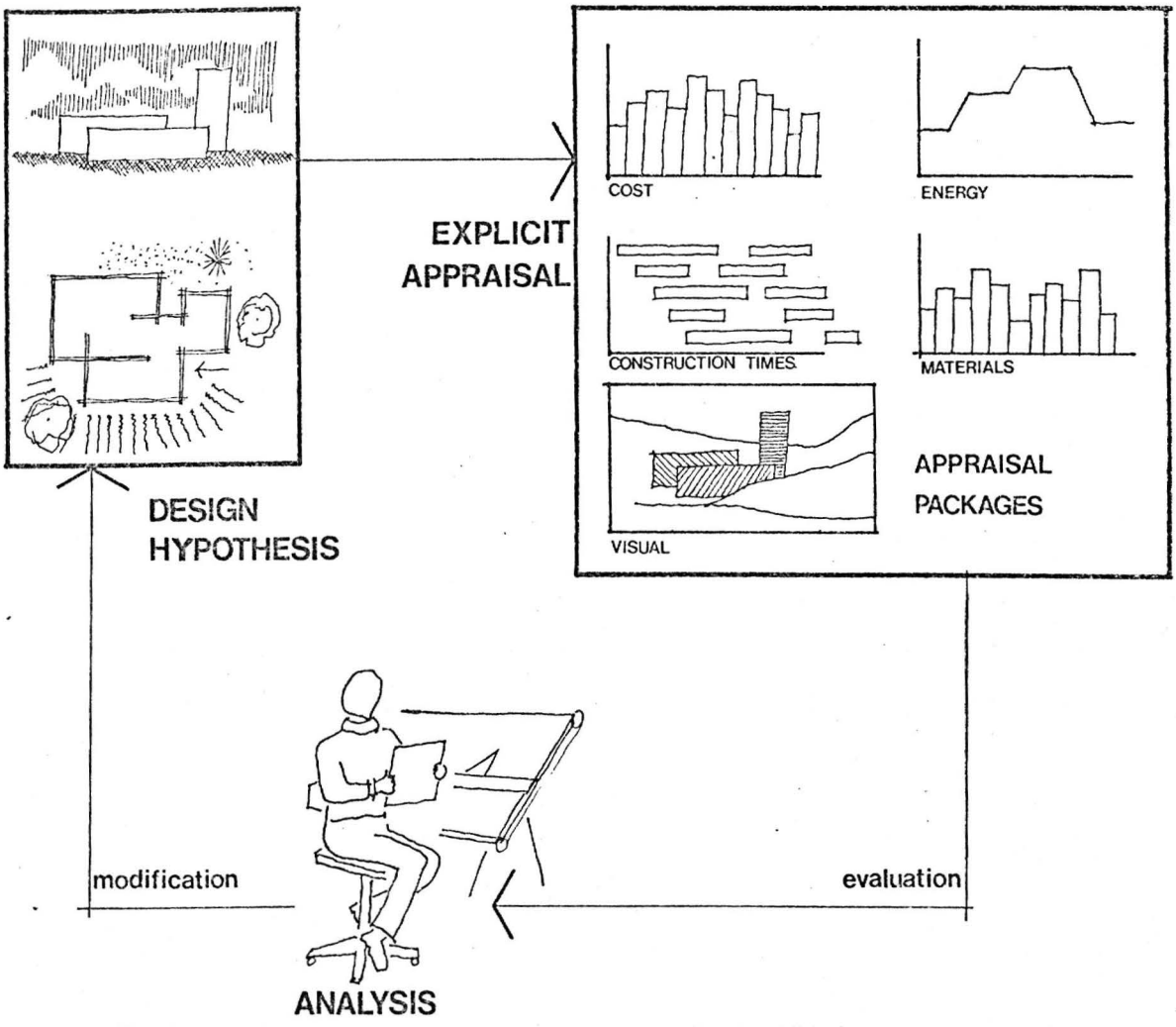
(G15) March's PDI model of the design process. (MARC76) p20



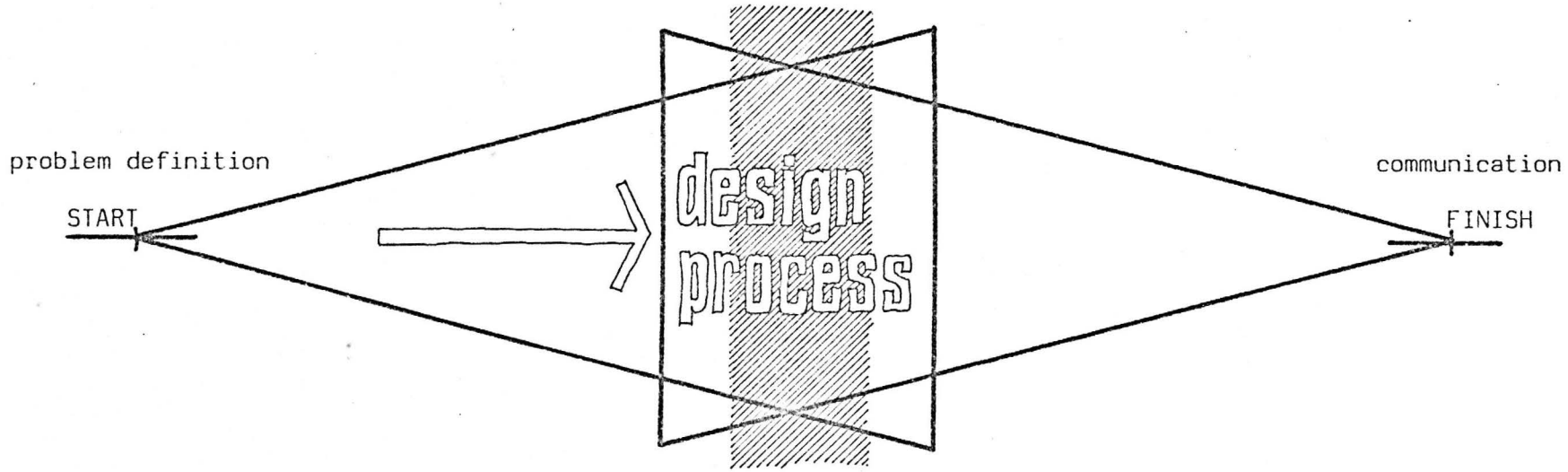
(G16) Darke's partial map of the design process (LAWS80) p34.



(G17) The importance of design decisions and quality of visual assessment procedures over time.



(G18) The design activity model (MAVE75).

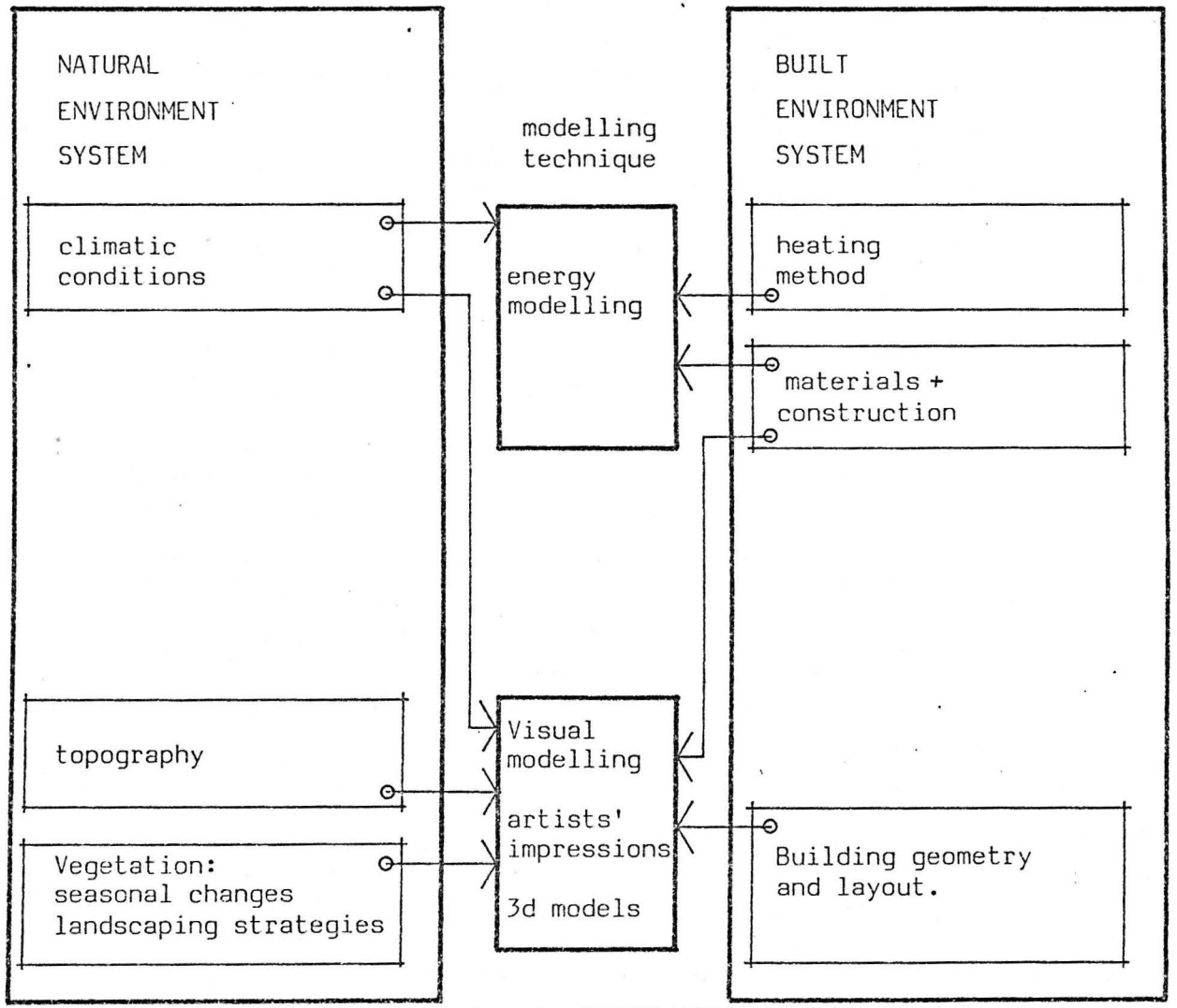


Divergence:
- i) the objectives are unstable and tentative.
- ii) the problem boundary is unstable and undefined.
- iii) evaluation is deferred till the convergence phase.
- iv) constant revision of client brief and objectives.

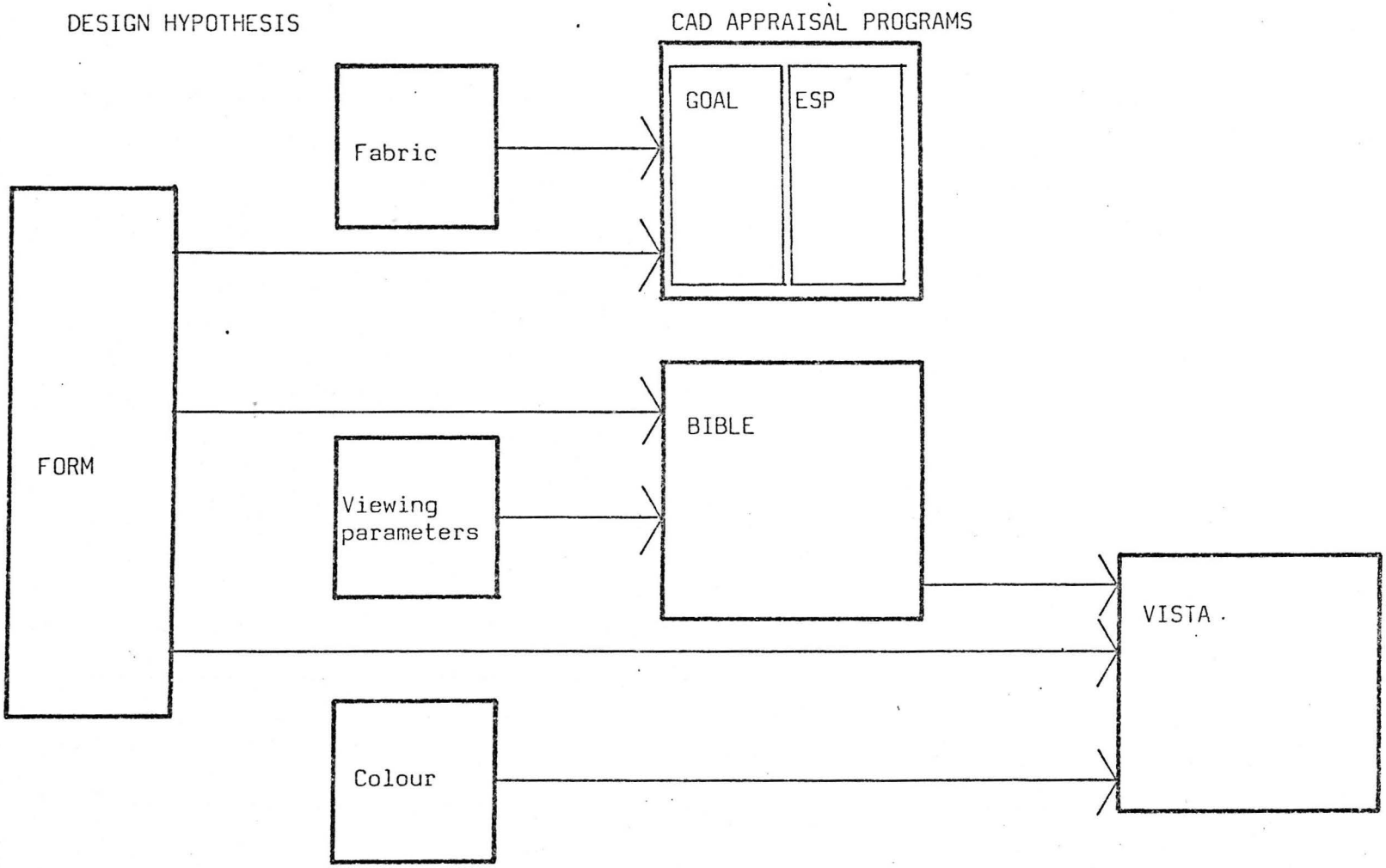
Transformation:
- i) the imposition of a pattern on the divergent search in order to permit convergence to a single design solution.
- ii) objectives, brief and problem boundaries fixed; constraints and variables recognised; judgements made.
- iii) sub division of the problem.

Convergence:
- i) reduction of uncertainty in hypothesised solutions.
- ii) sub problems arise with increasing convergence on a design solution.
- iii) representative models become less abstract.
- iv) reduction of options to a single chosen design.

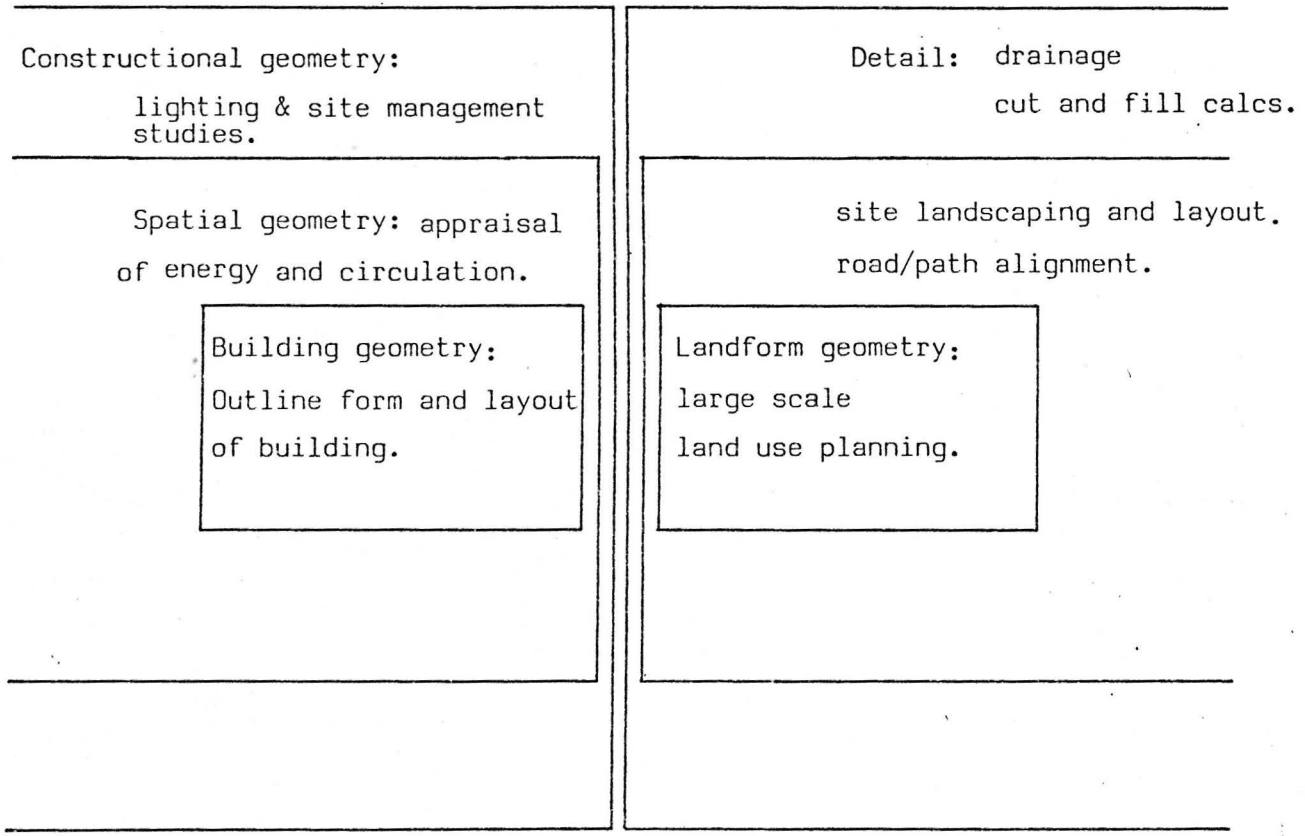
(G19) Jones' three stage design process : divergence/transformation/convergence. (JONE80).



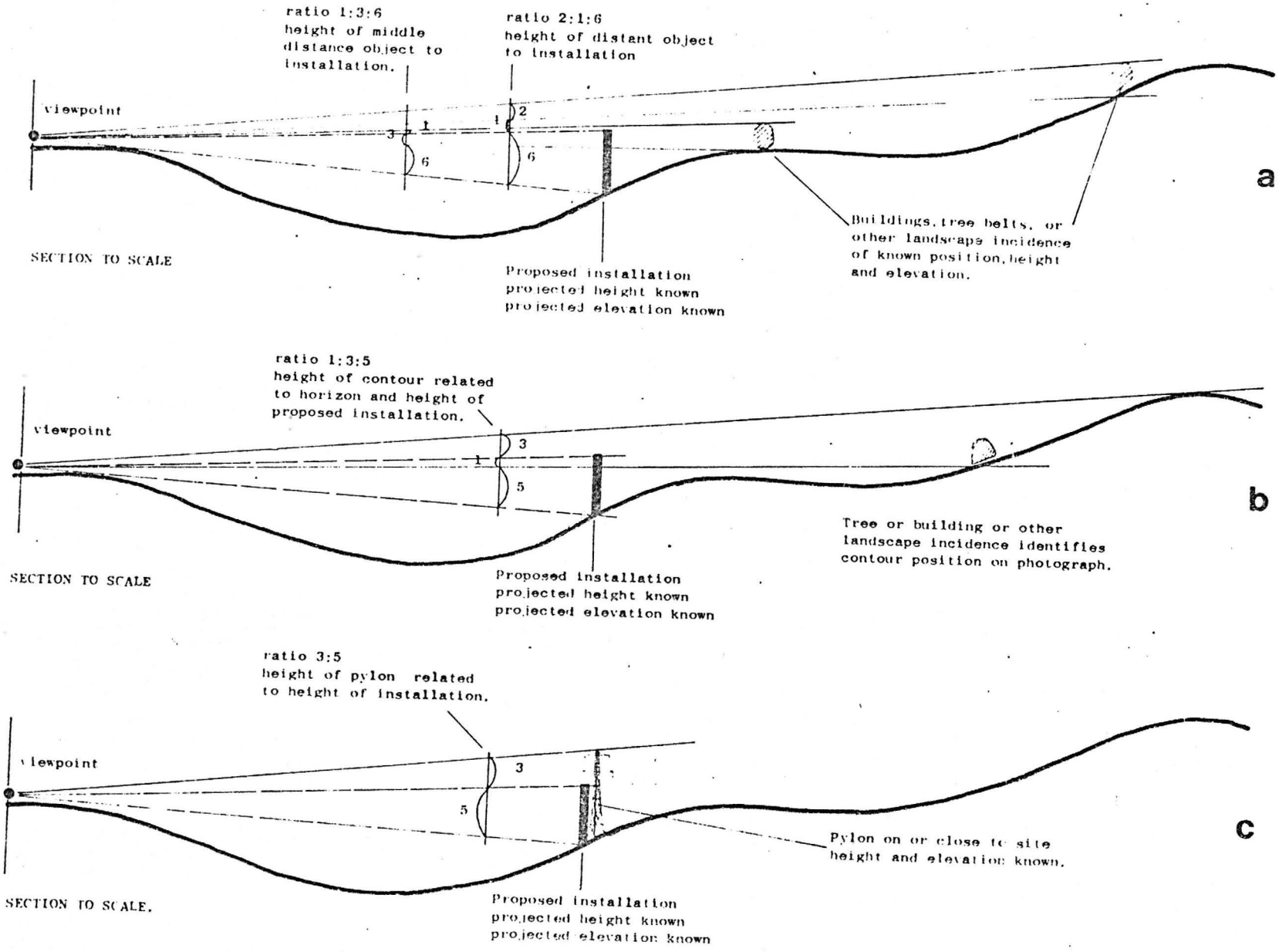
(G20) Modelling at the natural environment/built environment interface.



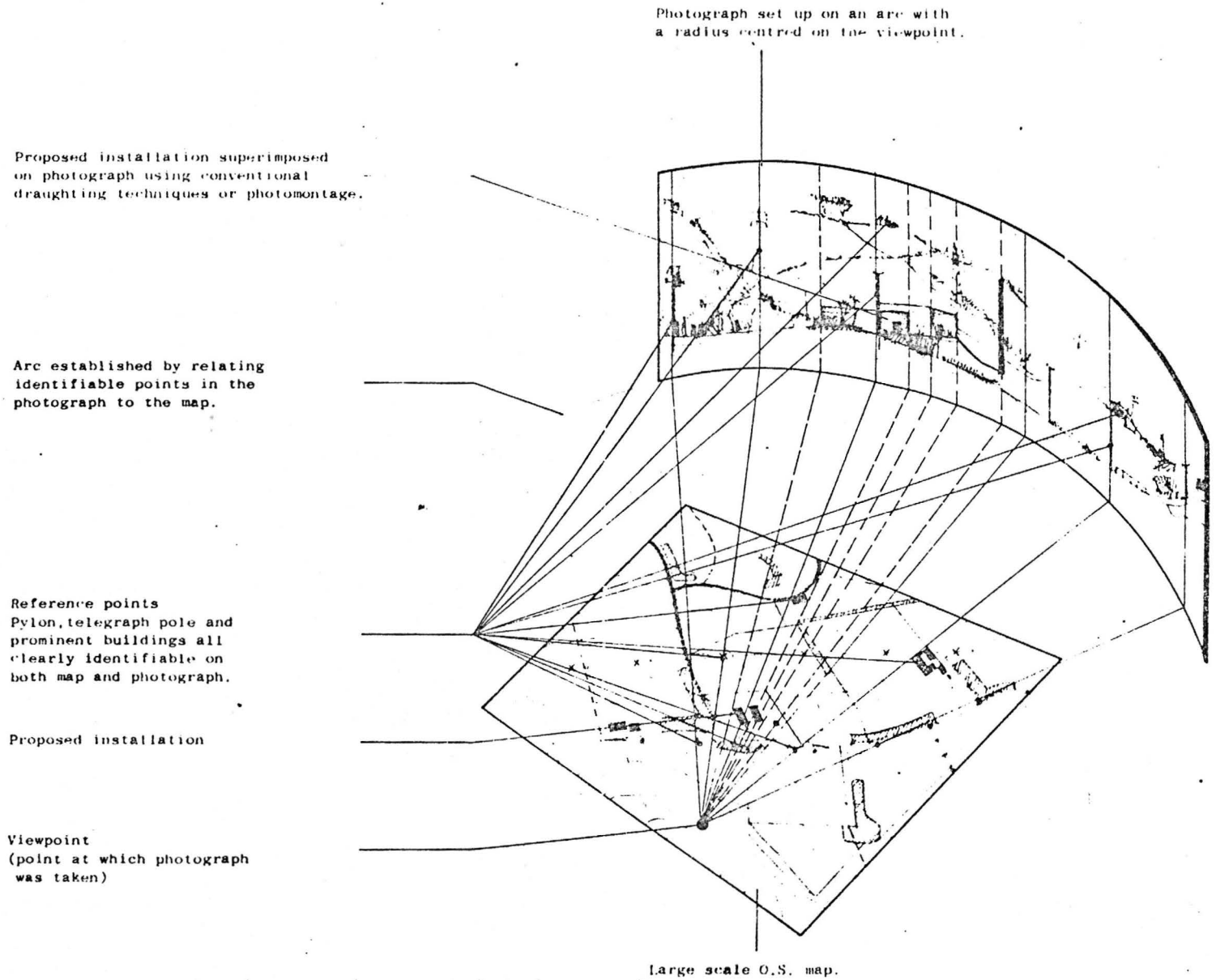
(G21) The role of geometrical form in computer modelling of buildings; reference to ABACUS programs.



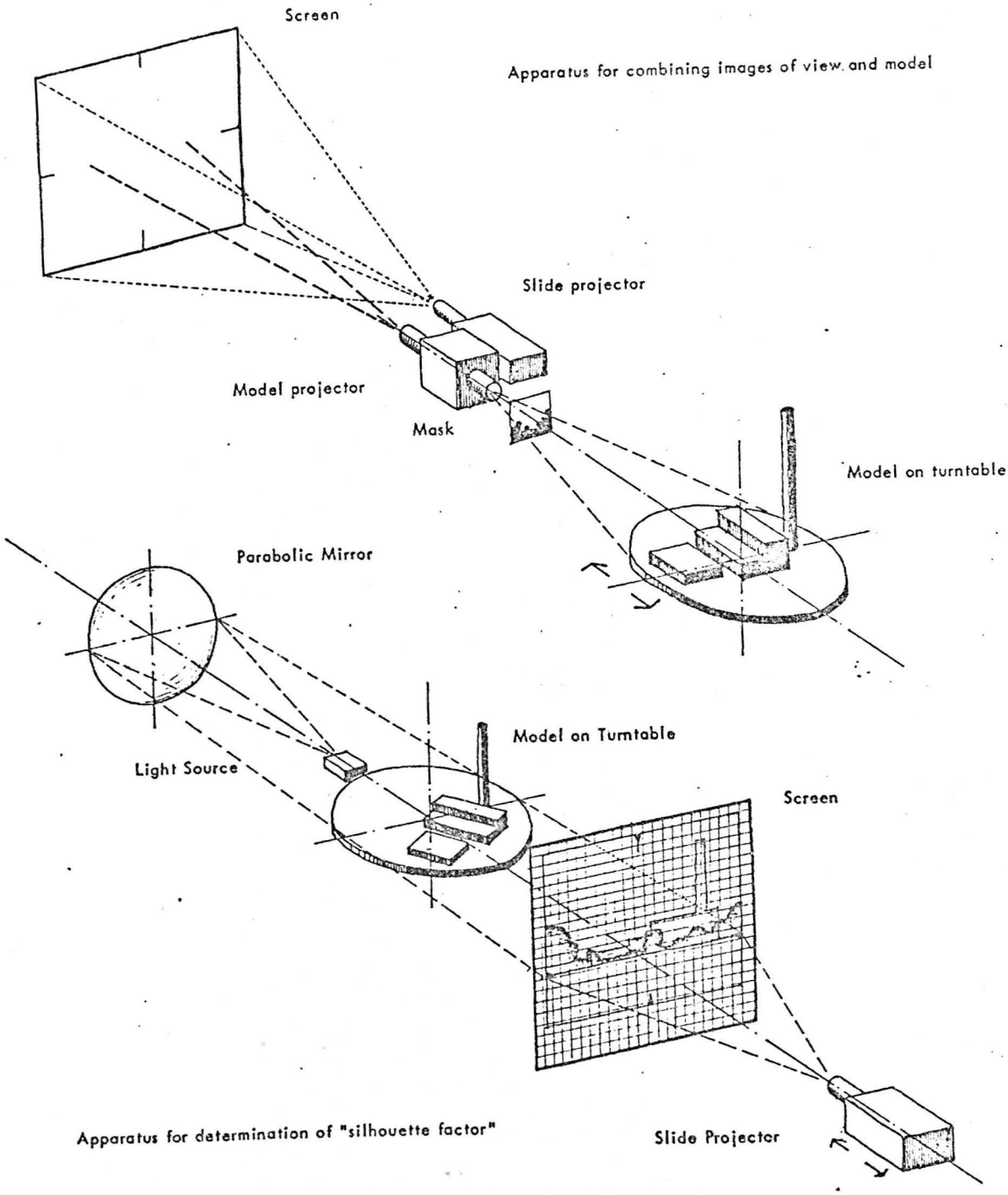
(G22) The hierarchy of geometries in building and planning.

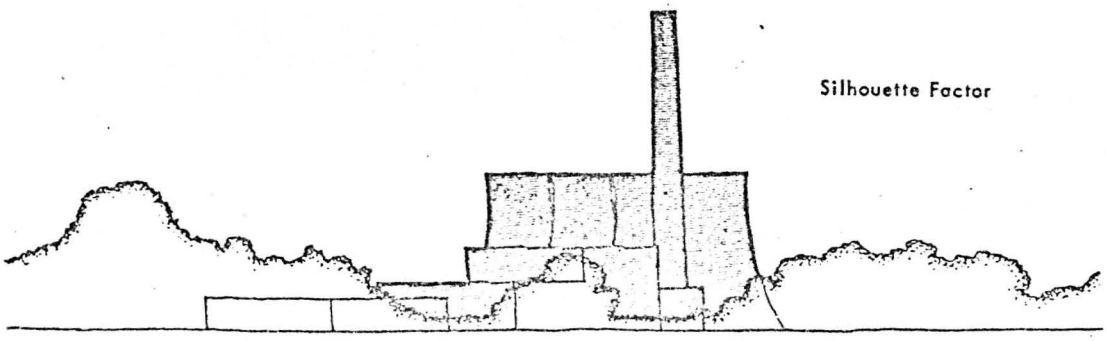


(G23) Sectional drawings for photomontage panorama, shown in (G24) (GRAH77).

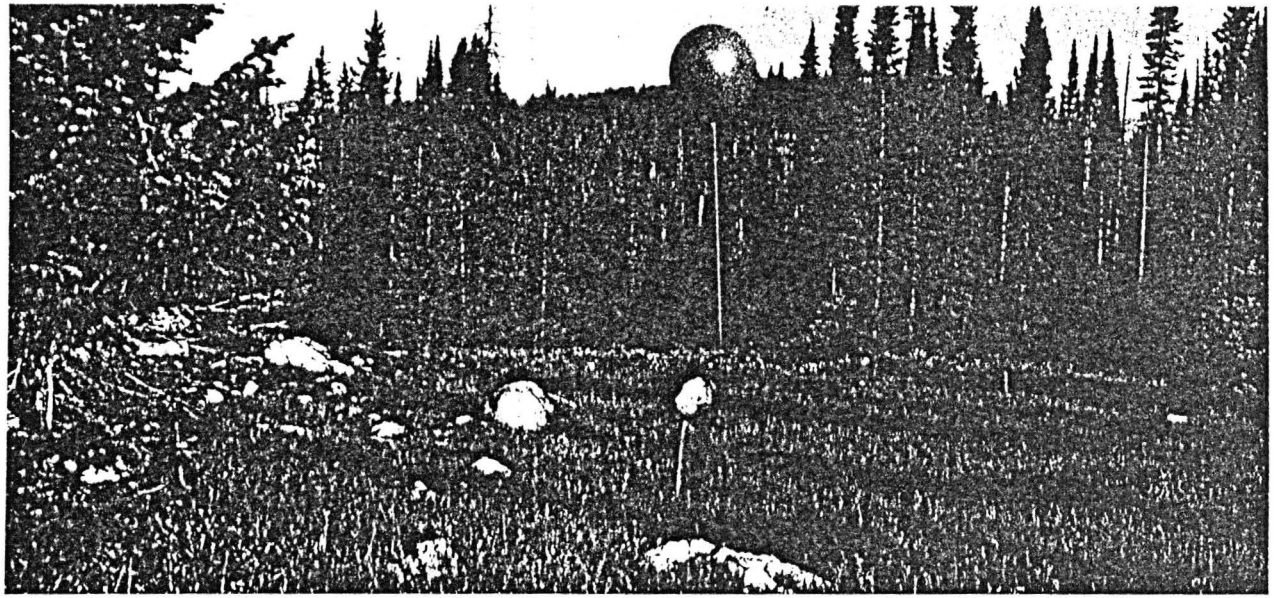


(G24) Photomontage construction. (GRAH77).



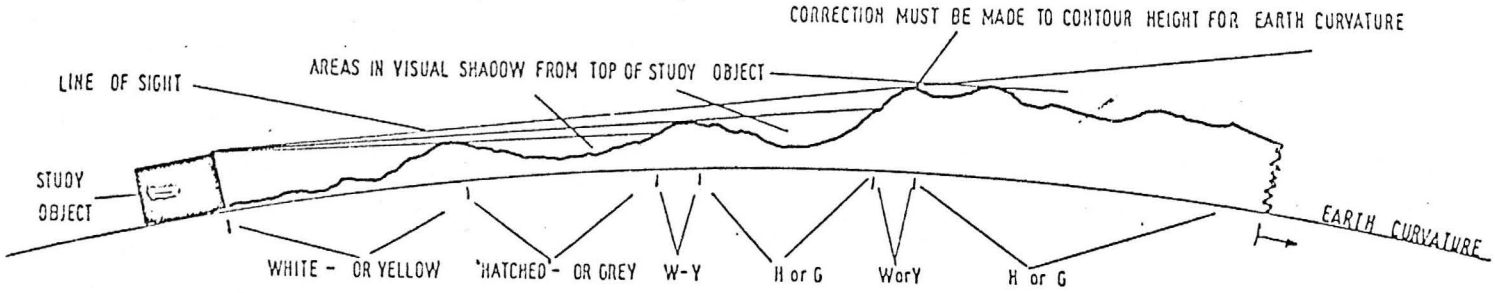


(G25) Slide and model montaging to determine a 'Silhouette Factor'. (MURR67)

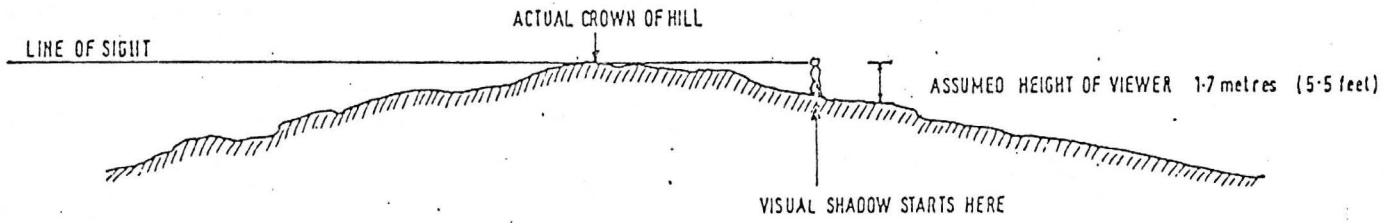


(G26) Helium filled balloons for assessing the visibility of tall structures. (BURE80) p37.

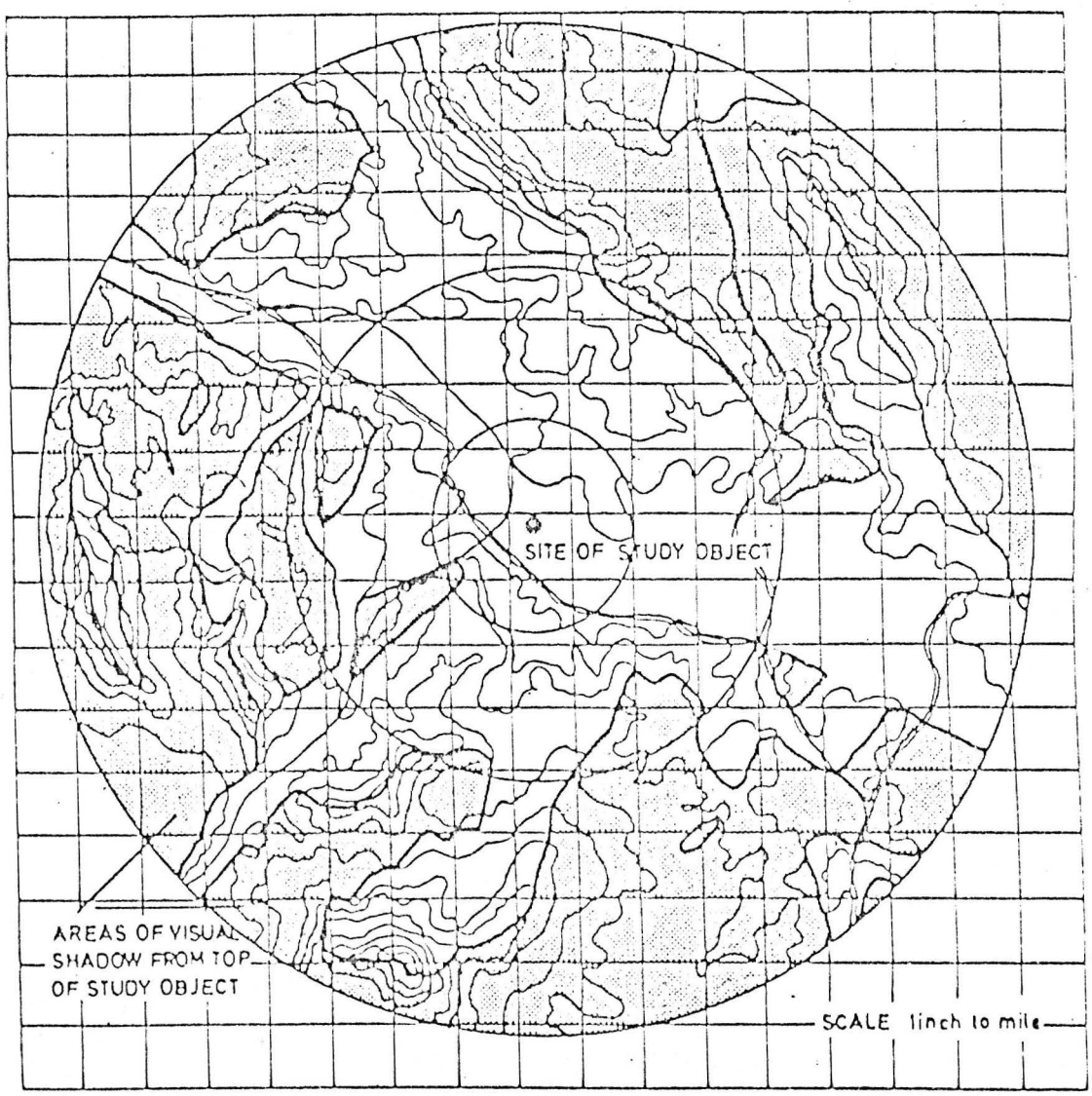
(G27) Visual Intrusion Envelope based on contours of the solid-angle subtended by a roadway from chosen locations along the roadside. (LOVE82)



ZONE OF VISUAL INFLUENCE.SHOWING CROSS SECTION



(G28) Zone of Visual Influence, CEGB. (HEBB75). Sectional drawings.



ZONE OF VISUAL INFLUENCE; A TYPICAL REDUCTION FROM 4 IN:1 MILE. NORMALLY DETAILS SHOWN ON A 1 IN:1 MILE ORDNANCE SURVEY MAP WOULD BE SHOWN. SHADED AREAS ARE THOSE IN VISUAL SHADOW.

(G29) Zone of Visual Influence, CEGB. (HEBB75)
Plan of impacted area around study object.

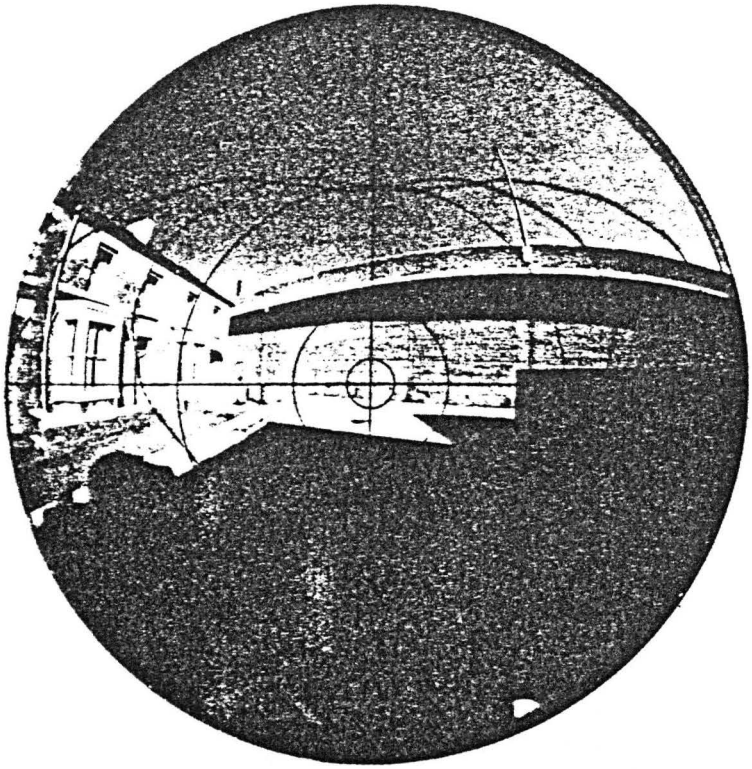
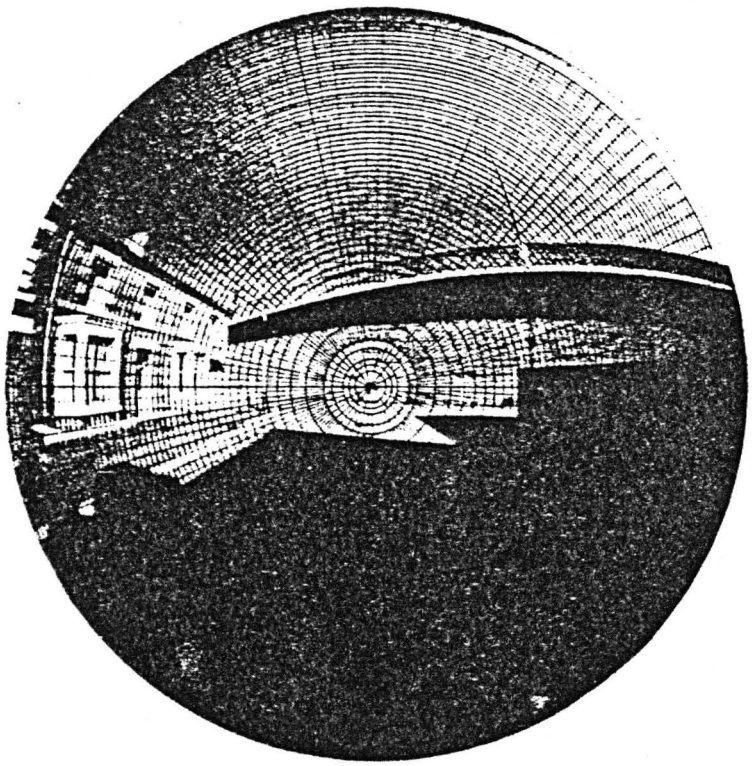


Figure 1 : Example of Visual Intrusion

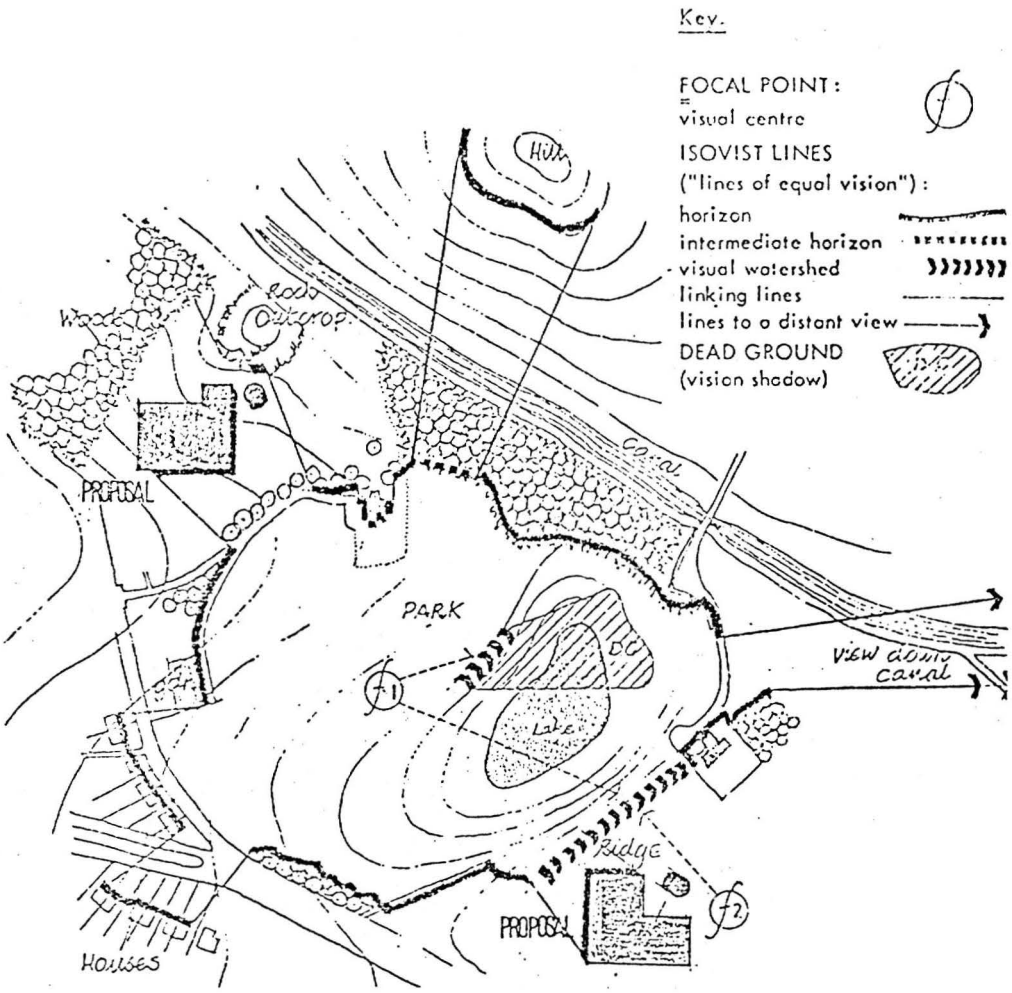
This photograph of an elevated motorway has imposed upon it the limits of the visual field of each eye (left eye full line, right eye dashed line). The area where the fields overlap is seen by both eyes. Inside this zone intrusion will be greater than in the areas seen by only one eye, and will be progressively greater towards the centre of the field. Zones of 6°, 20° and 50° are drawn on the photograph also.



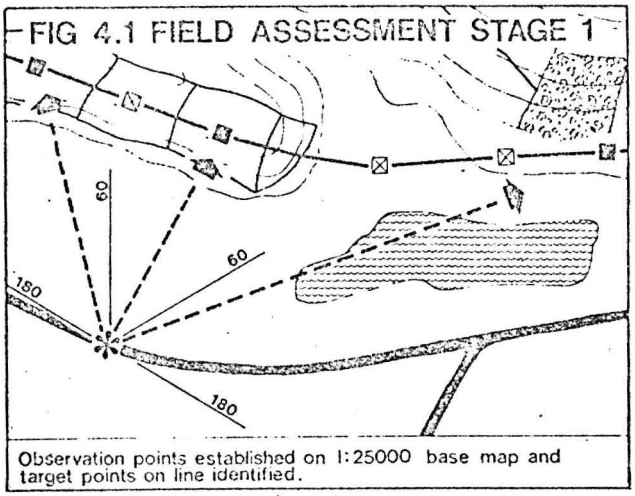
(G30) Visual Intrusion Index. (HOPK71).

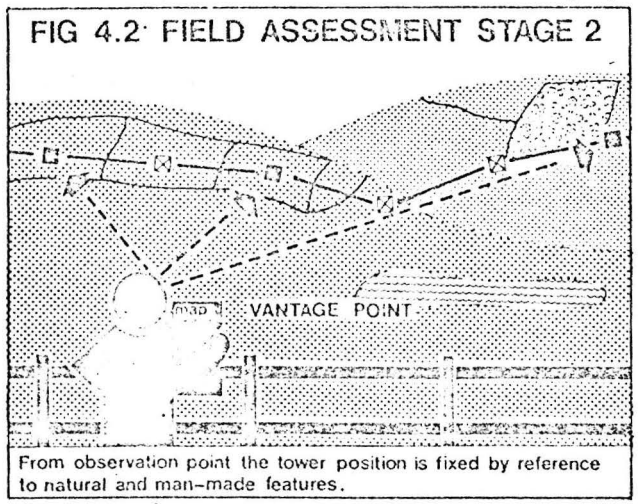
Figure 2: Assessment of the Visual Intrusion Index from an Existing Situation

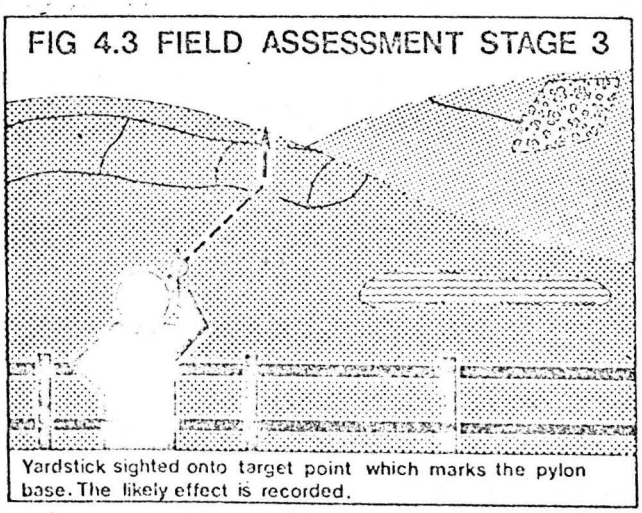
The full-field photograph as on Figure 1 which covers the whole visual field from the observing point, is placed under a solid angle transparency overlay as shown, each segment of which covers a solid angle of 1 millisteradian. Segments are counted in each of the annular zones 0°–6°, 6°–20°, 20°–50°, 50°–90° (edge of diagram). The appropriate multiplying factors (see Table 1) are applied to the values for each of these zones and the sum of these products found. This is the Visual Intrusion Index.



(G31) 'Isovist' Visual Assessment. (PIGG79)p.84







(G32) Zones of Visual Proximity (WHIT81).

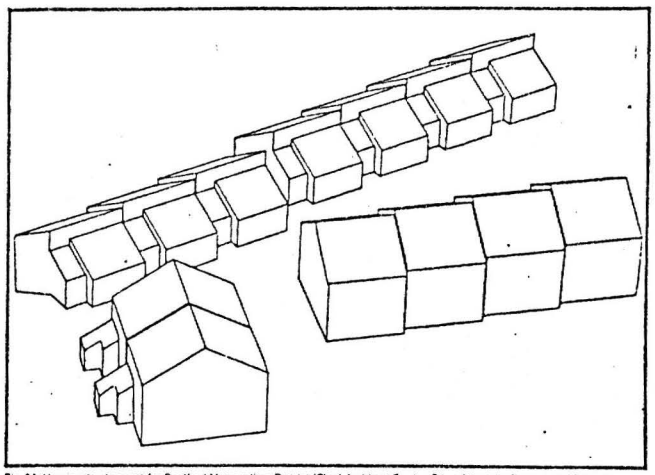
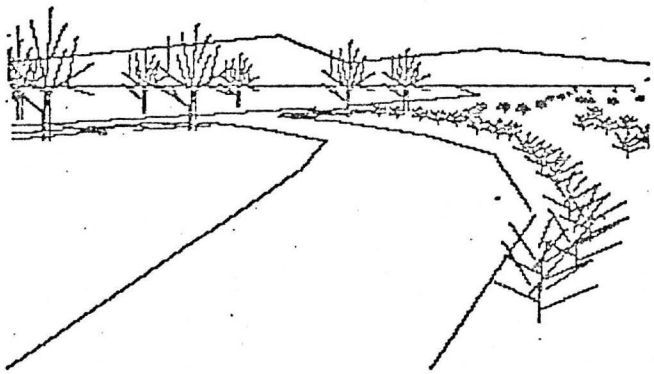
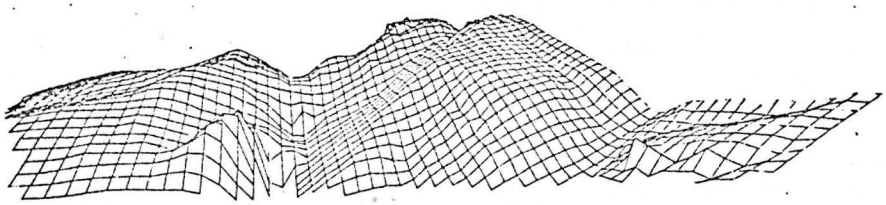


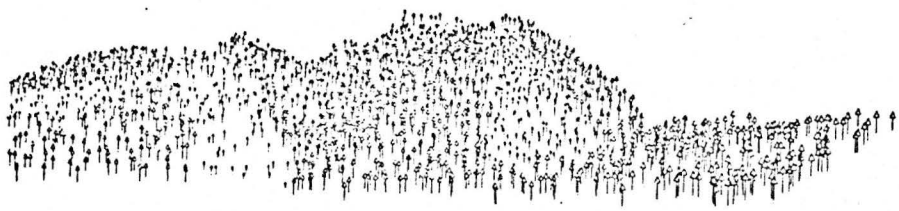
Fig. 14 Housing development for Bradford Metropolitan District (Chief Architect Gordon Elliott) by John Brunton and Partners. Plotted view drawn using AUTOPROD.



PERPSECTIVE VIEW DOWN ROADWAY

Computer Perspective Printouts





(G33) Visualisation by Computer.

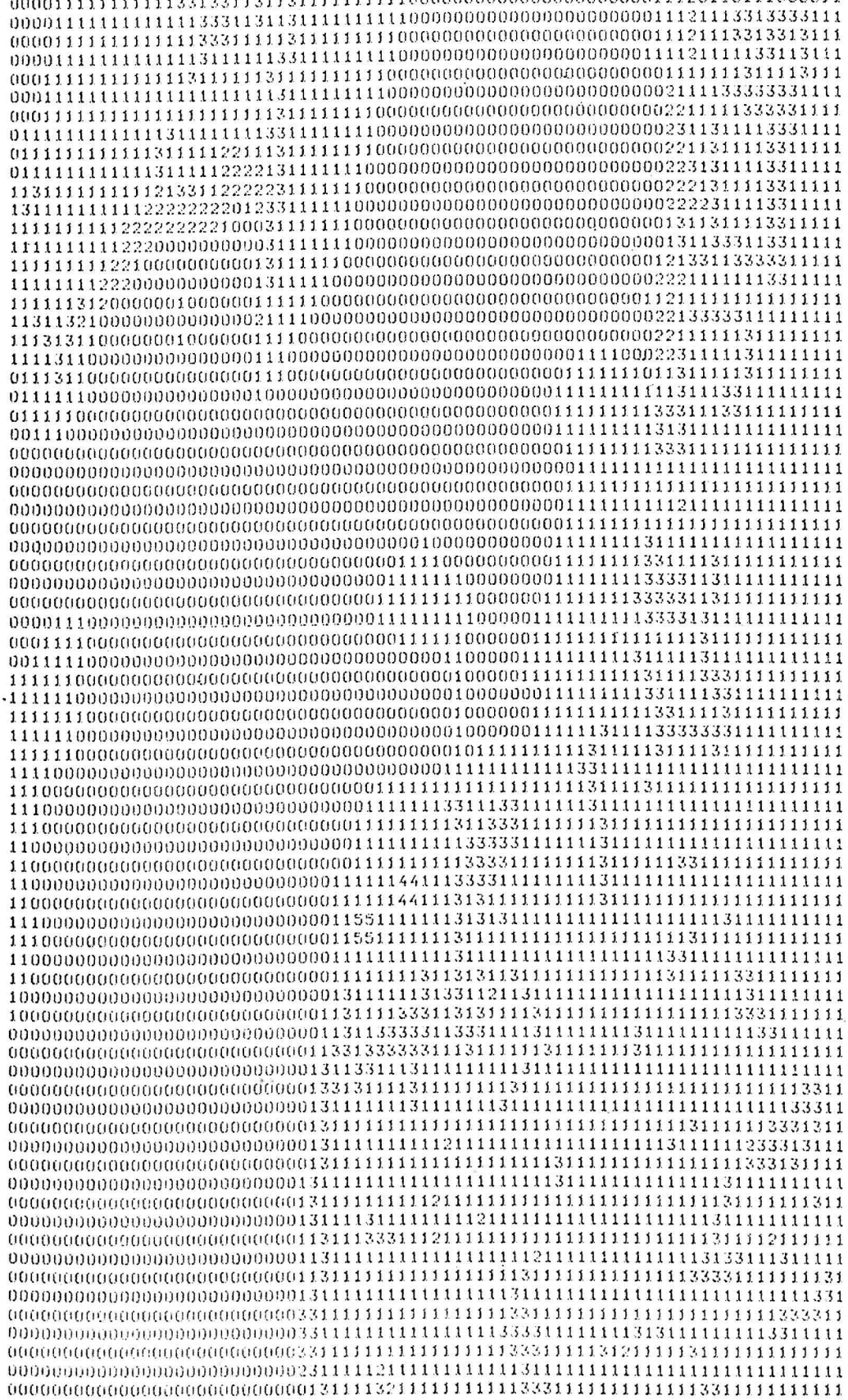
: top - buildings (BENS77).

: middle - landscaping (ERVI82).

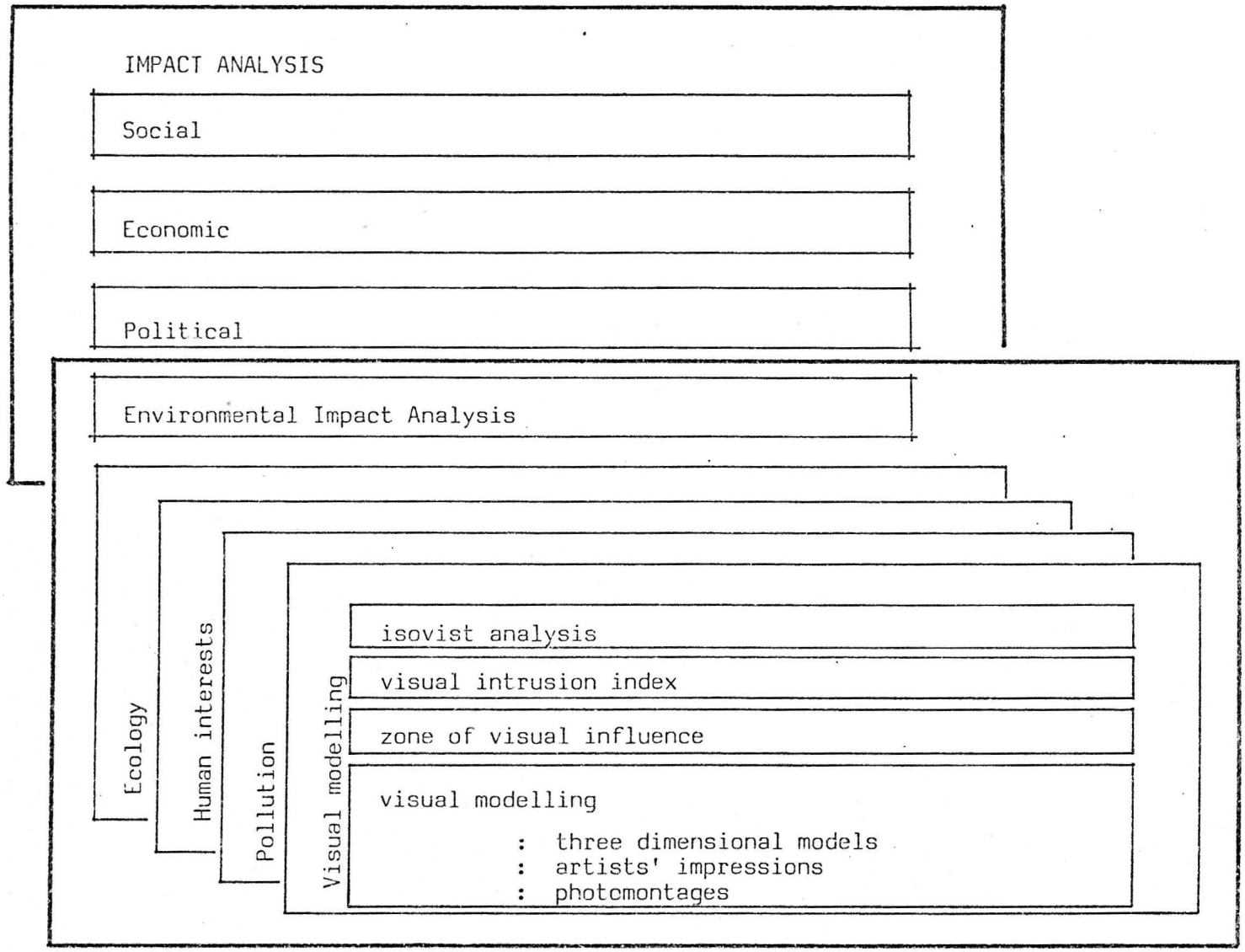
: bottom - landform and vegetation (BURE80).

HUNTERSTON LAND USE DATA MATRIX 75X75
0=SEA
1=LAND
2=BUILDINGS
3=WOODLAND

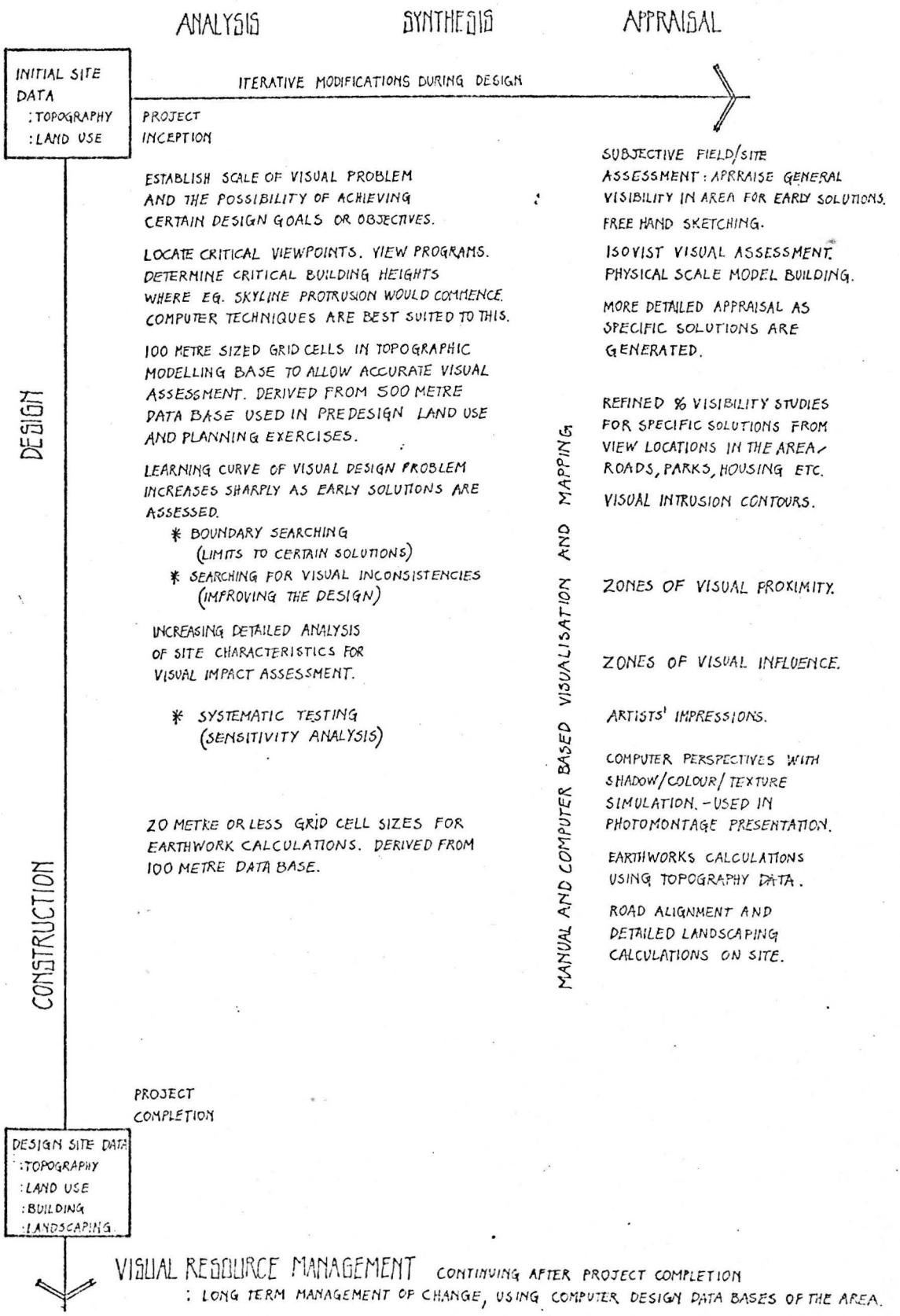
4=HUNTERSTON 'B' NPS
5=HUNTERSTON 'A' NPS



(G34) Mapping by Computer. Land-use data.

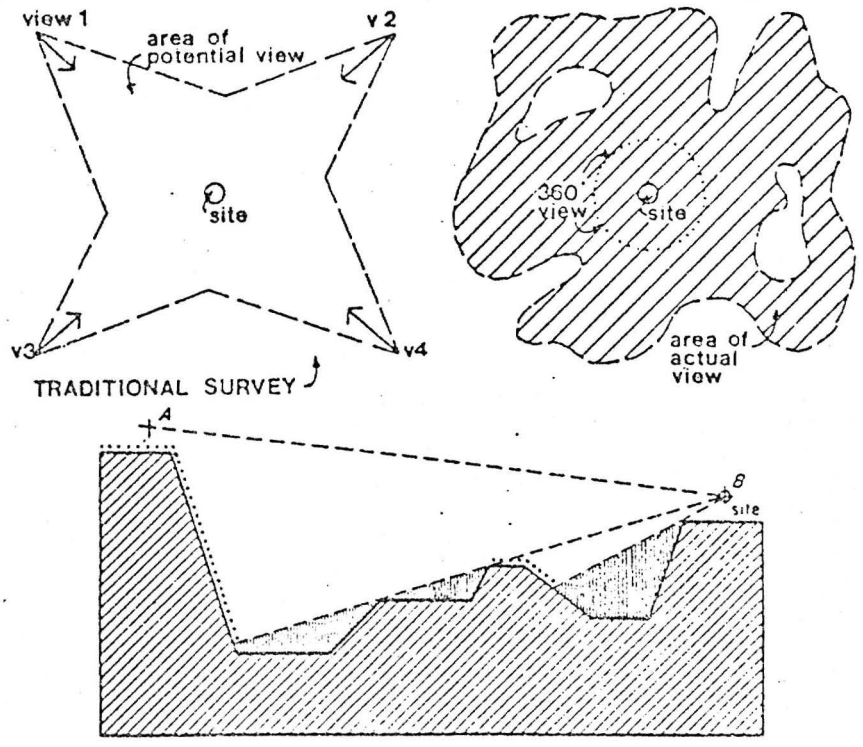


(G35) A Classification of Visual Assessment Techniques.

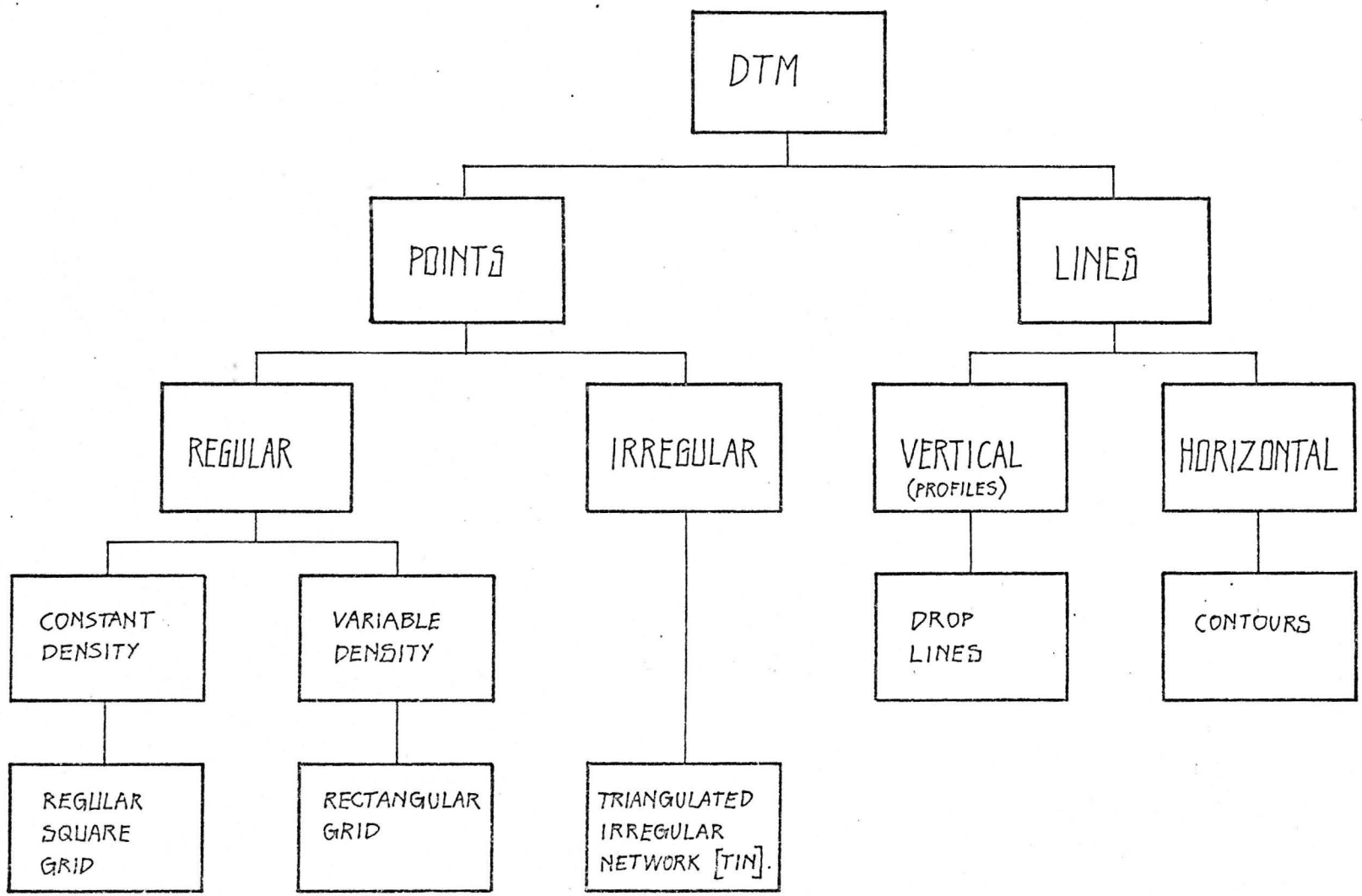


(G36) Visual assessment methods and models in the design process.

CHAPTER 3

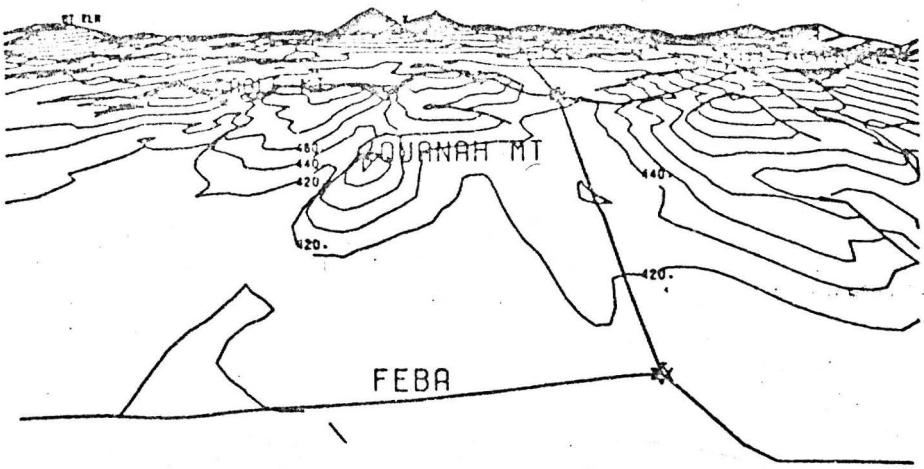


(G37) Intervisibility - the fundamental concept in VIEW processing. (AYLW82) p234.

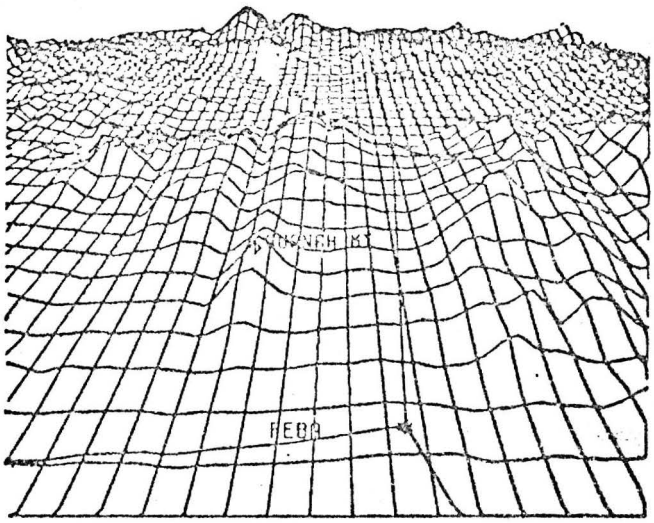


(G38) Digital terrain model classification.

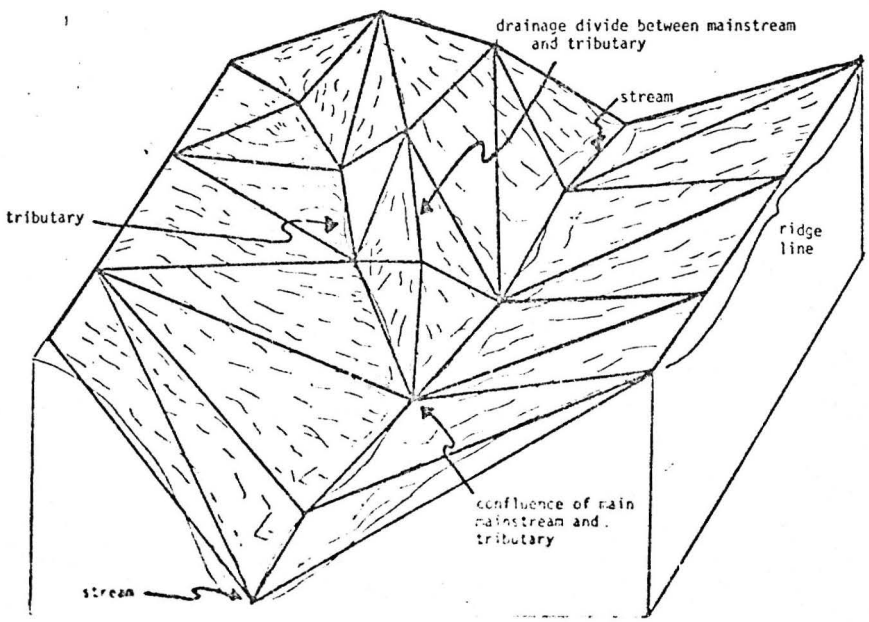
a)



b)



c)



(G39) a) contoured DTM. (AMER78) p385

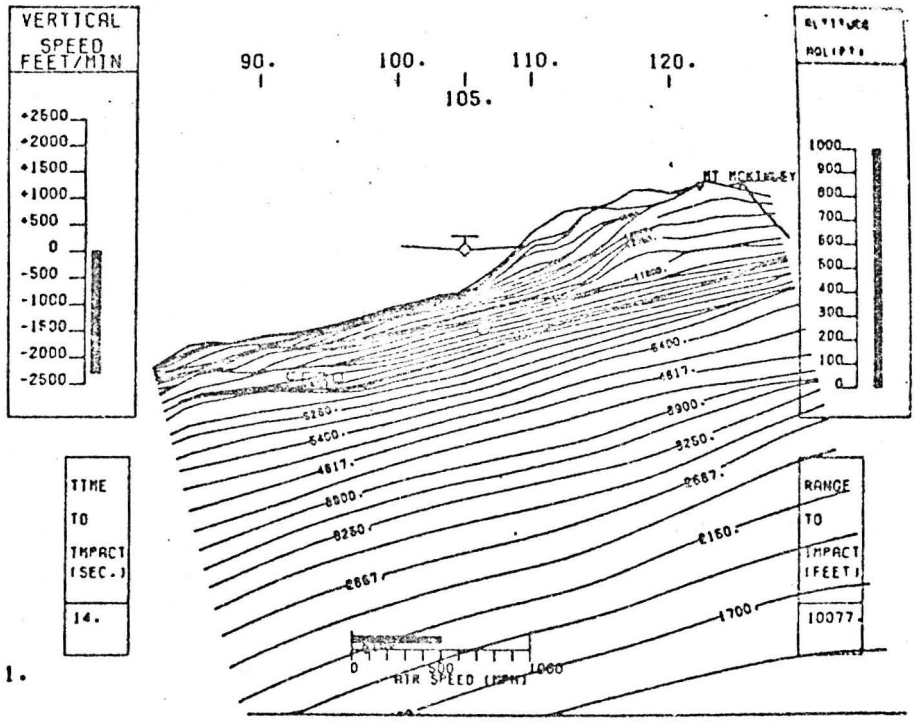
b) square grid DTM. (AMER78) p386

c) triangular grid DTM. (AMER78) p408

GROUND AREA VISIBILITY

- CLEAR AREAS ARE VISIBLE TO THE OBSERVER/RADAR LOCATED AT THE +
- LINED AREAS ARE NOT VISIBLE TO OBSERVER/RADAR

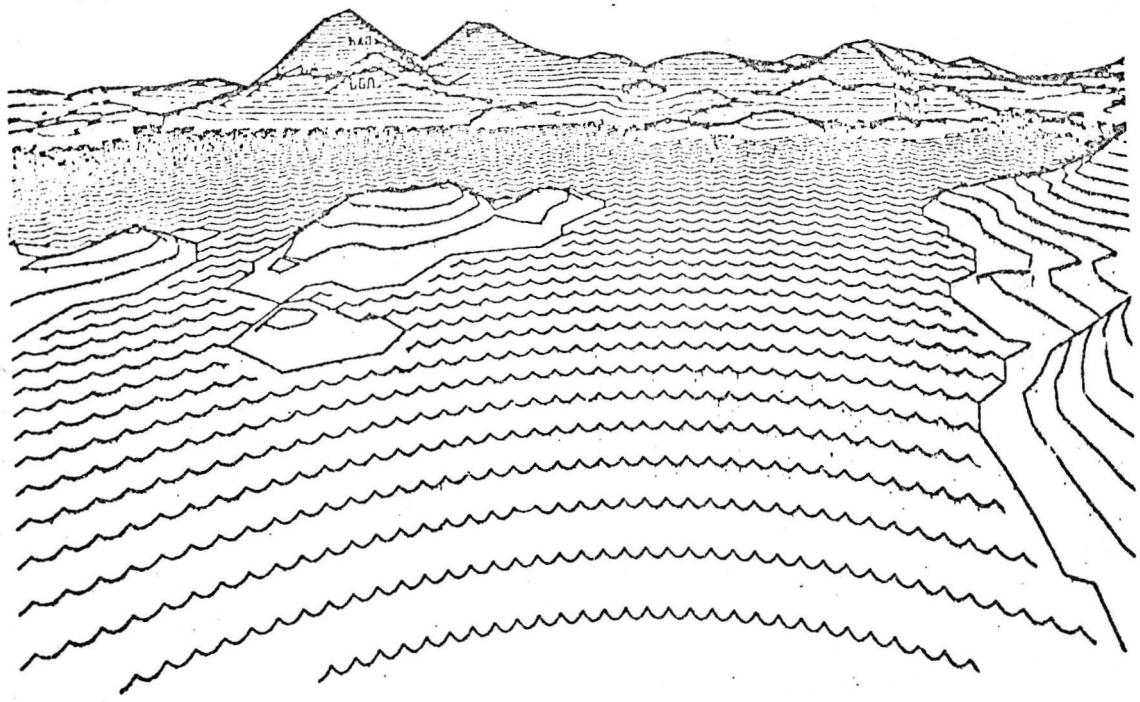
(G40) DTMs and radar scanning studies (AMER78) p391.



FLIGHT SIMULATION PERSPECTIVE VIEW #2

- SAME AS FIG 15 EXCEPT
- AIRCRAFT IS EXECUTING A RIGHT TURN AND TERRAIN BANKS LEFT AS IT WOULD APPEAR TO DO FROM THE COCKPIT OF A REAL AIRCRAFT

(G41) DTMs and flight simulation (AMER78) p390.



- TERRAIN FORM SHOWN USING CONTOUR LINES
- EFFECT OF FLOODING, WATER LEVEL SHOWN

(G42) DTMs and flood prediction effects (AMER78) p388.

(G43) Elevation values are interpolated manually from an Ordnance Survey map for each grid intersection of the DTM in VIEW. Land use values are recorded for each cell.

```
HUNTERSTON NUCLEAR POWER STATION EXISTING ELEVATION DATA  SECTOR 1
   0.   0.   0.   0.   0.   0.   0.   0.
   0.   0.   0.   0.  13.  55.  30.   0.
   0.   0.   0.  10.  40.  75.  72.   0.
   0.   0.  52.  50.  80. 105.  20.   0.
  34.  46.  82.  85. 117. 161.   0.   0.
  95. 114.  72. 125. 104.  47.   0.   0.
 135. 145. 130. 104.  41.  25.   5.   0.
 185. 165. 150.  64.  33.  15.   0.   0.
 188. 190. 170.  37.  25.   0.   0.   0.
 163. 162.  85.  10.   0.   0.   0.   0.
 198. 145.  35.   0.   0.   0.   0.   0.
 205. 130.  41.   0.   0.   0.   0.   0.
 210. 140.  14.   0.   0.   0.   0.   0.
 215. 120.   0.   0.   0.   0.   0.   0.
 218.  75.   0.   0.   0.   0.   0.   0.
 190.  42.   0.   0.   0.   0.   0.   0.
 130.  25.   0.   0.   0.   0.   0.   0.
 120.  40.   0.   0.   0.   0.   0.   0.
 119.  37.   0.   0.   0.   0.   0.   0.
 115.  23.   0.   0.   0.   0.   0.   0.
 112.   5.   0.   0.   0.   0.   0.   0.
 110.   0.   0.   0.   0.   0.   0.   0.
  40.   0.   0.   0.   0.   0.   0.   0.
   0.   0.   0.   0.   0.   0.   0.   0.
.TYP HUNTER2
HUNTERSTON NUCLEAR POWER STATION EXISTING ELEVATION DATA  SECTOR 2
   0.   0.   0.   0.  11.  40. 100. 125. 135. 167. 190. 190. 190. 225. 275. 320. 330. 300.
 280. 220. 205. 175. 140. 130. 150. 160. 175. 170. 180. 180. 193. 176. 145. 130. 110.   0.
   0.   0.   0.   0.  17. 102. 113. 120. 130. 170. 192. 200. 230. 270. 306. 290. 302. 270.
 230. 173. 165. 135. 110. 100. 120. 171. 102. 196. 180. 184. 190. 197. 160. 143. 115.   0.
   0.   0.   0.   0.  32. 104. 110. 131. 175. 175. 170. 210. 270. 320. 305. 285. 265. 230.
 190. 170. 150.  75.  95.  75.  50. 175. 192. 196. 171. 194. 205. 200. 180. 150. 102.   0.
   0.   0.   0.   0.  35. 111. 125. 150. 170. 175. 190. 245. 320. 340. 294. 250. 215. 187.
 165. 170. 130.  80.  65.  65.  95. 185. 200. 202. 205. 210. 220. 215. 200. 140.   0.   0.
   0.   0.   0.   7.  40. 113. 130. 155. 172. 185. 200. 240. 292. 293. 240. 180. 175. 150.
 120. 120.  80.  47.  45.  50.  90. 204. 210. 225. 220. 220. 225. 210. 180. 125.   0.   0.
   0.   0.   0.  12. 105. 110. 140. 140. 180. 192. 200. 245. 287. 250. 203. 150. 130. 110.
  85.  75.  47.  45.  30.  44.  65. 215. 225. 235. 245. 233. 222. 200. 141.   0.   0.   0.
   0.   0.   0.  27. 103. 117. 135. 136. 184. 192. 214. 250. 265. 210. 165. 125.  95.  83.
  65.  45.  40.  40.  34.  60.  94. 210. 230. 273. 267. 239. 210. 160.  90.   0.   0.   0.
   0.   5.  12.  35. 102. 115. 132. 132. 170. 191. 210. 220. 220. 175. 120.  80.  80.  65.
  40.  33.  25.  34.  55.  42.  90. 227. 250. 250. 233. 220. 203. 145.  85.   0.   0.   0.
   0.   4.  15.  40.  75. 107. 130. 115. 140. 190. 190. 210. 165. 130.  80.  70.  93.  68.
  40.  35.  30.  30.  20.  45. 114. 231. 245. 240. 253. 245. 215. 150.   0.   0.   0.   0.
   0.  10.  24.  75.  85. 134. 117. 110. 150. 145. 166. 200. 150.  90.  65.  50.  90.  68.
  47.  32.  29.  38.  30.  14. 105. 225. 245. 270. 264. 230. 203. 110.   0.   0.   0.   0.
  12.  28. 100. 110. 104. 104. 115. 105.  97. 103. 133. 135. 115.  75.  40.  40.  65.  65.
  62.  45.  31.  20.  25.  40. 206. 220. 227. 235. 225. 200. 165.  26.   0.   0.   0.   0.
  30. 100. 104. 115. 110. 110. 110. 100.  80.  87. 103.  95.  80.  40.  25.  31.  49.  49.
  35.  25.   0.   0.  17.  36. 165. 210. 215. 210. 207. 185.  65.   0.   0.   0.   0.   0.
```

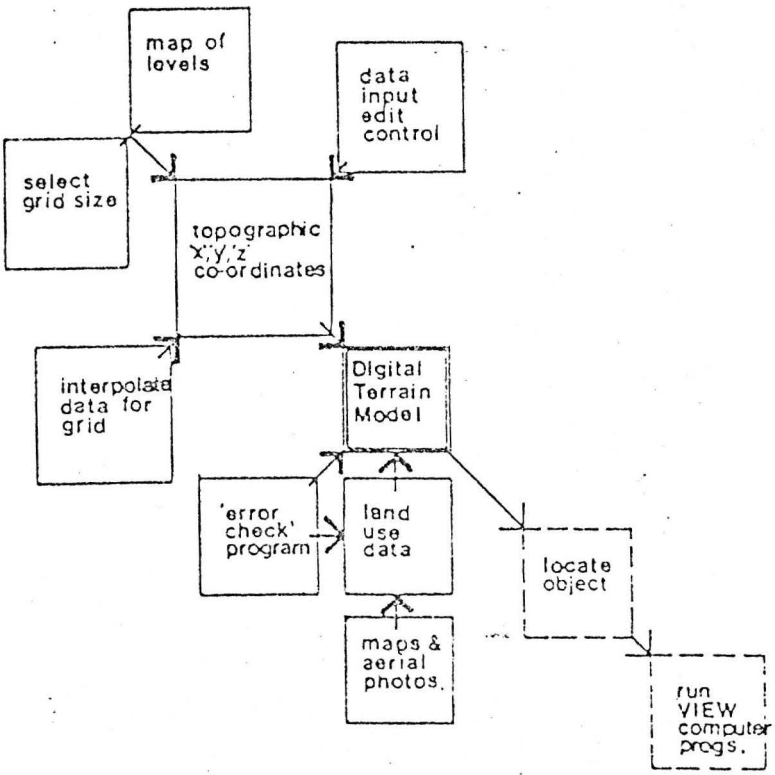
(G44) VIEW data files for topography.

HUNTERSTON NUCLEAR POWER STATION ELEVATION DATA

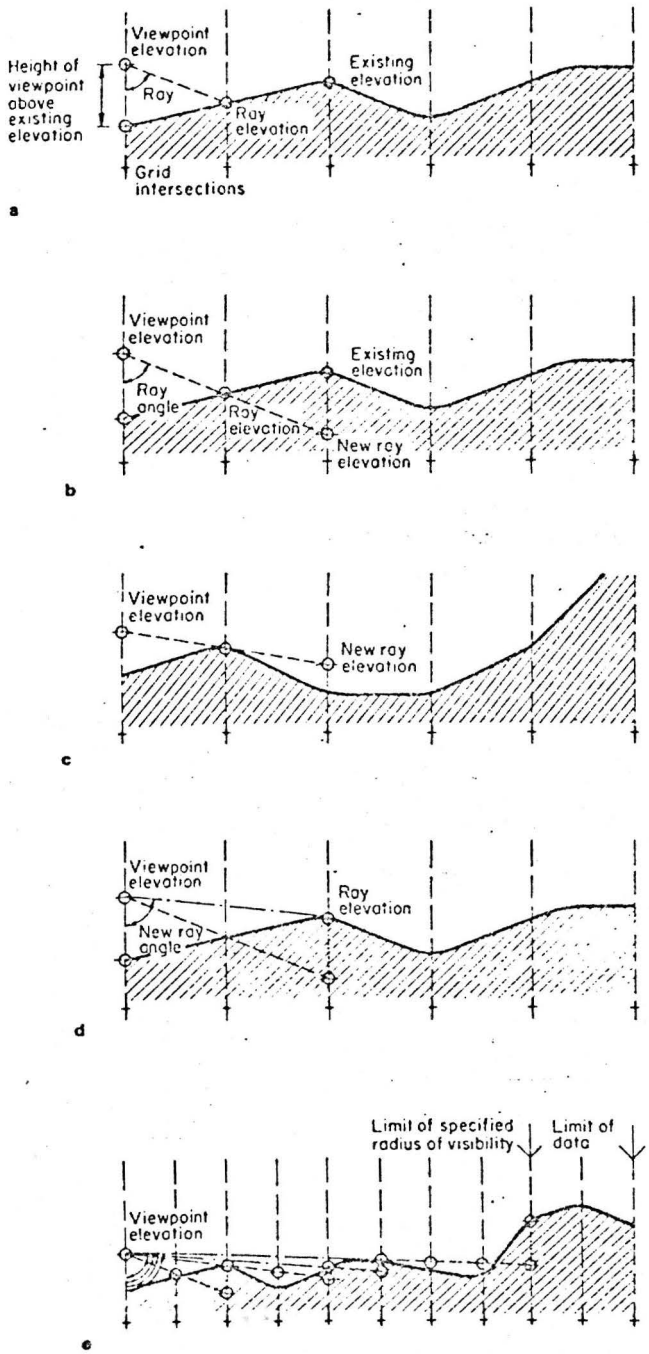
J ⟶

I ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	11	40	109	125	135	167	188	190	190	225	275	320	330	300	290	220	205	175	140	130
2	0	0	0	0	17	102	113	128	139	170	192	200	230	270	306	290	302	270	230	173	165	135	110	100
3	0	0	0	0	32	106	118	131	175	175	190	210	270	320	325	295	265	230	190	170	150	95	95	75
4	0	0	0	0	35	111	125	150	170	175	195	245	320	340	294	250	215	197	165	170	130	90	65	65
5	0	0	0	7	48	113	132	155	172	185	200	240	293	293	240	180	175	150	128	120	80	47	45	50
6	0	0	0	16	102	116	140	148	180	192	209	265	293	250	203	150	130	110	95	75	47	45	38	41
7	0	0	0	30	103	117	135	136	184	192	214	250	265	210	165	125	95	93	65	45	40	42	34	42
8	0	5	12	35	102	115	132	132	170	191	210	220	220	175	120	90	90	65	48	38	35	36	28	43
9	0	4	15	40	78	107	130	115	160	190	190	210	185	130	80	70	93	56	40	35	30	30	28	45
10	0	10	26	75	95	104	113	110	150	145	166	200	150	90	65	50	90	68	47	33	25	29	30	46
11	12	25	100	110	104	106	115	105	97	103	133	135	115	75	40	40	65	65	62	45	21	20	25	48
12	30	100	104	115	110	110	110	100	80	83	103	96	80	40	25	31	40	40	35	25	0	0	17	35

(G45) Geographic co-ordinate system - VIEW.

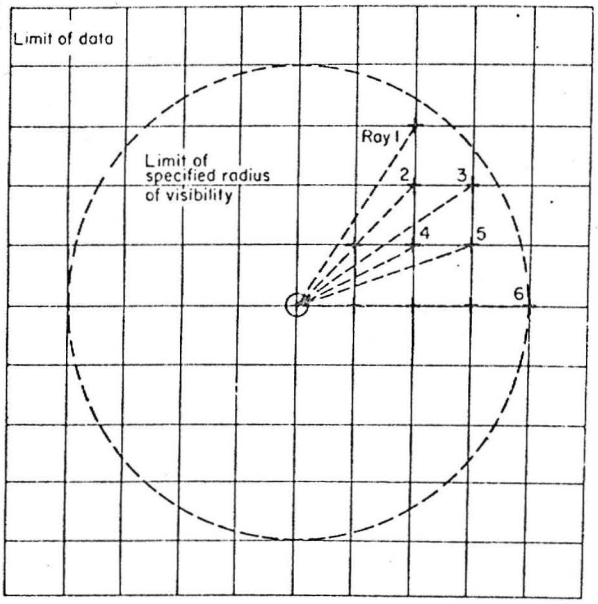


(G46) VIEW data preparation sequence. (AYLW82) p234.



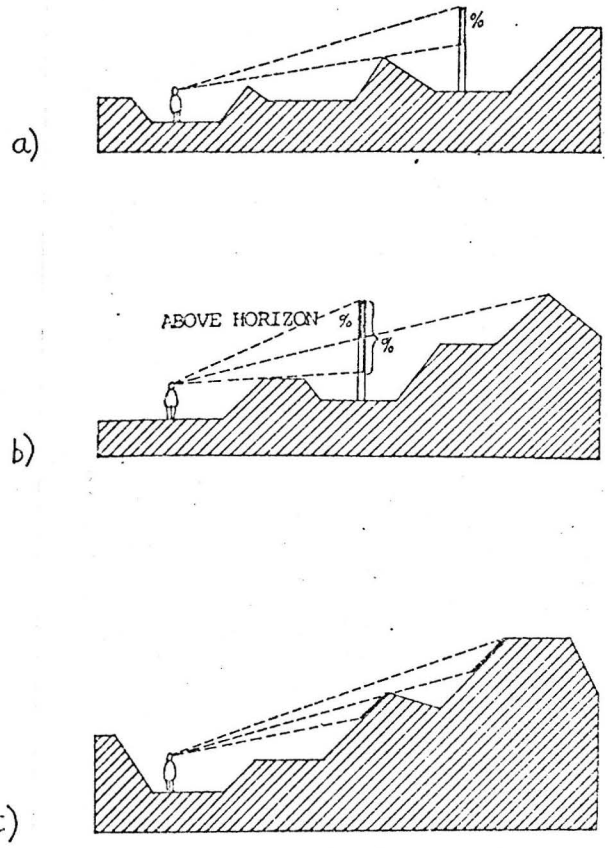
General procedure for determining visibility of elevations at grid intersections: (a) step 1; (b) step 2 – elevation visible; (c) step 2 – elevation invisible; (d) step 3 – if elevation in step 2 visible; (e) step 4

(G47) Visibility determination : the VIEW procedure (AYLW77) p105.

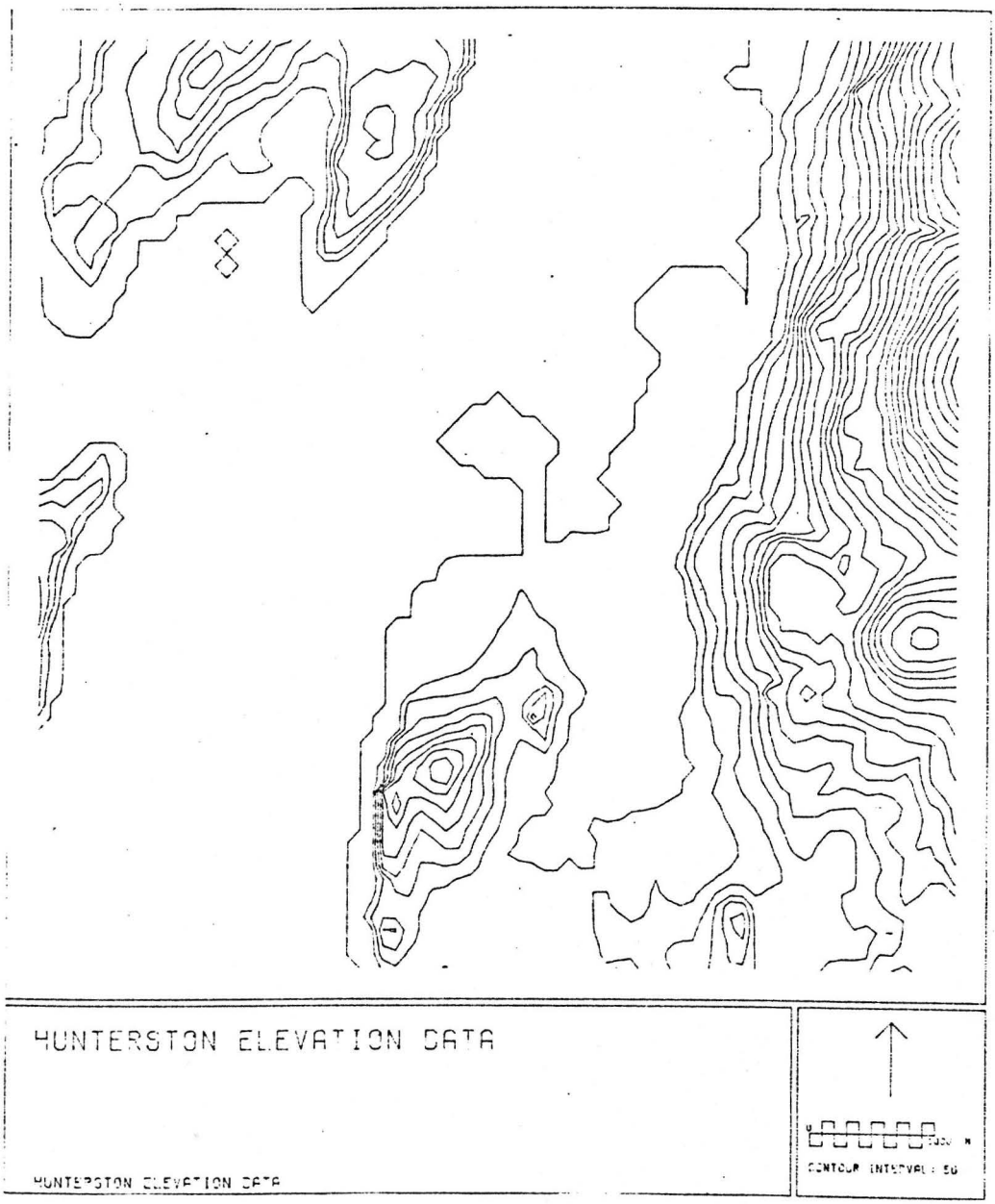


Visual rays

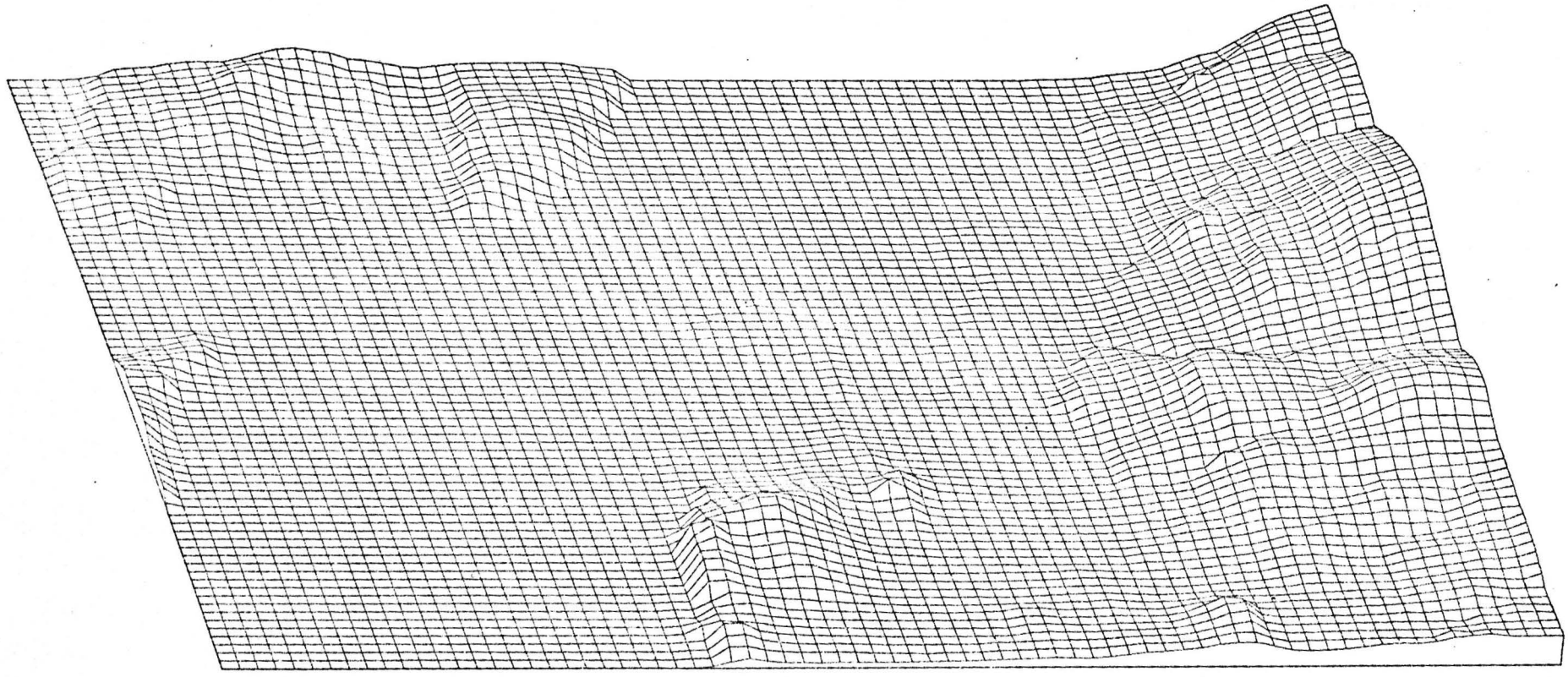
(G48) The user defined limit of visibility from a chosen observer location. (AYLW77) p105.



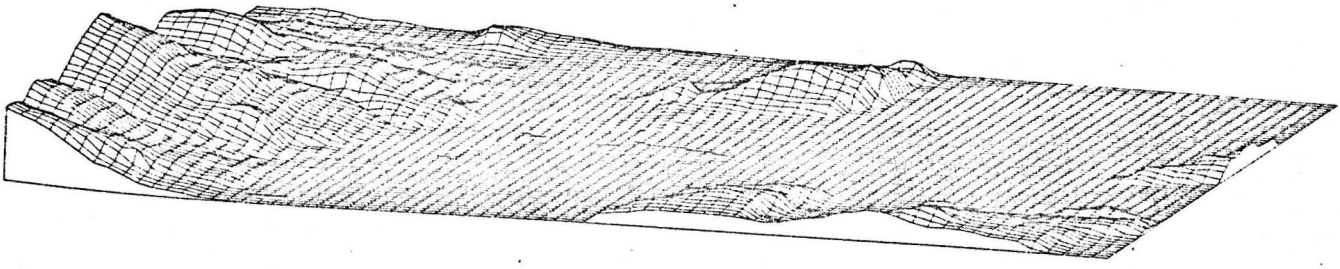
(G49) a) % visibility
b) % visible above horizon
c) areas acting as backcloth. (AYLW82) p106.

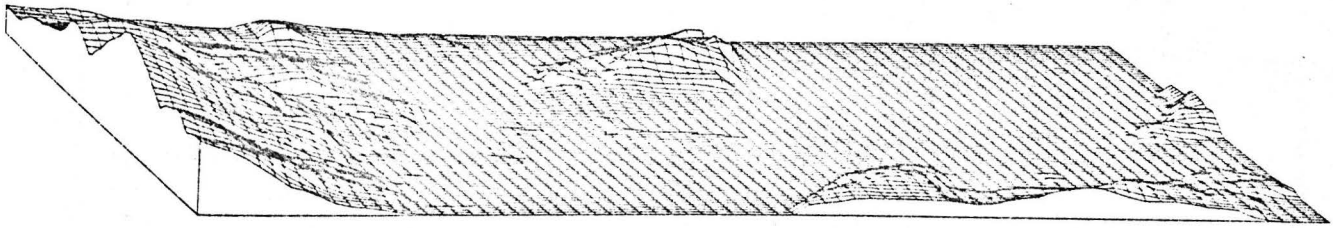


(G50) SYMCON output : contour map.

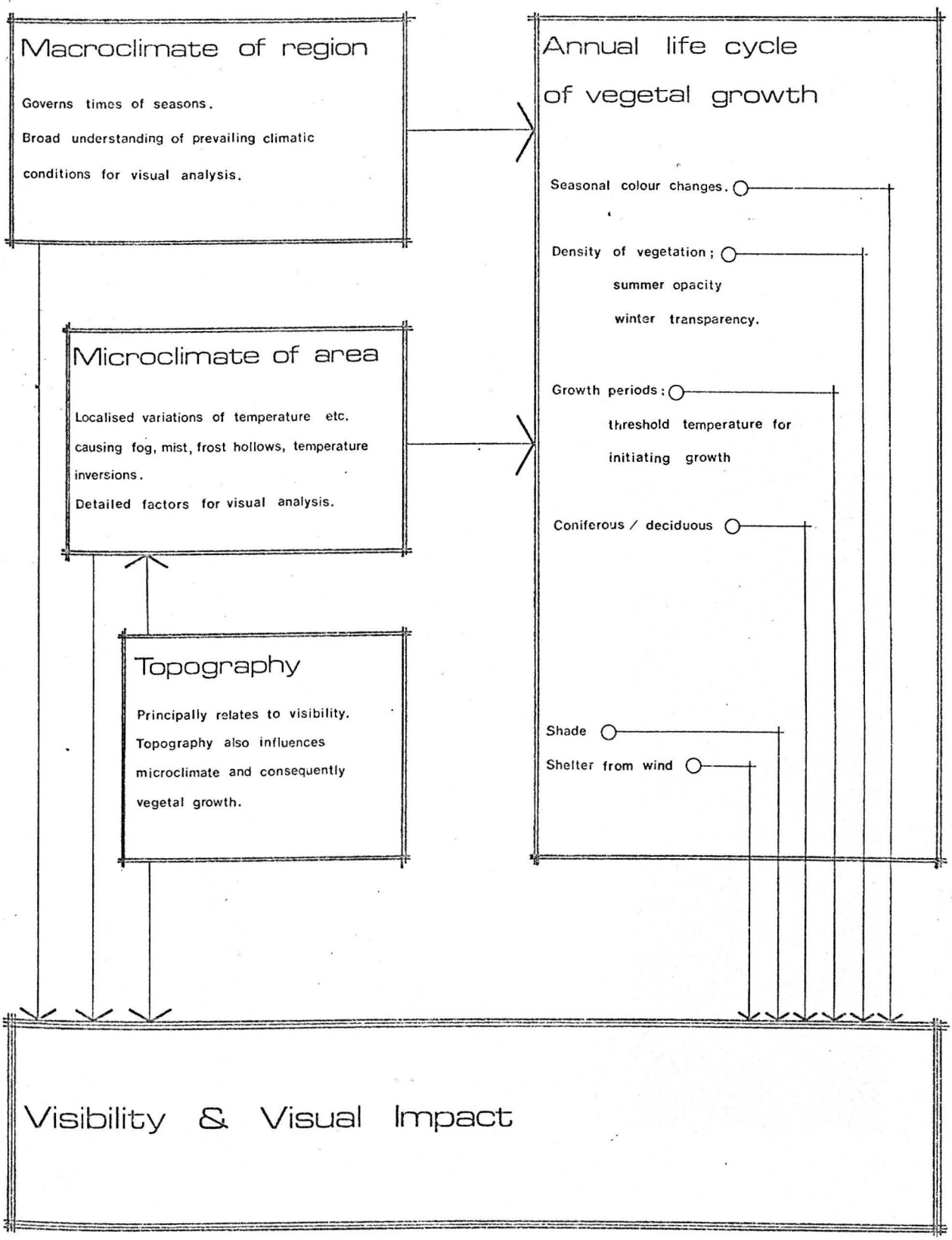


(G51) Birds eye view of DTM described in (G50).



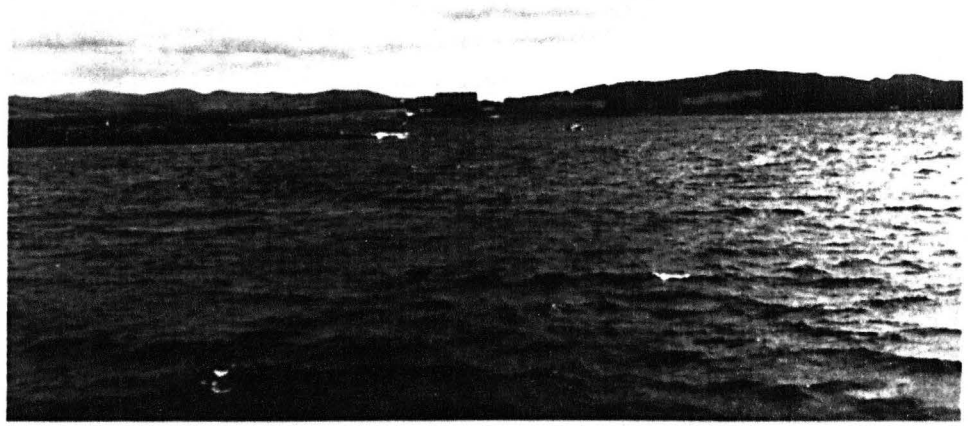


(G52) The flexibility of low level DTM viewing may be of benefit in assessing the implications of landform changes, eg. the addition of environmental hills to provide visual screening, or the impact of quarrying operations.



(G53) The relationship between environmental conditions/vegetal growth, and the visual impact of developments over time.

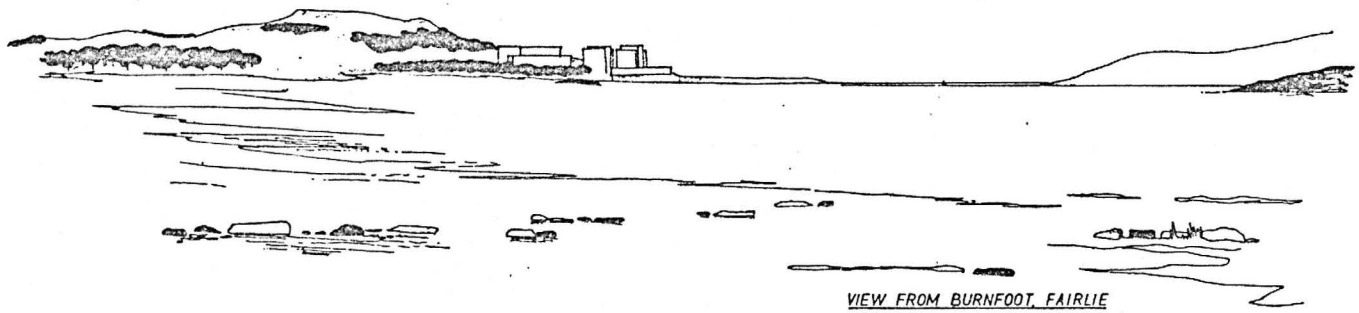
1



(G54) a) Sketch perspective of Hunterston from Millport.

b) Corresponding photographic view.

2



VIEW FROM BURNFOOT, FAIRLIE

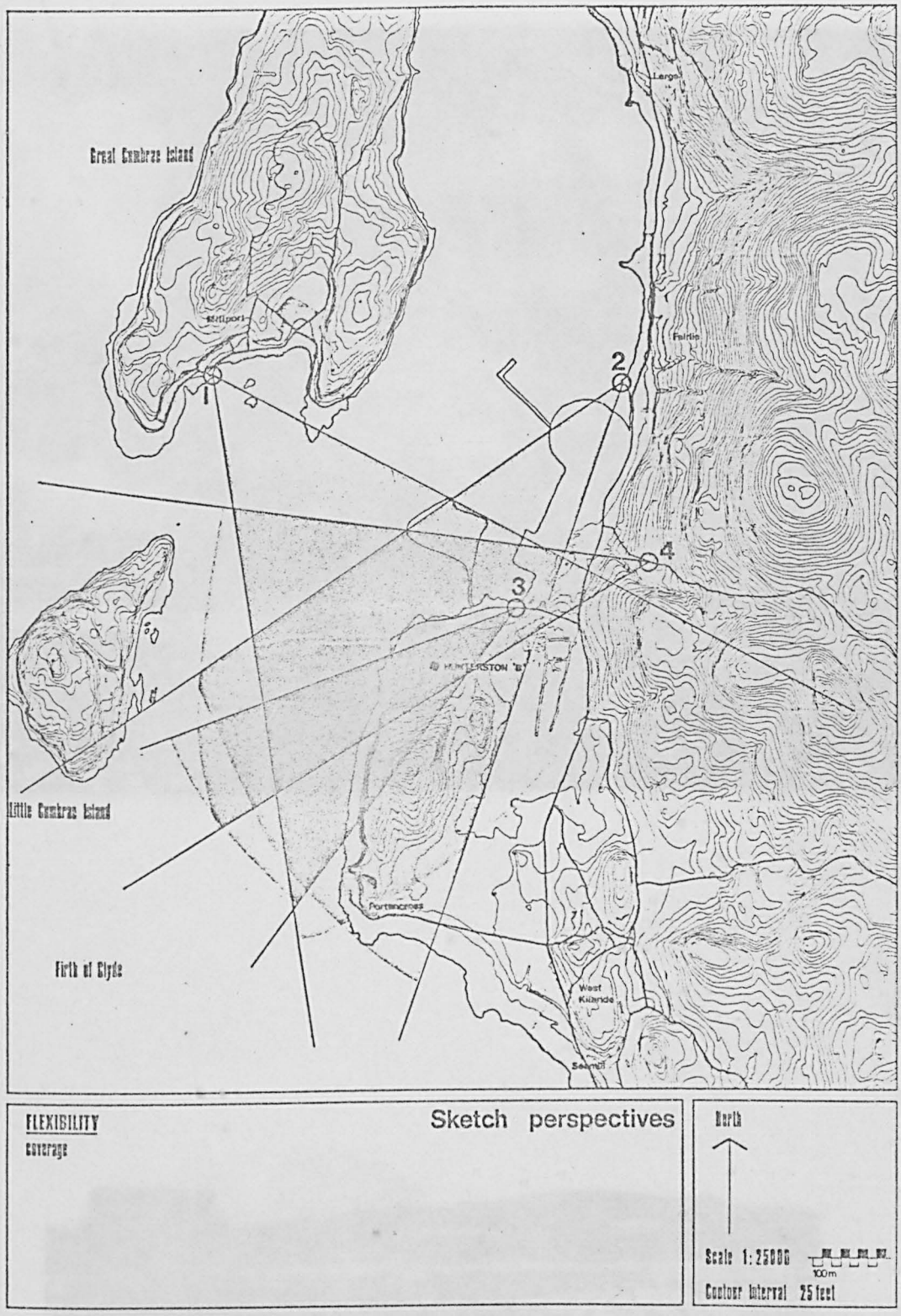
(G55) a) Sketch perspective of Hunterston from Fairlie.
This view no longer exists.

(G56) a) Sketch perspective of Hunterston from approach road.

b) Corresponding photographic view

(G57) a) Sketch perspective of Hunterston from surrounding hillside.

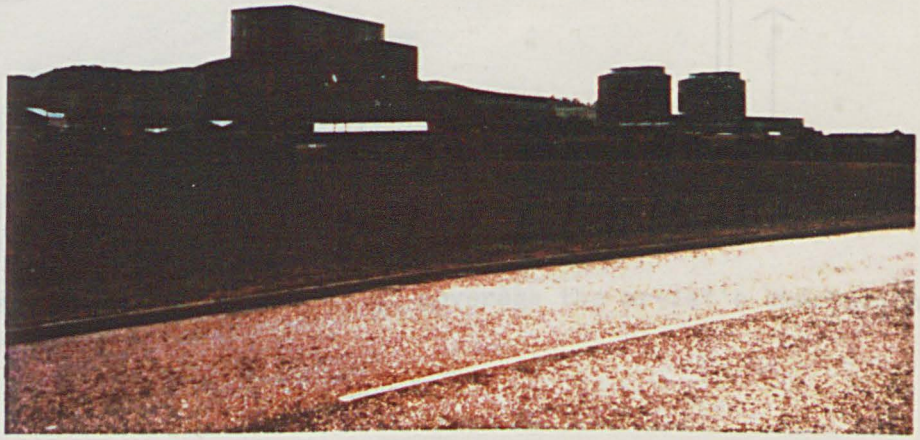
b) Corresponding photographic view.



(G58) Map depicting the degree of coverage the sketch perspectives offer.

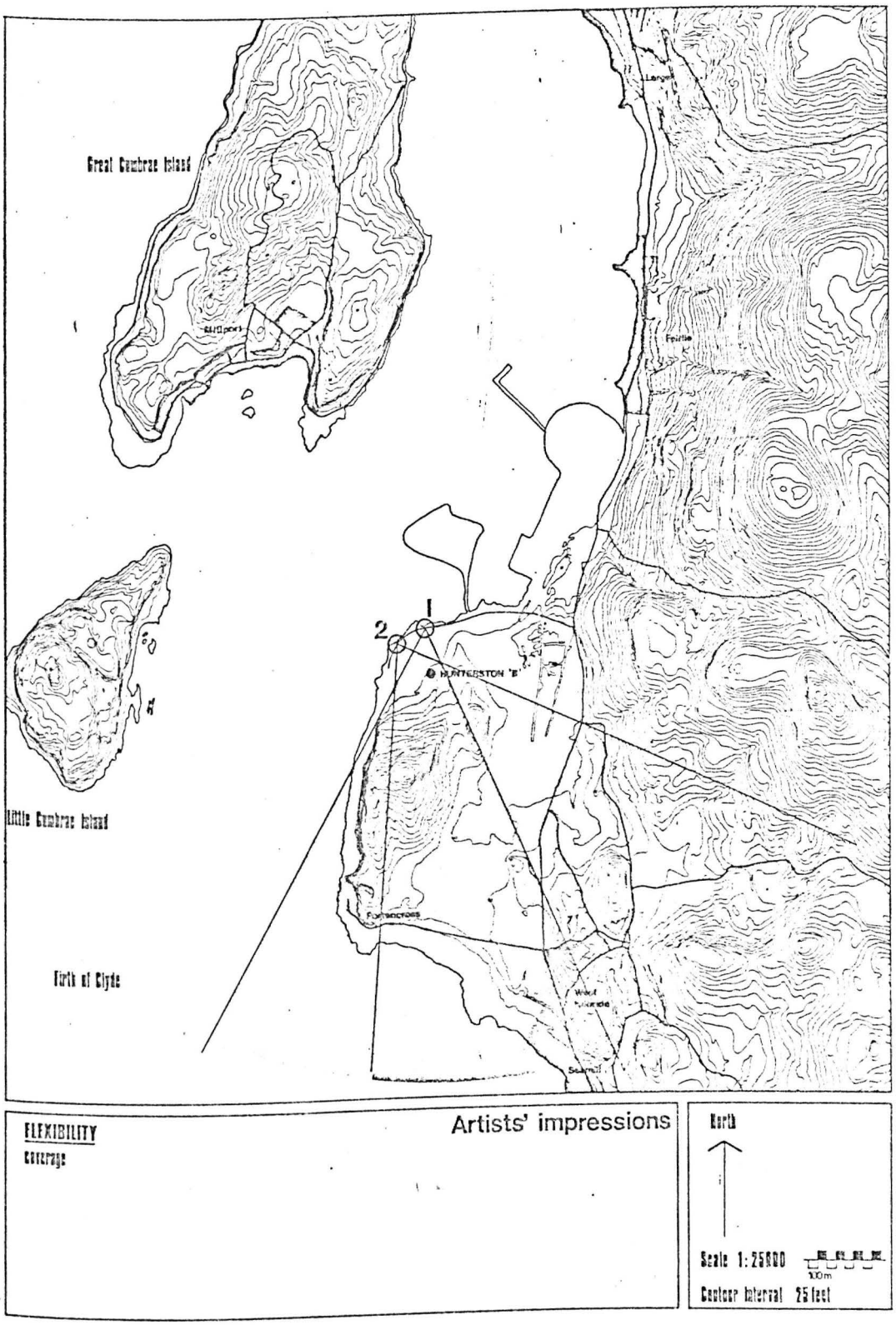
(G59) a) Artist's impression of Hunterston from the shore.

b) Corresponding photographic view.



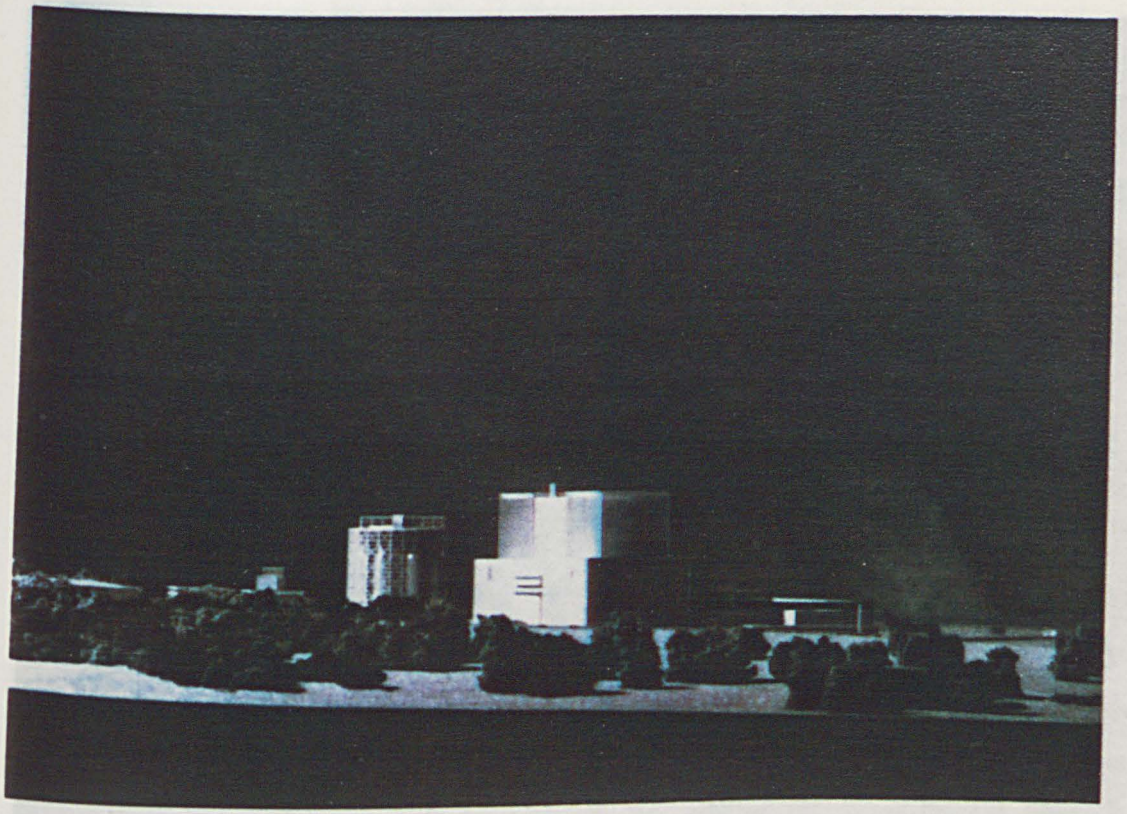
(G60) a) Artist's impression of Hunterston from the approach road.

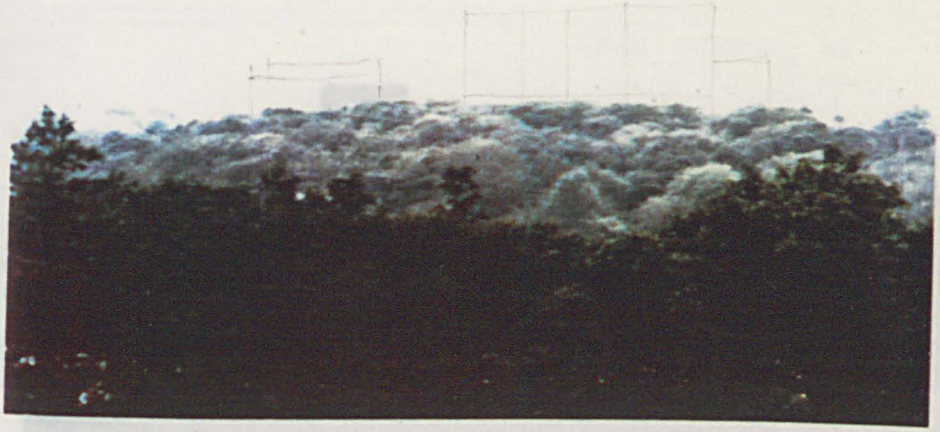
b) Corresponding photographic view.



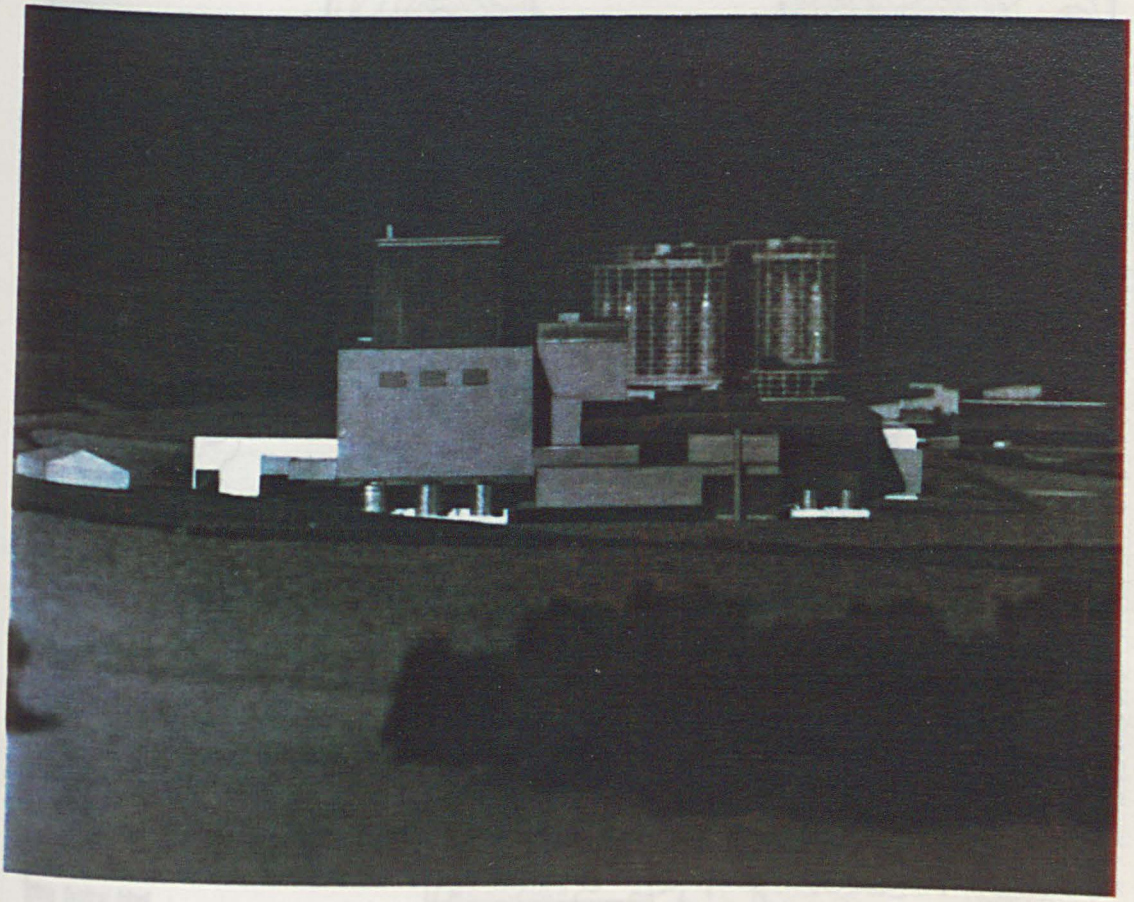
(G61) Map depicting the degree of coverage the artist's impressions offer.

(G62) Hunterston site model.

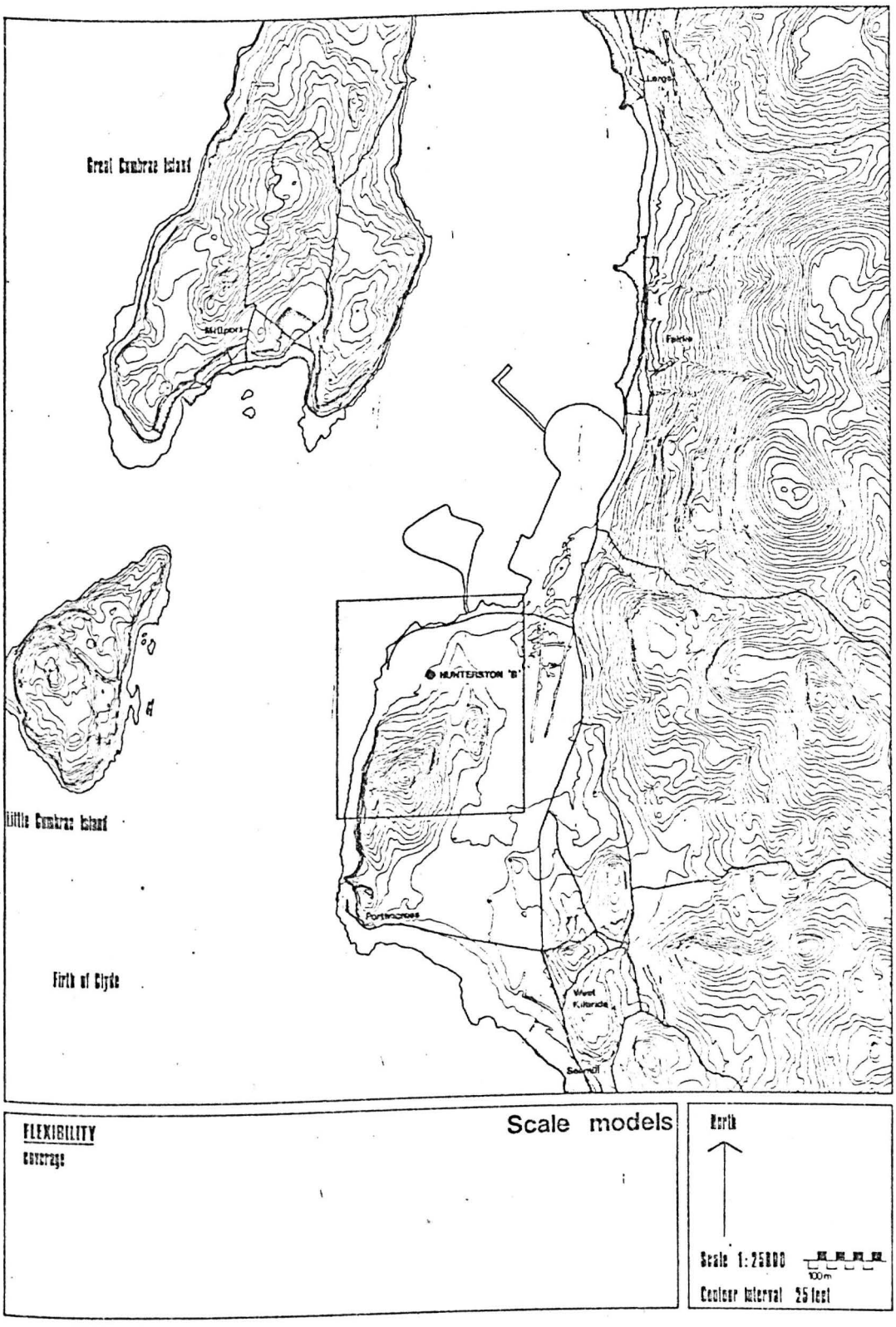




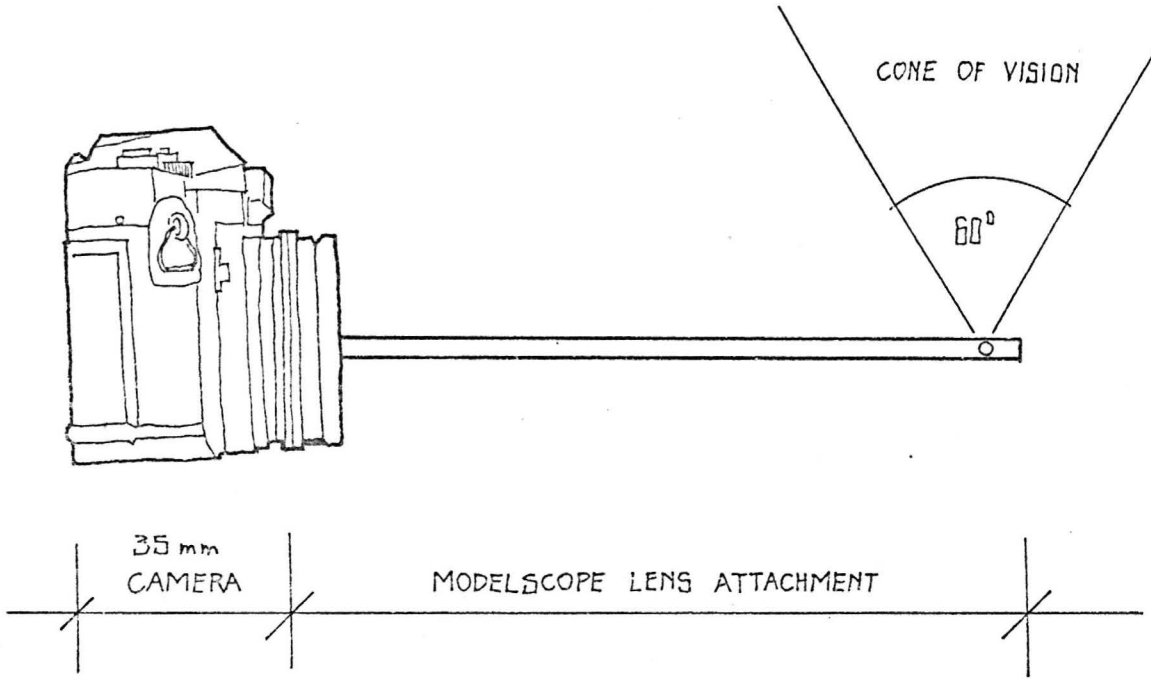
(G63) a) Model simulation photograph of Hunterston.
b) Corresponding site view.



(G64) a) Model simulation photograph of Hunterston.
b) Corresponding site view.

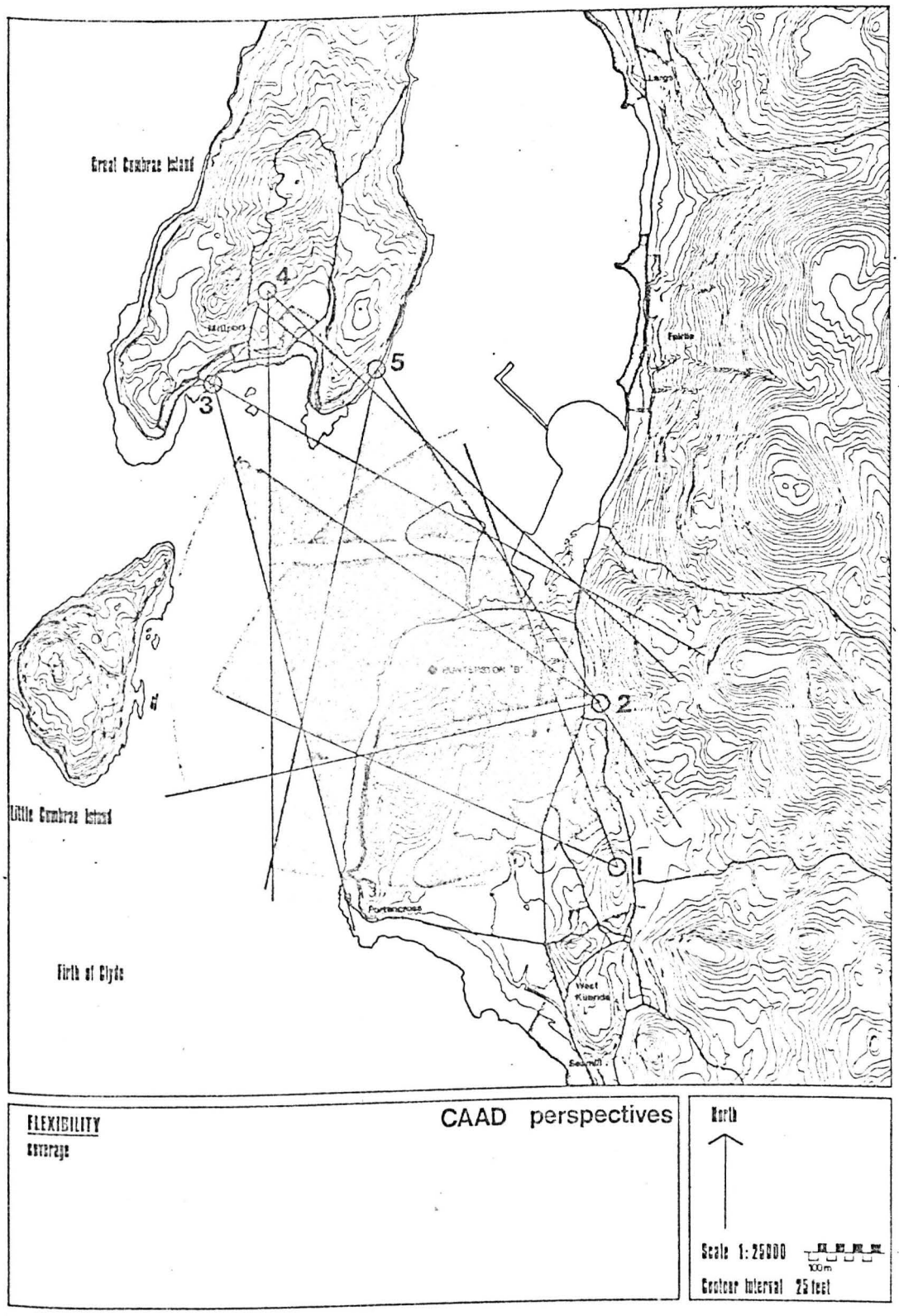


(G65) Map depicting the degree of coverage associated with physical scale model building. Views outside the model may be taken, however,these may be affected by terrain, between the observer and the model boundary, that has not been simulated.

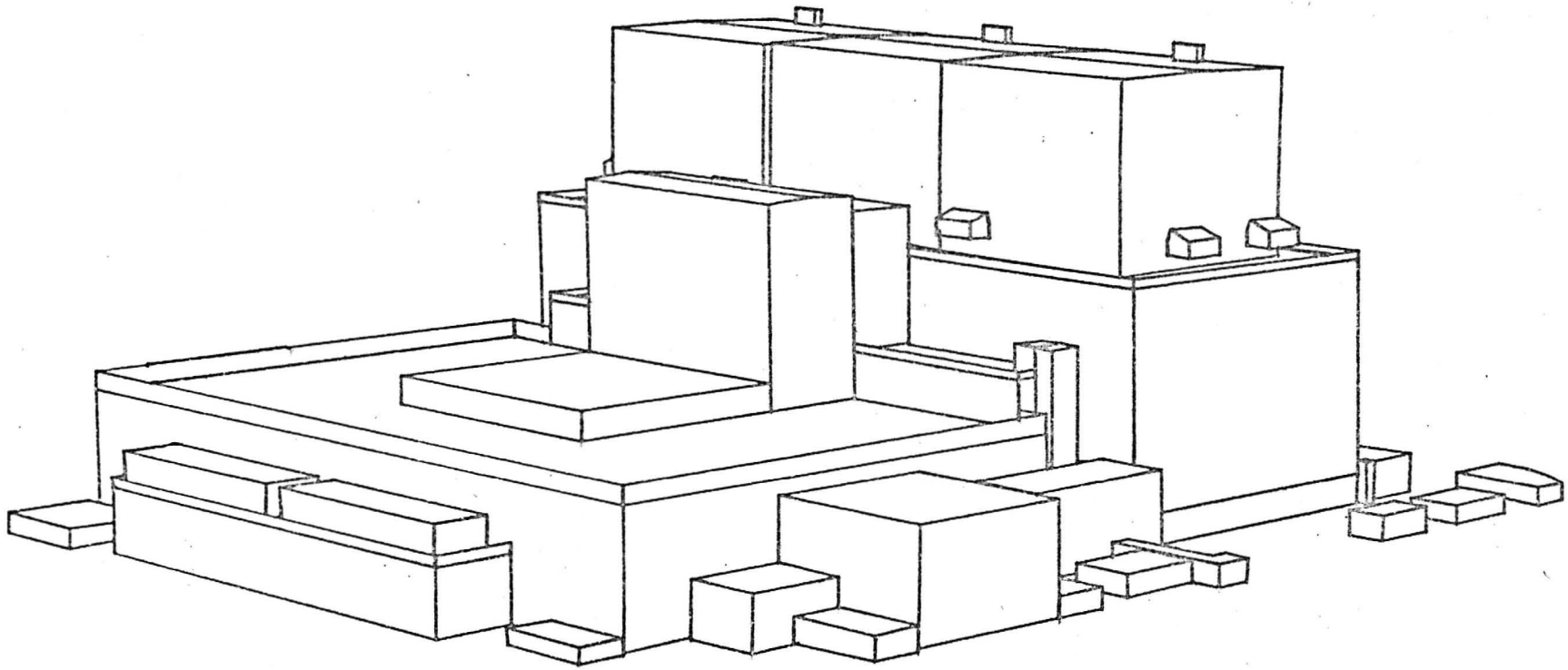


(G66) Camera modelscope attachment for viewing inside physical models.

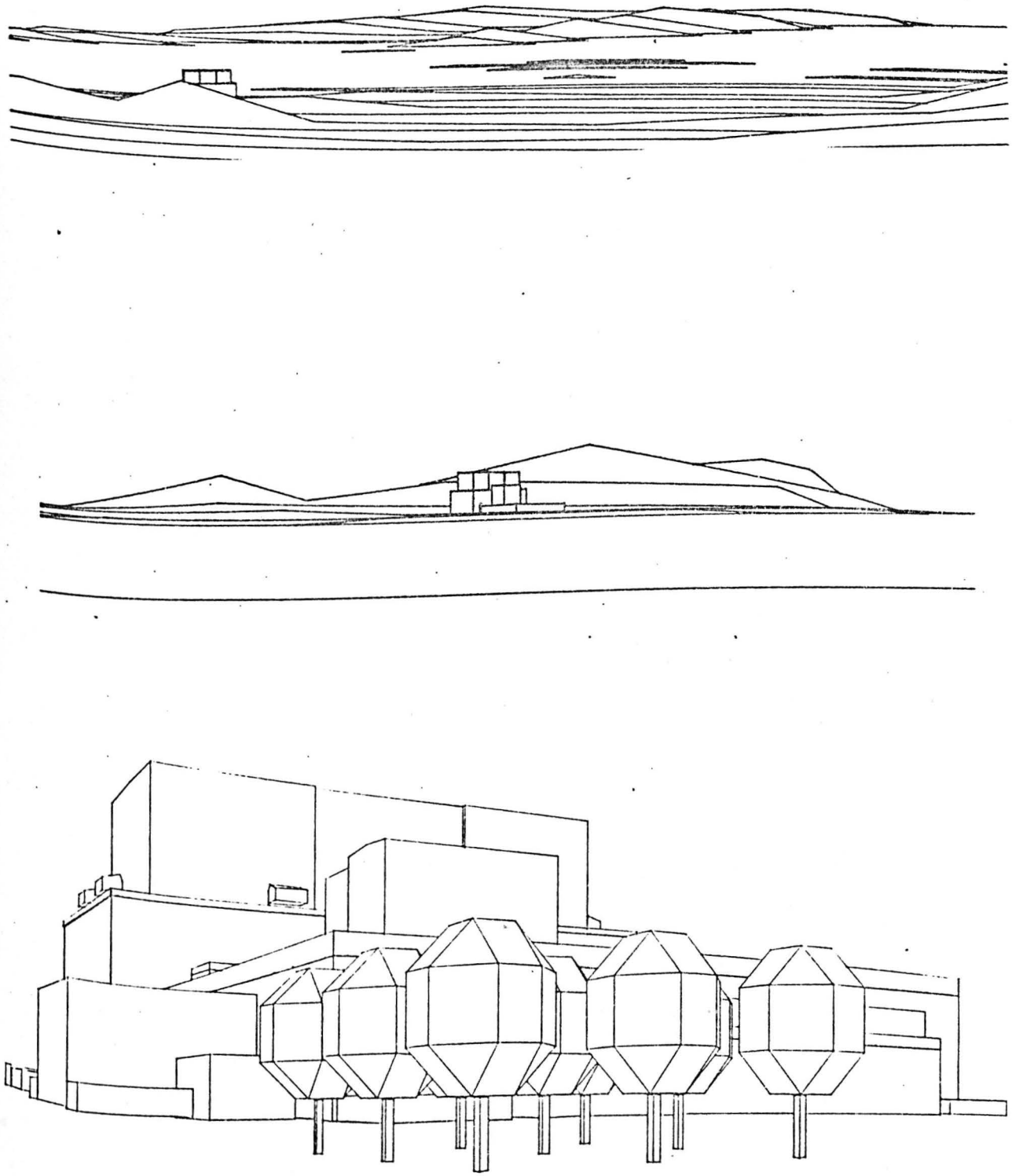
(G67) Modelscope system at Berkeley Environmental Simulation Laboratory, California University. (BURE80) p20.



(G68) Map depicting the degree of coverage associated with the computer based perspectives.

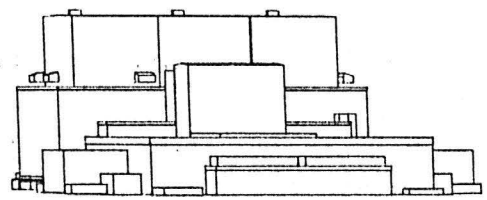


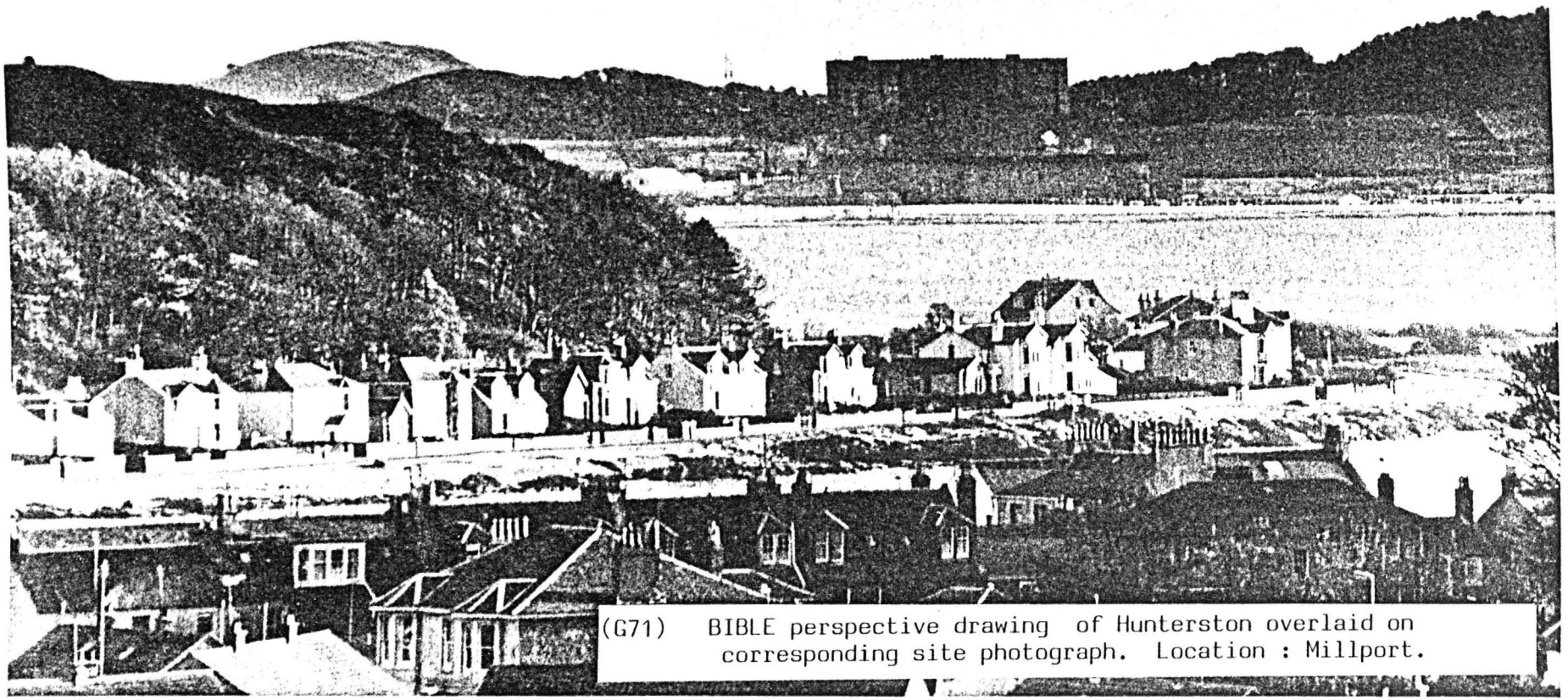
(G69) Detailed model of Hunterston 'B' Power Station (80 elements).



(G70) Landform/builtform/vegetation modelling for visibility assessment using BIBLE.

ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=16685
Y=55730
Z=38.1
FOCUS POINT
X=18557
Y=51468
Z=45.9
MID-POINT
X=18557
Y=51468
Z=45.9
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE



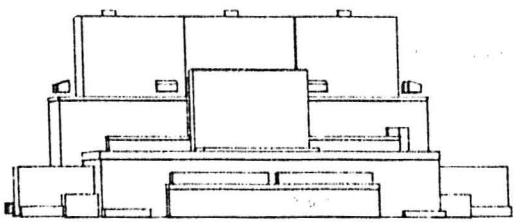


(G71) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Millport.

ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=16685
Y=55730
Z=38.1
FOCUS POINT
X=18557
Y=51468
Z=45.9
MID-POINT
X=18557
Y=51468
Z=45.9
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE

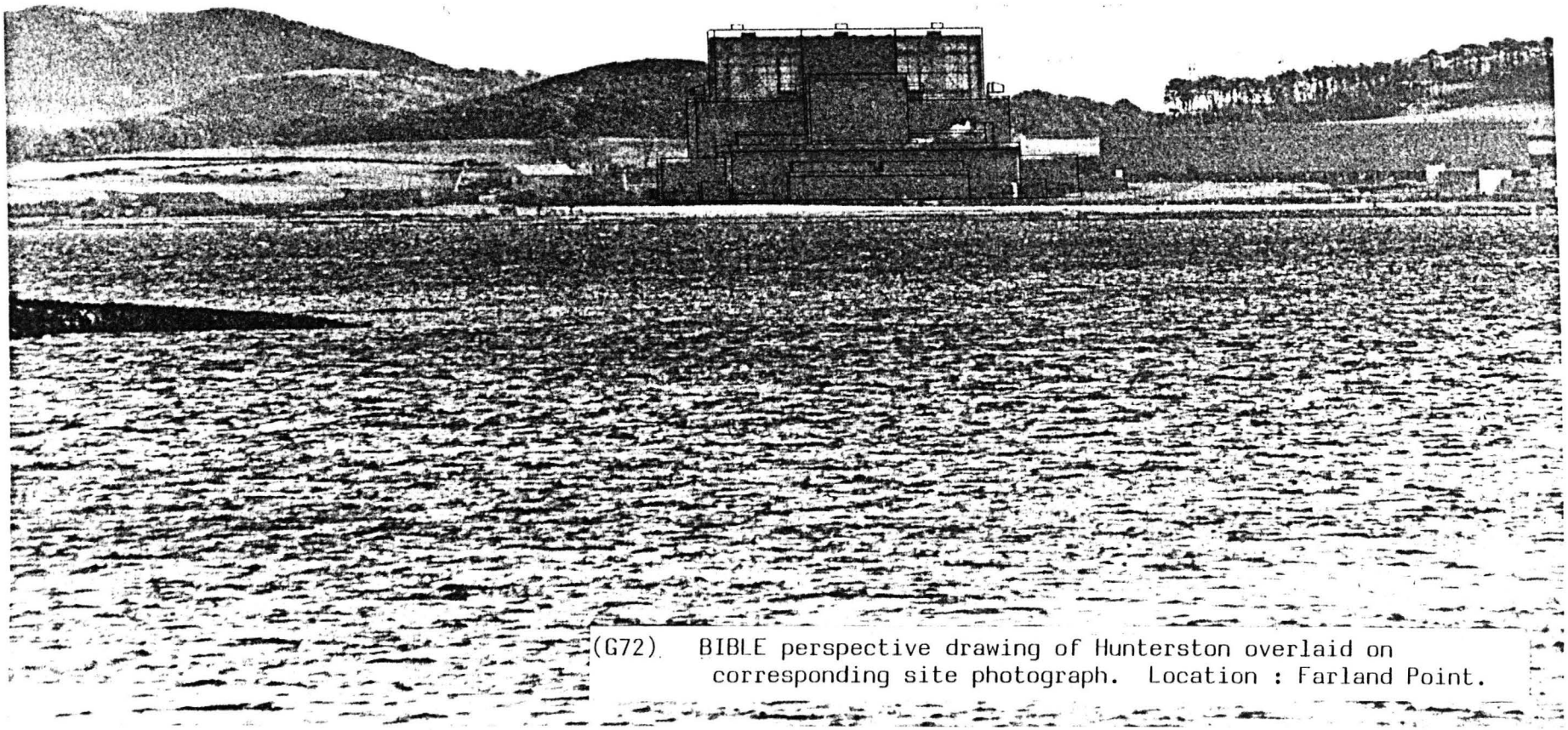
(G71) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Millport.

ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=16160
Y=54680
Z=3.7
FOCUS POINT
X=18555
Y=51466
Z=40.5
MID-POINT
X=18555
Y=51466
Z=40.5
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE



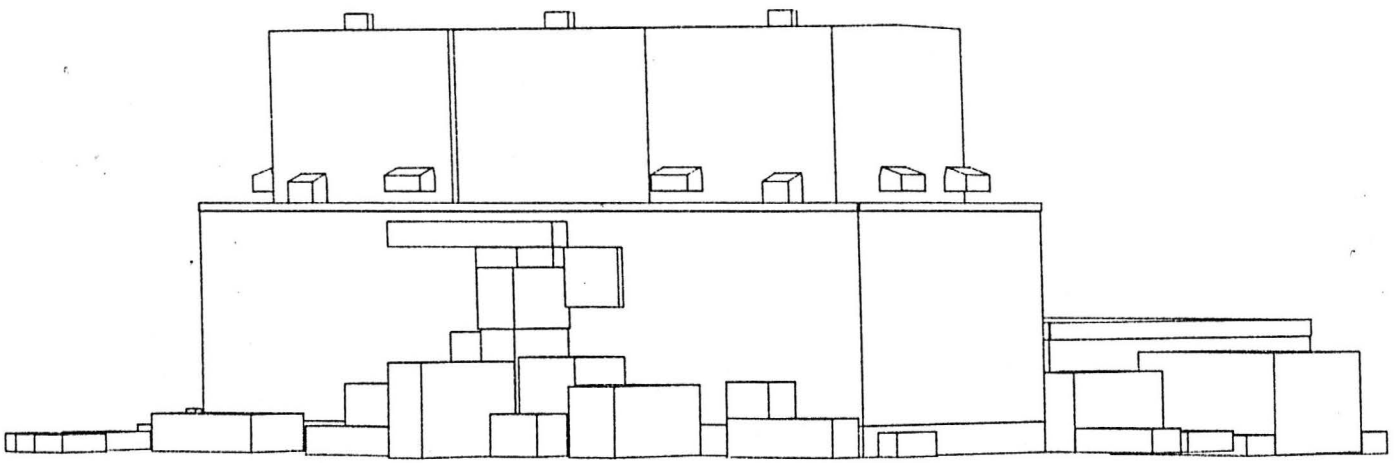
(G72) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Farland Point.

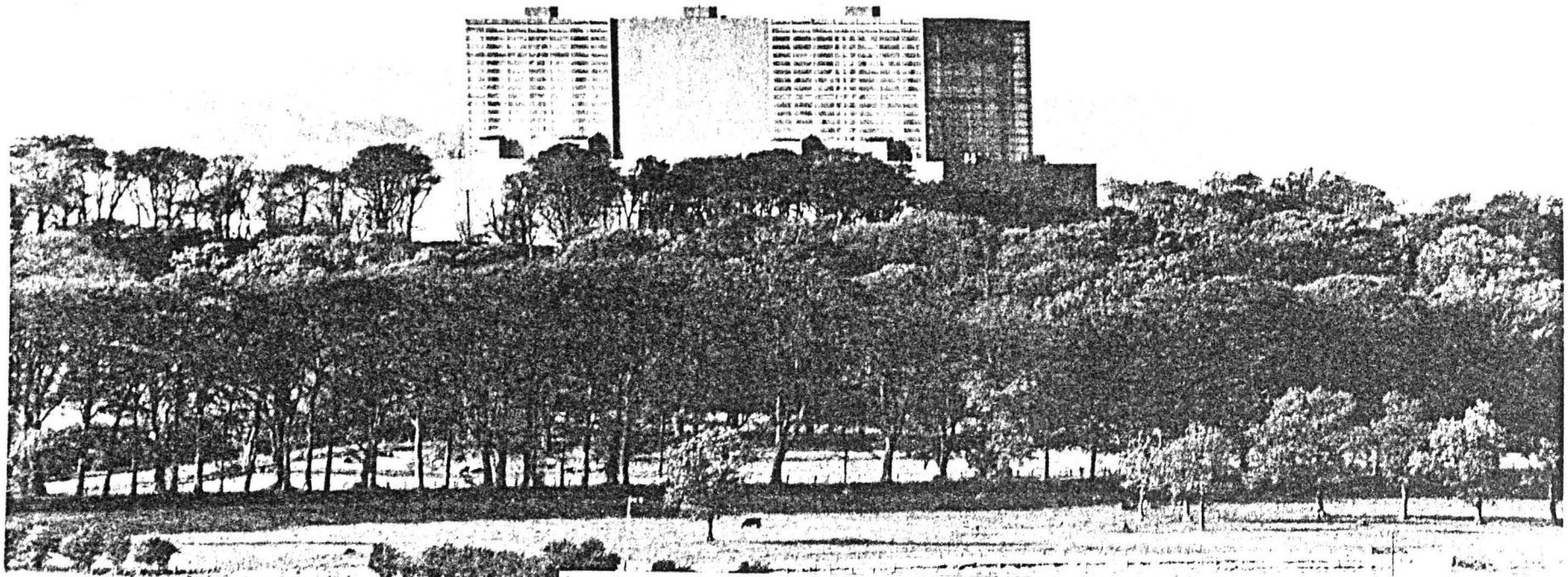
ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=16160
Y=54680
Z=3.7
FOCUS POINT
X=18555
Y=51466
Z=40.5
MID-POINT
X=18555
Y=51466
Z=40.5
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE



(G72) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Farland Point.

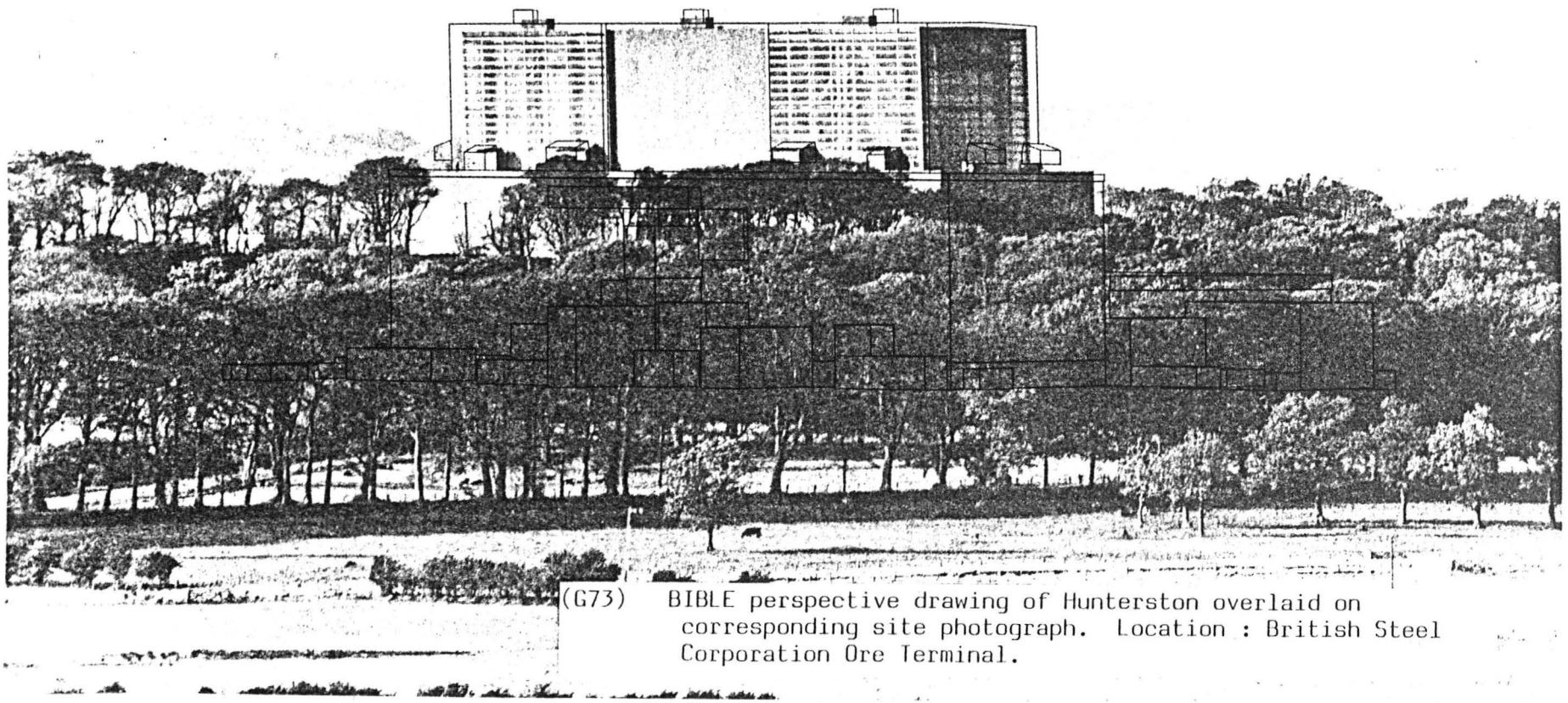
ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=20425
Y=50970
Z=44.2
FOCUS POINT
X=18606
Y=51463
Z=54.3
MID-POINT
X=18606
Y=51463
Z=54.3
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE





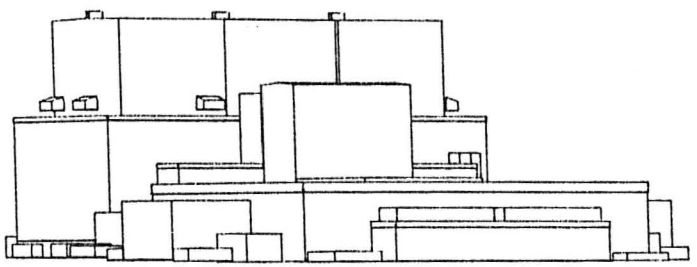
(G73) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : British Steel Corporation Ore Terminal.

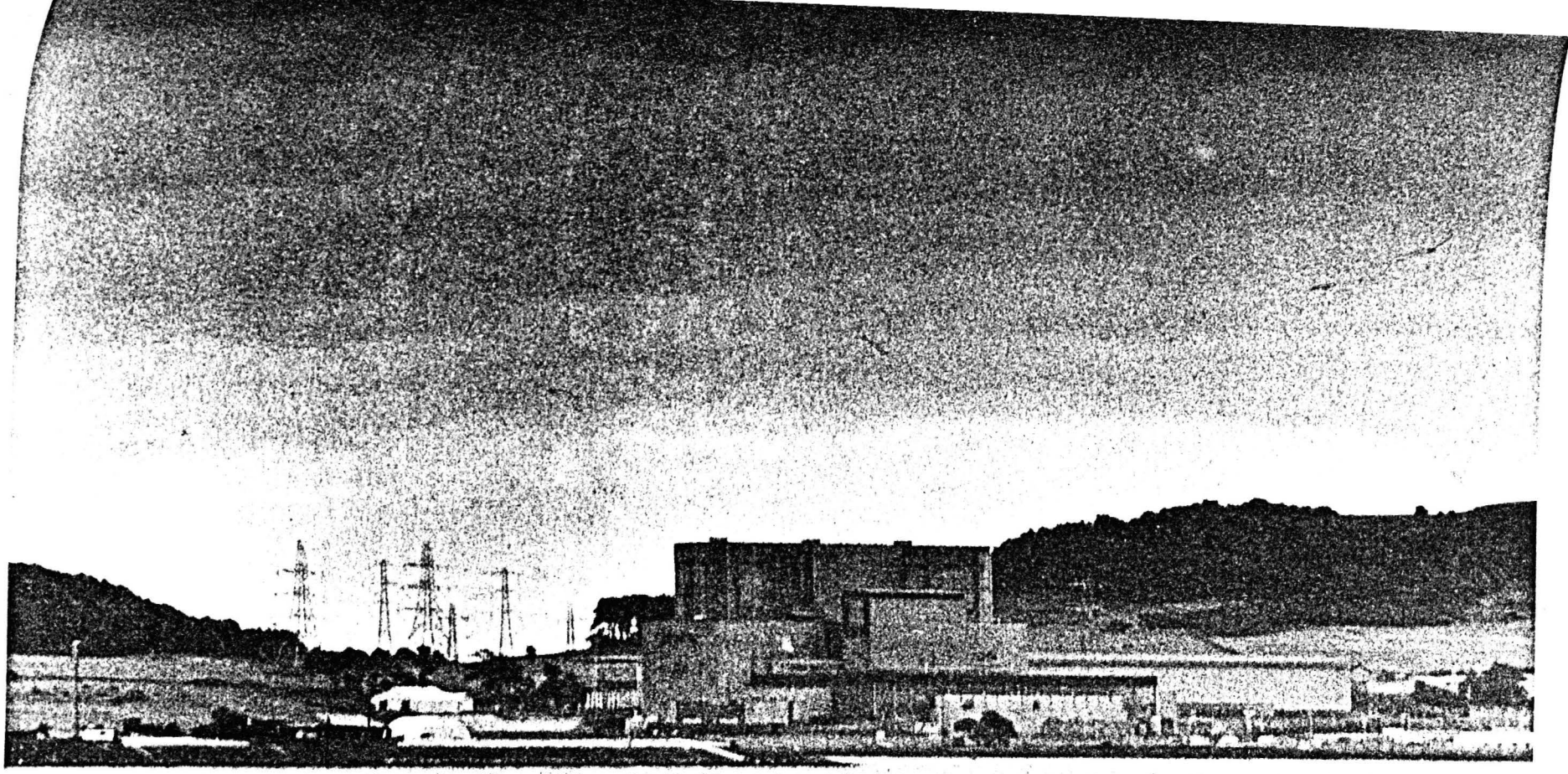
ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=20425
Y=50970
Z=44.2
FOCUS POINT
X=18606
Y=51463
Z=54.3
MID-POINT
X=18606
Y=51463
Z=54.3
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE



(G73) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : British Steel Corporation Ore Terminal.

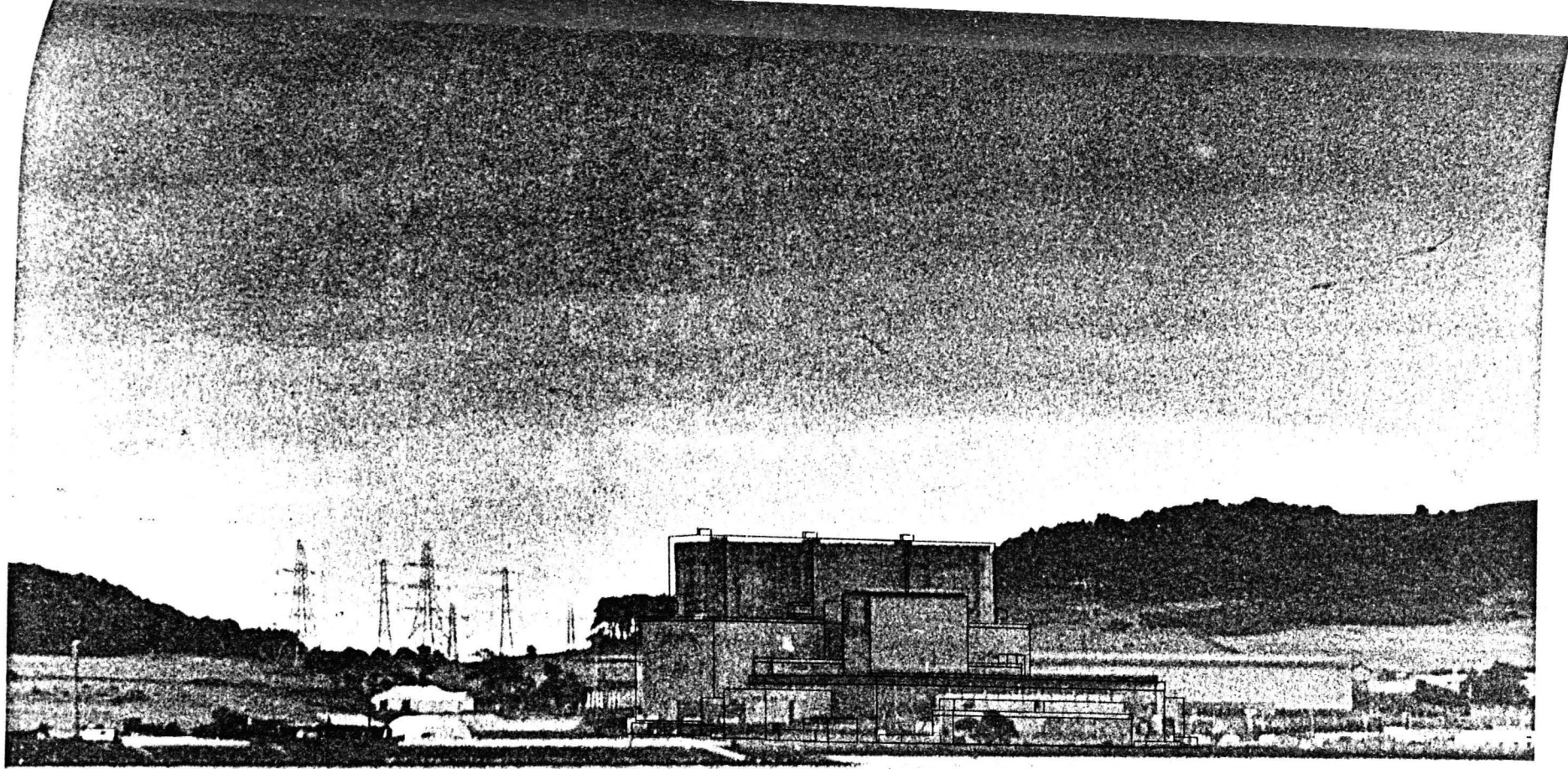
ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=17930
Y=54840
Z=4.9
FOCUS POINT
X=18556
Y=51467
Z=49.5
MID-POINT
X=18556
Y=51467
Z=49.5
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE





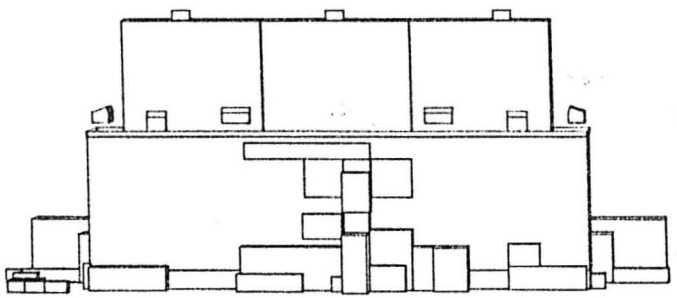
(G74) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Keppel.

ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=17930
Y=54840
Z=4.9
FOCUS POINT
X=18556
Y=51467
Z=49.5
MID-POINT
X=18556
Y=51467
Z=49.5
HIDDEN
F(MM)=200
TIMES=8.357
PERSPECTIVE



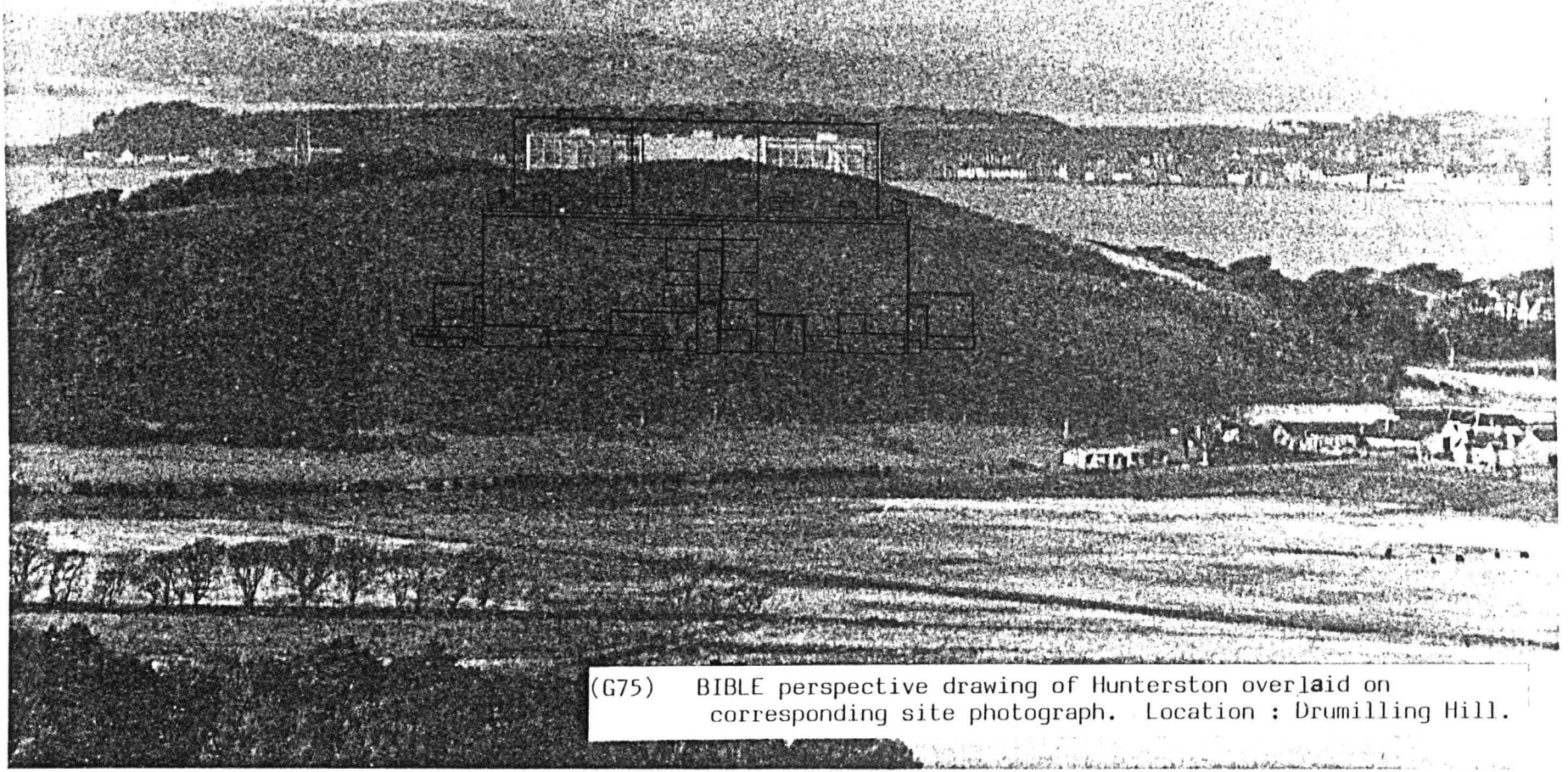
(G74) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Keppel.

ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=20660
Y=49240
Z=101.5
FOCUS POINT
X=18582
Y=51442
Z=68.8
MID-POINT
X=18582
Y=51442
Z=68.8
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE

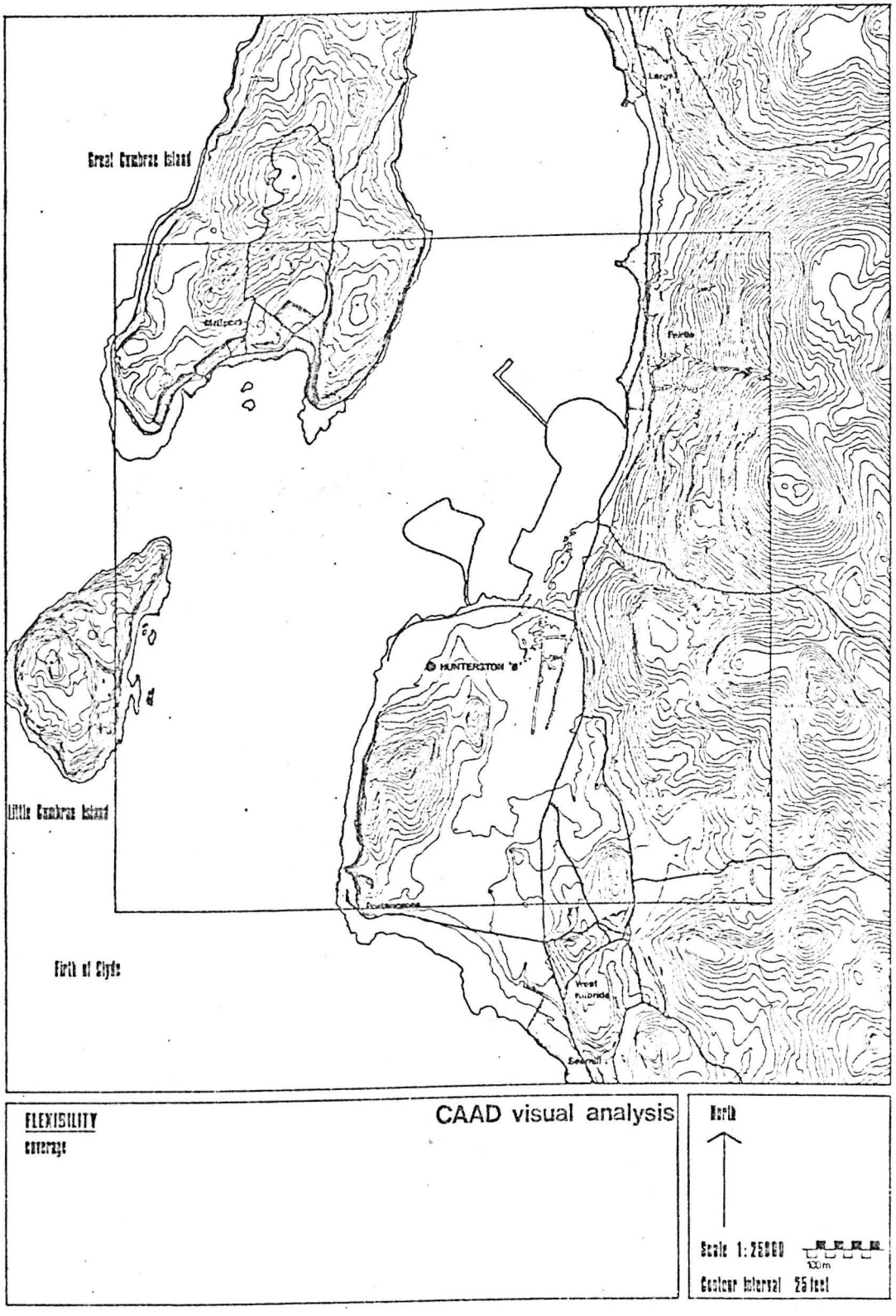


(G75) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Drumilling Hill.

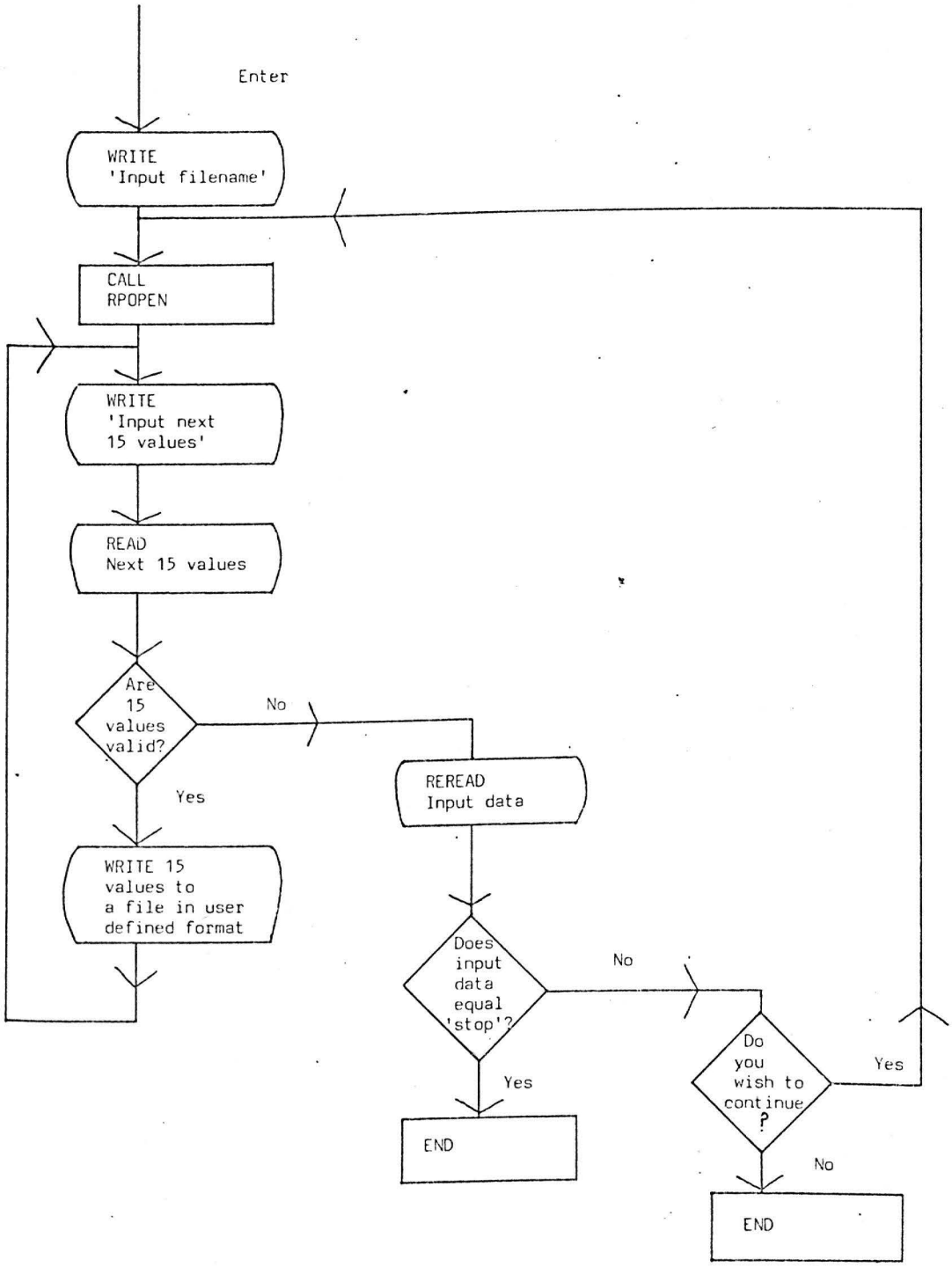
ZMIN=6.1042
ZMAX=75.195
EYE POINT
X=20660
Y=49240
Z=101.5
FOCUS POINT
X=18582
Y=51442
Z=68.8
MID-POINT
X=18582
Y=51442
Z=68.8
HIDDEN
F(MM)=200
TIMES 8.357
PERSPECTIVE



(G75) BIBLE perspective drawing of Hunterston overlaid on corresponding site photograph. Location : Drumilling Hill.

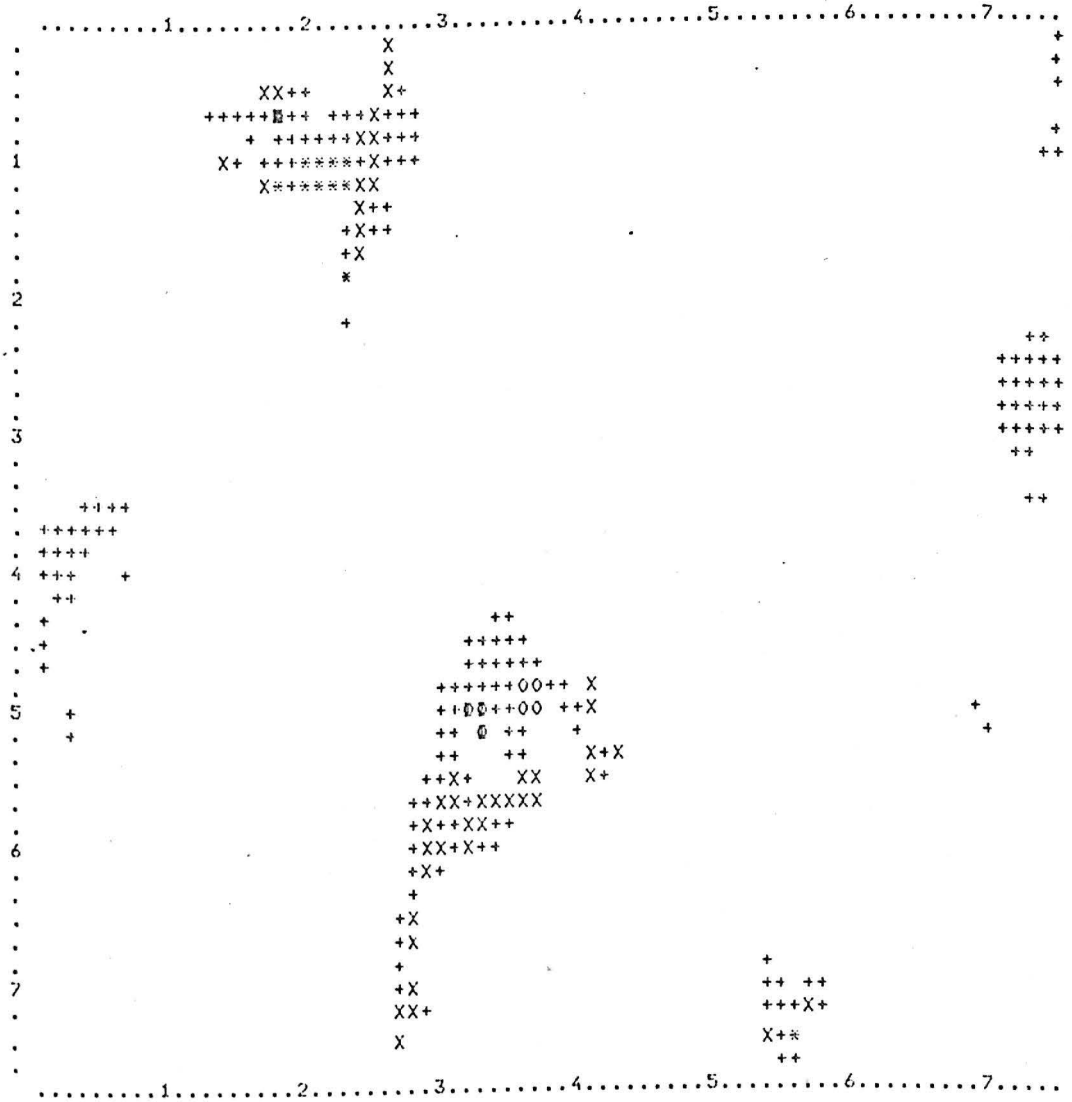


(G76) Map depicting the degree of coverage associated with the program VIEW for visibility determination. Views outside the data set are permissible, however, they may be affected by terrain, between the observer and the data set edge, that has not been modelled.



(G77) Algorithm flow chart for the program EDIT.

```
MAP TITLE: HUNTERSTON VISIBILITY STUDY  EYE HEIGHT AT 6,18
OBSERVER POSITION FOR VIEW  1
ICENT=     6
JCENT=    18
ELEVATION OF OBSERVER POSITION ABOVE INPUT DATA ELEVATION     6
OBSERVER POSITION TREATED AS A POINT
(IPOINT=0 AANGLE AND BANGLE NOT USED)
CURVATURE PARAMETER                                    1
VISIBILITY MATRIX PRINT PARAMETER                      1
VISIBLE CELL COORDINATE PRINT PARAMETER                0
VISIBILITY MATRIX OUTPUT PARAMETER                     0
ABOVE VERTICAL VIEWING ANGLE                        80.0
BELOW VERTICAL VIEWING ANGLE                       -80.0
STARTING SCAN ANGLE                                  0.0
ENDING SCAN ANGLE                                    0.0
```



HUNTERSTON VISIBILITY STUDY EYE HEIGHT AT 6,18 [5·7, 17·85] on site.

INVISIBLE CELLS WITHIN RADIUS OF VISIBILITY
+ VISIBLE OPEN LAND
* VISIBLE BUILDINGS
X VISIBLE TREES
0 HUNTERSTON A
@ HUNTERSTON B
■ VIEW POINT

(G78) Hunterston visibility study using the program VIEW2.
Observer location : Millport.

```
MAP TITLE: HUNTERSTON VISIBILITY STUDY  EYE HEIGHT AT 16,13
OBSERVER POSITION FOR VIEW  2
ICENT=   16
JCENT=   13
ELEVATION OF OBSERVER POSITION ABOVE INPUT DATA ELEVATION     6
OBSERVER POSITION TREATED AS A POINT
(IPOINT=0 AANGLE AND BANGLE NOT USED)
CURVATURE PARAMETER                                    1
VISIBILITY MATRIX PRINT PARAMETER                      1
VISIBLE CELL COORDINATE PRINT PARAMETER                0
VISIBILITY MATRIX OUTPUT PARAMETER                     0
ABOVE VERTICAL VIEWING ANGLE                        80.0
BELOW VERTICAL VIEWING ANGLE                       -80.0
STARTING SCAN ANGLE                                  0.0
ENDING SCAN ANGLE                                    0.0
```

HUNTERSTON VISIBILITY STUDY EYE HEIGHT AT 16,13 [16·2, 12·6] on site.

INVISIBLE CELLS WITHIN RADIUS OF VISIBILITY
\+ VISIBLE OPEN LAND
* VISIBLE BUILDINGS
X VISIBLE TREES
0 HUNTERSTON A
Ø HUNTERSTON B
■ VIEW POINT

(G79) Hunterston visibility study using the program VIEW2.
Observer location : Farland Point.

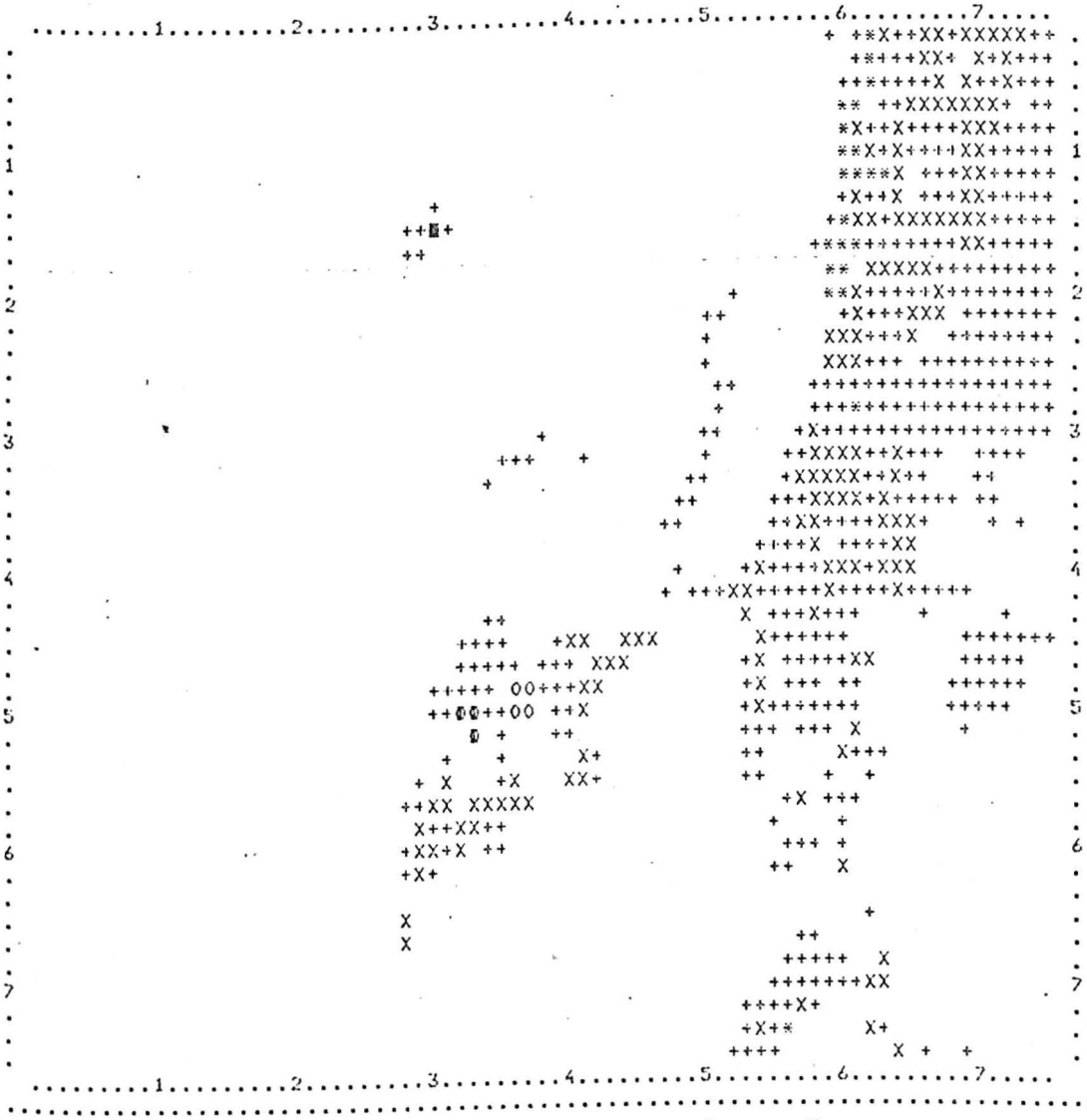
```
MAP TITLE: HUNTERSTON VISIBILITY STUDY  EYE HEIGHT AT 53,55
OBSERVER POSITION FOR VIEW  3
ICENT=    53
JCENT=    55
ELEVATION OF OBSERVER POSITION ABOVE INPUT DATA ELEVATION     6
OBSERVER POSITION TREATED AS A POINT
(IPOINT=0 AANGLE AND BANGLE NOT USED)
CURVATURE PARAMETER                                  1
VISIBILITY MATRIX PRINT PARAMETER                    1
VISIBLE CELL COORDINATE PRINT PARAMETER              0
VISIBILITY MATRIX OUTPUT PARAMETER                   0
ABOVE VERTICAL VIEWING ANGLE                      80.0
BELOW VERTICAL VIEWING ANGLE                     -80.0
STARTING SCAN ANGLE                                0.0
ENDING SCAN ANGLE                                  0.0
```

HUNTERSTON VISIBILITY STUDY EYE HEIGHT AT 53,55 [53·4, 55·4] on site.

INVISIBLE CELLS WITHIN RADIUS OF VISIBILITY
\+ VISIBLE OPEN LAND
* VISIBLE BUILDINGS
X VISIBLE TREES
0 HUNTERSTON A
@ HUNTERSTON B
■ VIEW POINT

(G80) Hunterston visibility study using the program VIEW2.
Observer location : British Steel Corporation Ore Terminal.

```
MAP TITLE: HUNTERSTON VISIBILITY STUDY  EYE HEIGHT AT 15,30
OBSERVER POSITION FOR VIEW  4
ICENT=    15
JCENT=    30
ELEVATION OF OBSERVER POSITION ABOVE INPUT DATA ELEVATION     6
OBSERVER POSITION TREATED AS A POINT
(IPOINT=0 AANGLE AND BANGLE NOT USED)
CURVATURE PARAMETER                                 1
VISIBILITY MATRIX PRINT PARAMETER                   1
VISIBLE CELL COORDINATE PRINT PARAMETER             0
VISIBILITY MATRIX OUTPUT PARAMETER                  0
ABOVE VERTICAL VIEWING ANGLE                     80.0
BELOW VERTICAL VIEWING ANGLE                    -80.0
STARTING SCAN ANGLE                               0.0
ENDING SCAN ANGLE                                 0.0
```



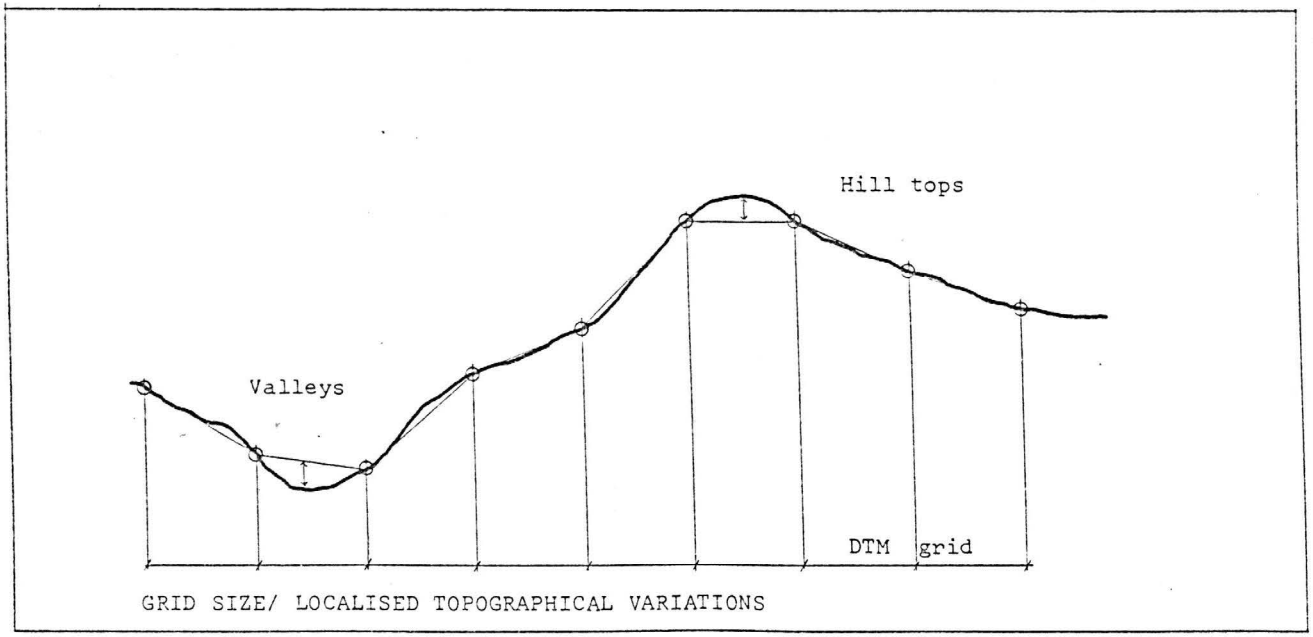
HUNTERSTON VISIBILITY STUDY EYE HEIGHT AT 15,30 [14·7,30·3] on site.

INVISIBLE CELLS WITHIN RADIUS OF VISIBILITY
\+ VISIBLE OPEN LAND
* VISIBLE BUILDINGS
X VISIBLE TREES
0 HUNTERSTON A
@ HUNTERSTON B
■ VIEW POINT

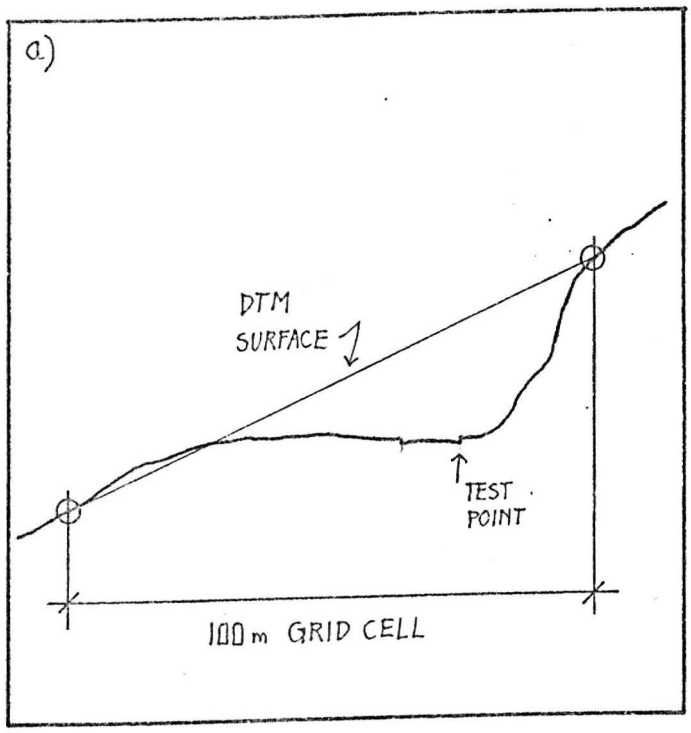
(G81) Hunterston visibility study using the program VIEW2.
Observer location : Keppel.

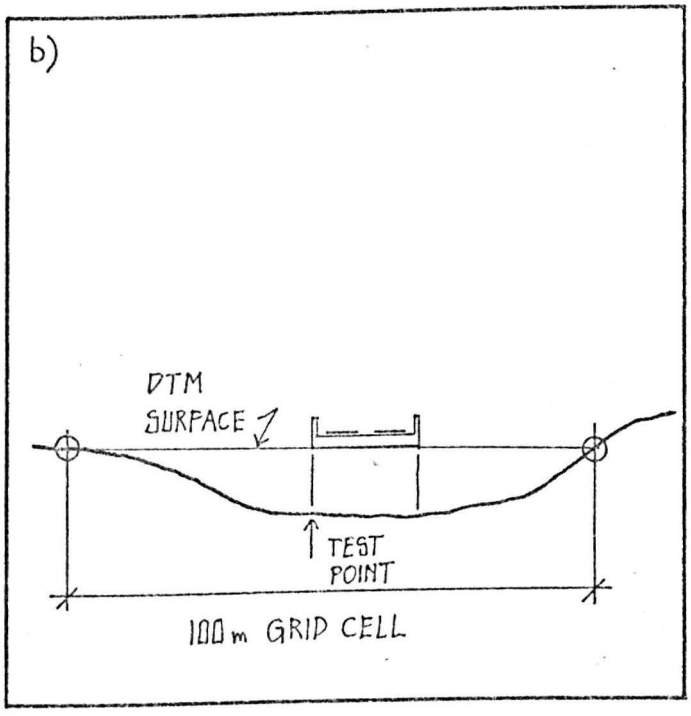
```
MAP TITLE: HUNTERSTON VISIBILITY STUDY  EYE HEIGHT AT 71,58
OBSERVER POSITION FOR VIEW  5
ICENT=    71
JCENT=    58
ELEVATION OF OBSERVER POSITION ABOVE INPUT DATA ELEVATION     6
OBSERVER POSITION TREATED AS A POINT
(IPOINT=0 AANGLE AND BANGLE NOT USED)
CURVATURE PARAMETER                                  1
VISIBILITY MATRIX PRINT PARAMETER                    1
VISIBLE CELL COORDINATE PRINT PARAMETER              0
VISIBILITY MATRIX OUTPUT PARAMETER                   0
ABOVE VERTICAL VIEWING ANGLE                      80.0
BELOW VERTICAL VIEWING ANGLE                     -80.0
STARTING SCAN ANGLE                                0.0
ENDING SCAN ANGLE                                  0.0
```

(G82) Hunterston visibility study using the program VIEW2.
Observer location : Drumilling Hill.



(G83) Ridge and valley inconsistencies between modelled DTM and actual topography.

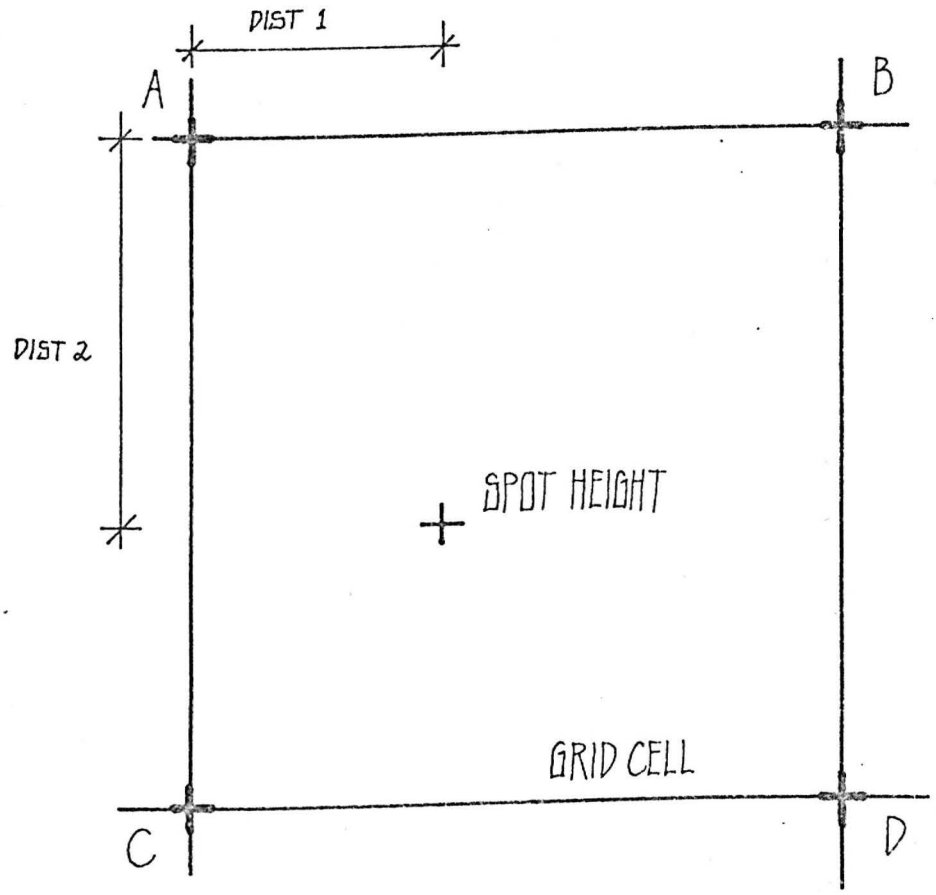




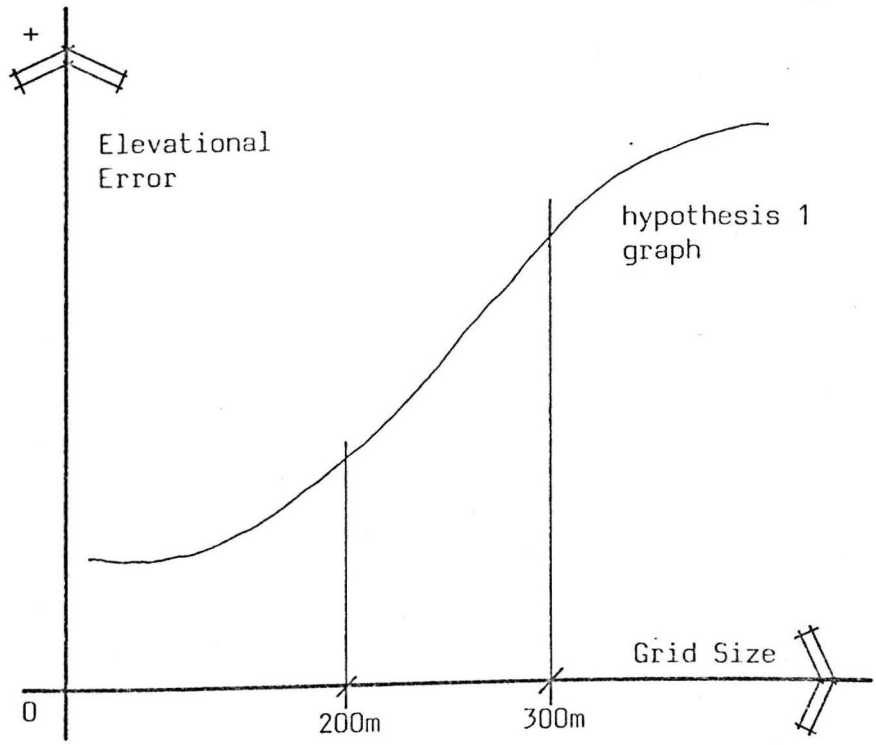
(G84) Gross variations between actual spot heights and DTM interpolated heights, eg. at

a) road cutting.

b) road cutting under railbridge.



(G85) Data requirements for program DIGERR.
A, B, C, D, DIST1, DIST2 and spot height.



(G86) Graph describing hypothesis 1.
The graph describing the relationship between grid size and elevational errorr is ogival in shape.

100m

NUMBER OF DATA OBSERVATIONS	122
NUMBER OF POINTS ACTUALLY DIGITISED	4017
SAMPLE %	3.0371
MAXIMUM ERROR	26.9101
MINIMUM ERROR	0.0183
AVERAGE ERROR	4.5344
STANDARD DEVIATION	4.7429

200m

NUMBER OF DATA OBSERVATIONS	122
NUMBER OF POINTS ACTUALLY DIGITISED	4017
SAMPLE %	3.0371
MAXIMUM ERROR	51.4349
MINIMUM ERROR	0.0209
AVERAGE ERROR	9.4217
STANDARD DEVIATION	10.1677

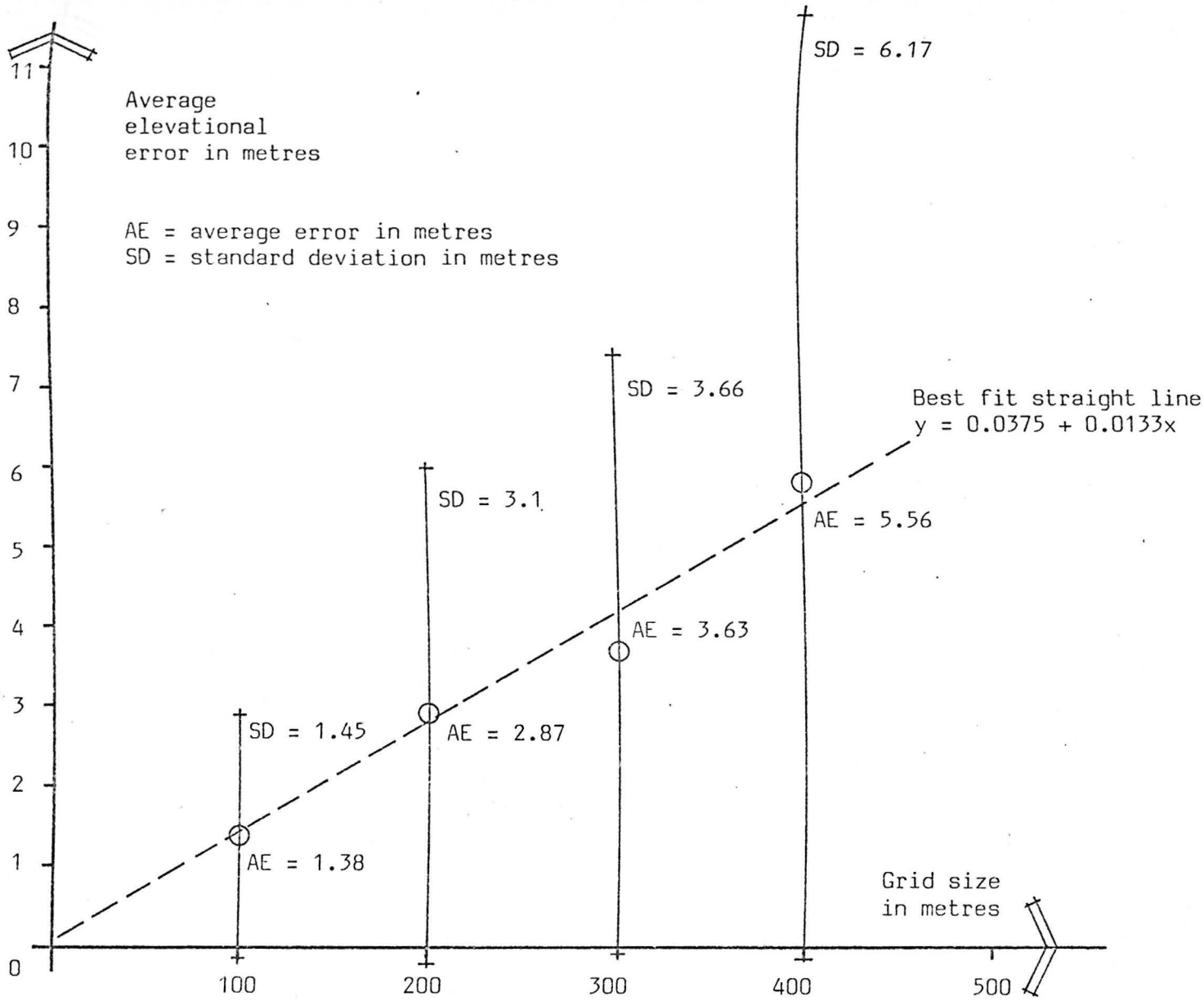
300m

NUMBER OF DATA OBSERVATIONS	122
NUMBER OF POINTS ACTUALLY DIGITISED	4017
SAMPLE %	3.0371
MAXIMUM ERROR	60.8797
MINIMUM ERROR	0.0118
AVERAGE ERROR	11.9169
STANDARD DEVIATION	12.0124

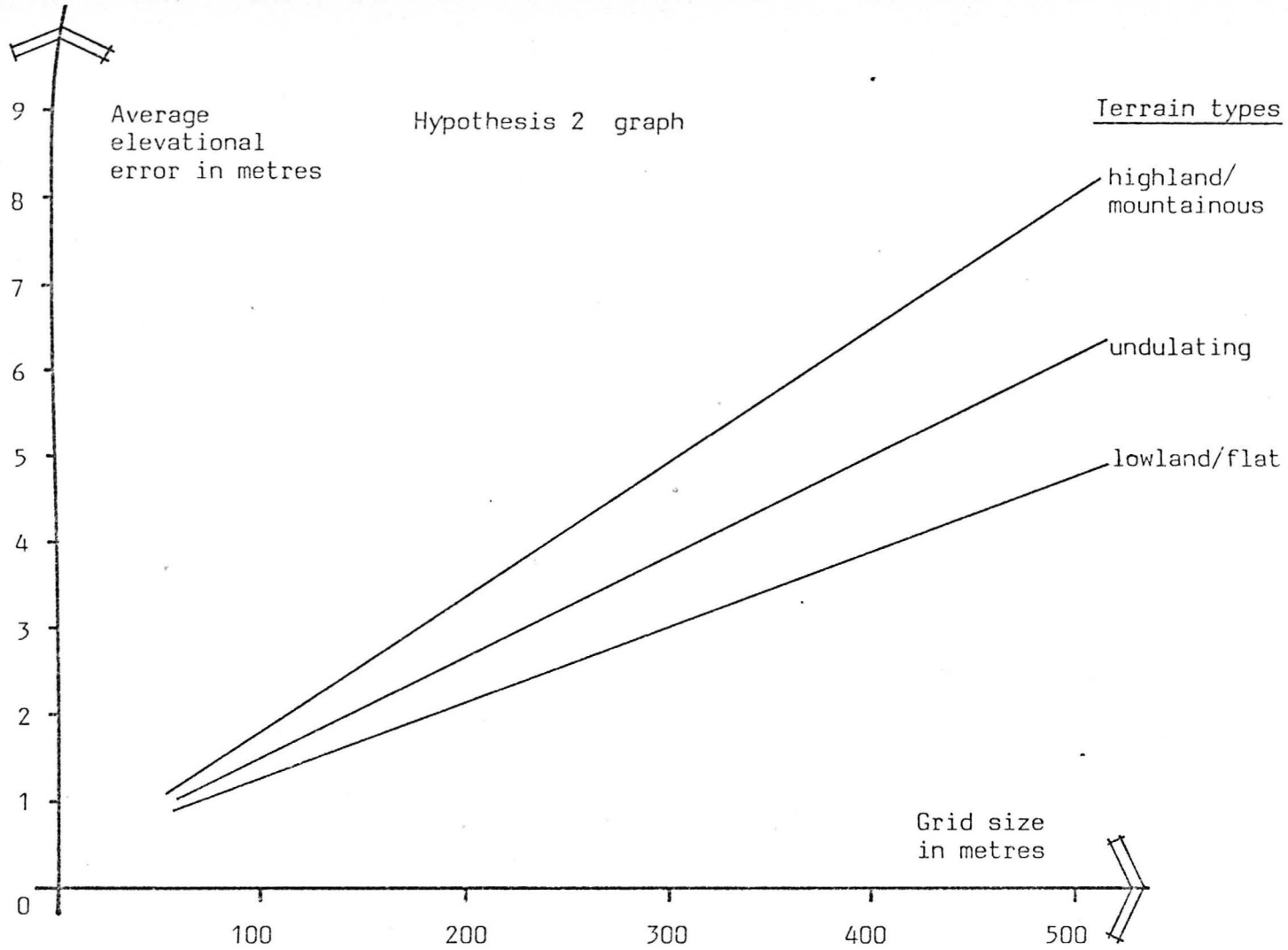
400m

NUMBER OF DATA OBSERVATIONS	122
NUMBER OF POINTS ACTUALLY DIGITISED	4017
SAMPLE %	3.0371
MAXIMUM ERROR	145.8461
MINIMUM ERROR	0.1289
AVERAGE ERROR	18.2287
STANDARD DEVIATION	20.2425

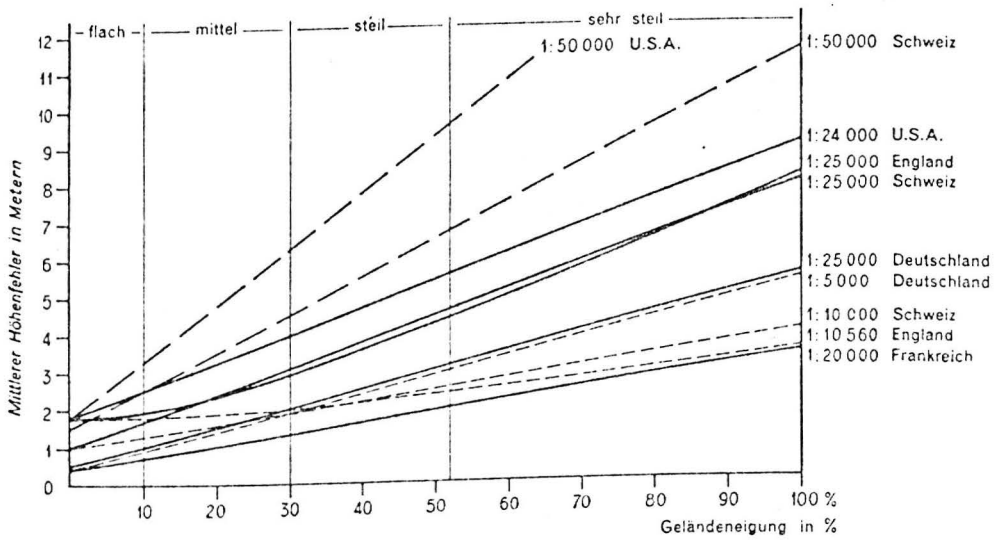
(G87) DIGERR output for 100m,200m,300m, and 400m grid sizes.



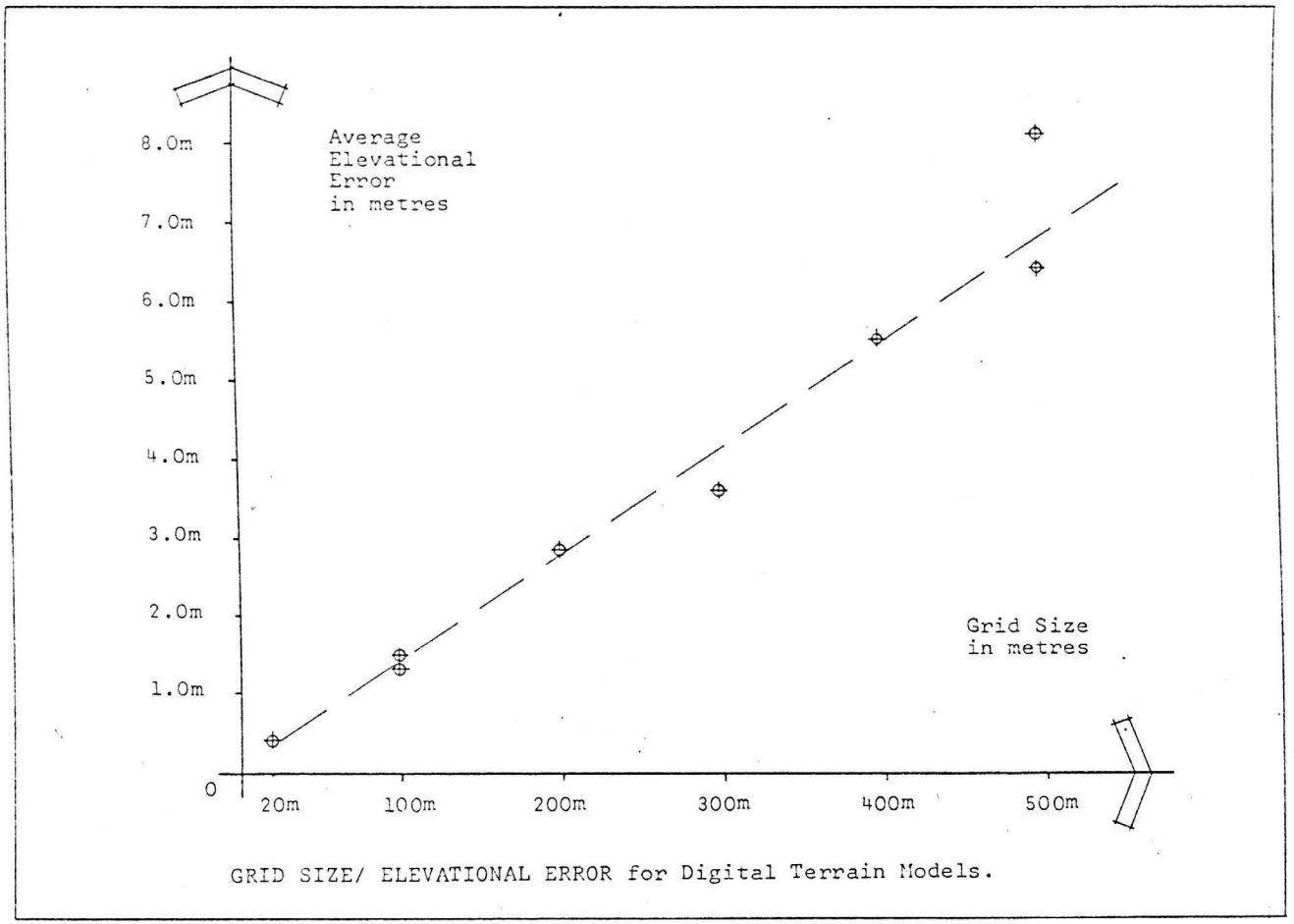
(G88) Graph of DIGERR output from (G87). Average elevational error against grid size.



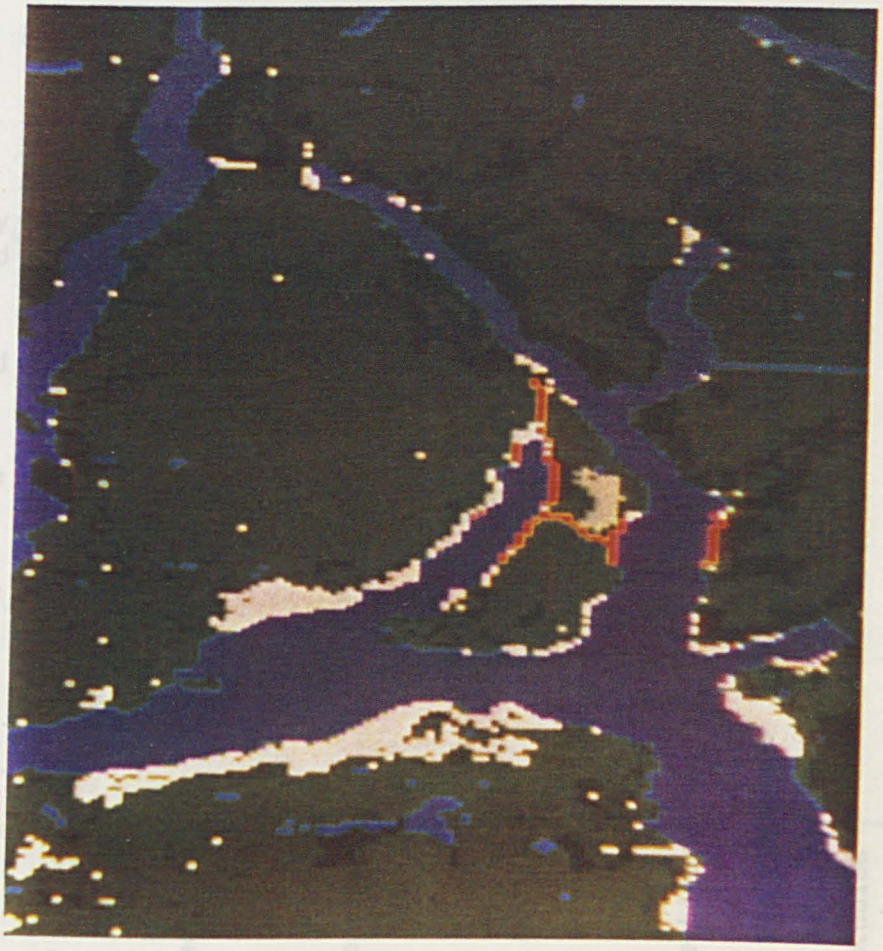
(G89) Graph describing hypothesis 2.
The straigh line graph which maps grid size to elevational error has different degrees of slope which correspond to different types of terrain.



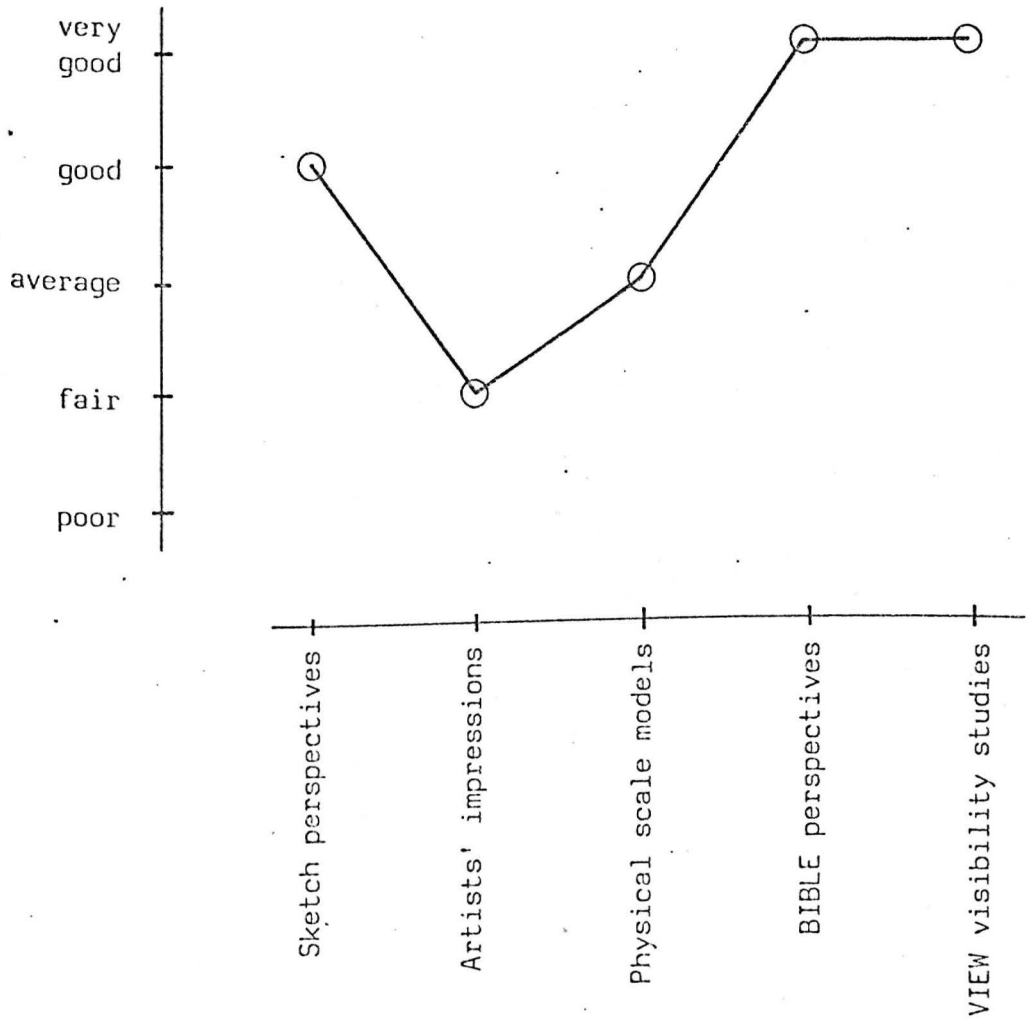
(G90) Imhof's graph of terrain slope or steepness (increasing along the x-axis)against the average elevational error (increasing up the y-axis). (IMH065) p42.



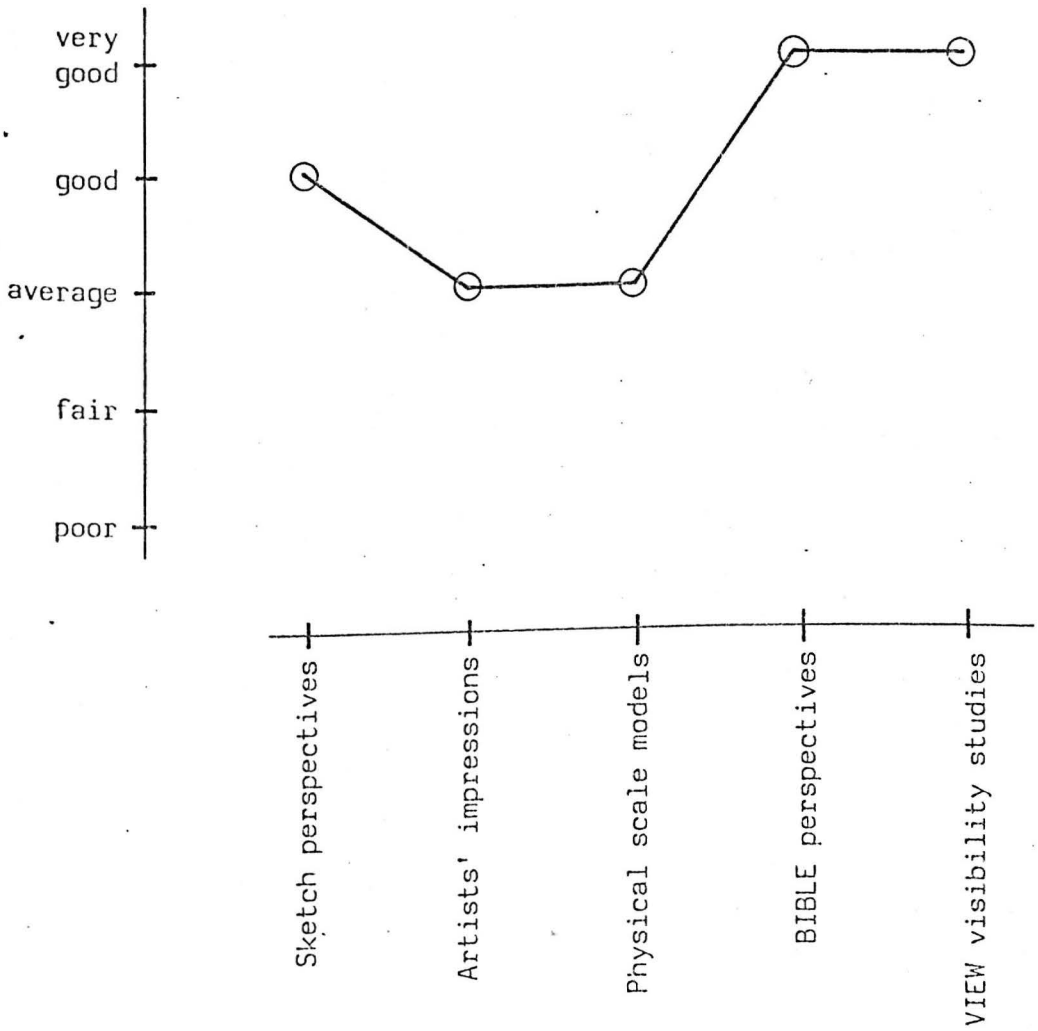
(G91) Graph of grid size against average elevational error for eight DTMs ranging in grid size from 20m to 500m.
Best fit straight line: $y = -0.0277 + 0.01418x$; x & y in metres.



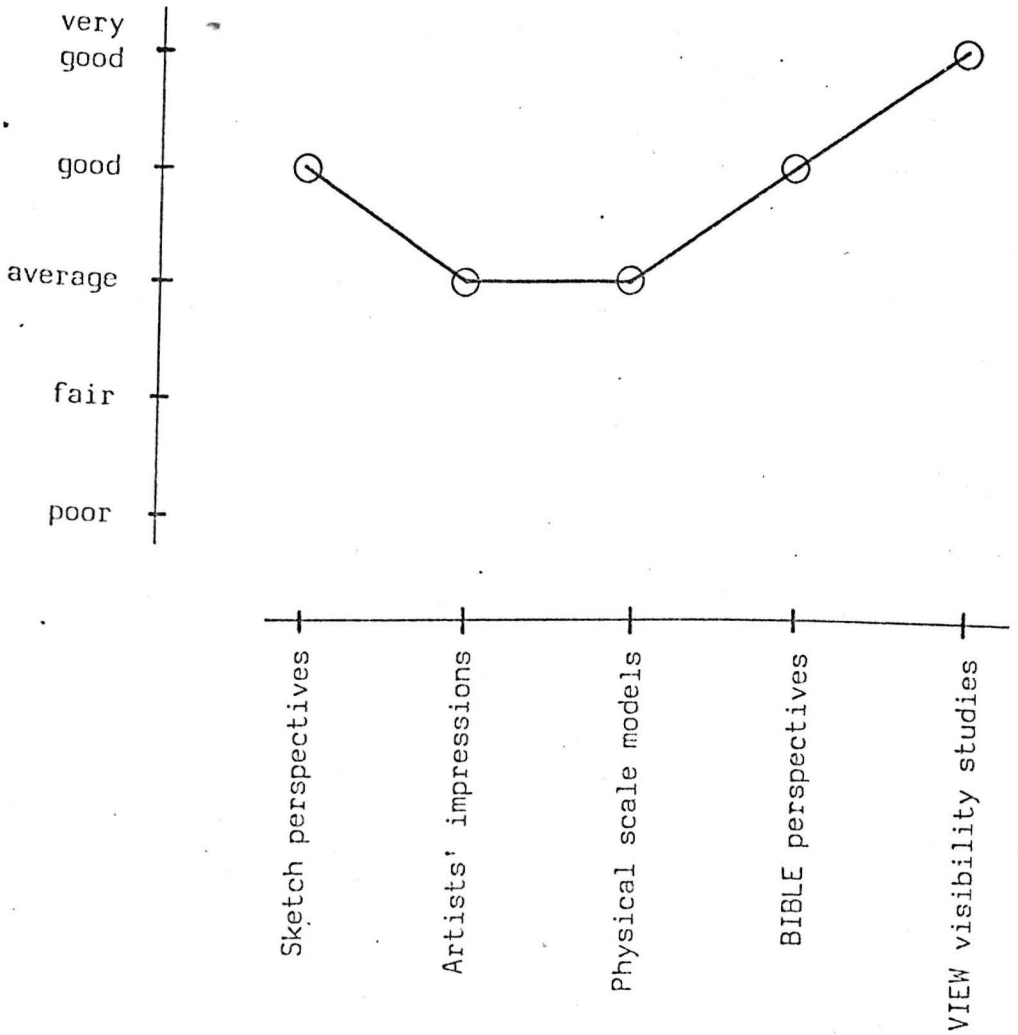
(G92) Colour graphics presentation of 2-d map information can dramatically increase legibility. Data errors can be spotted quite readily, saving significant amounts of time.



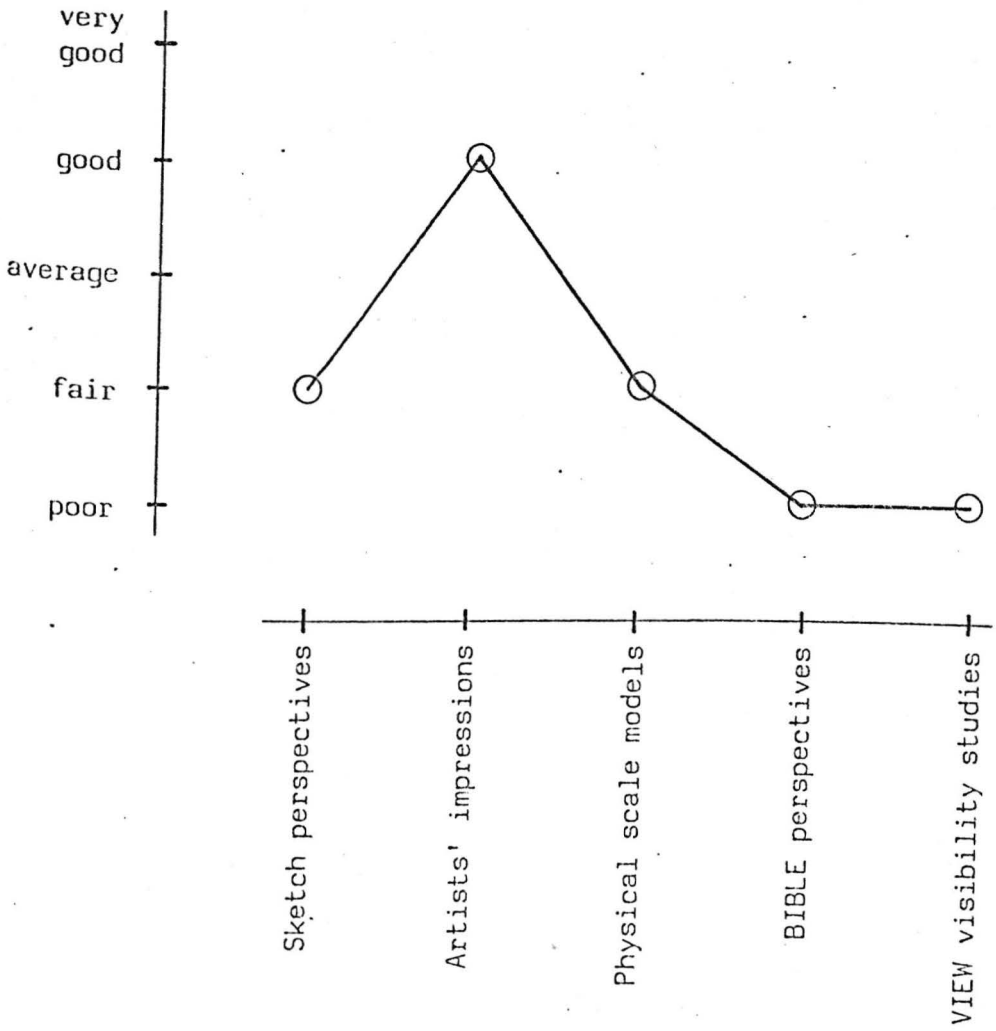
(G93) Comparative ordinal ranking of visual assessment techniques.
Criterion : Flexibility - coverage.



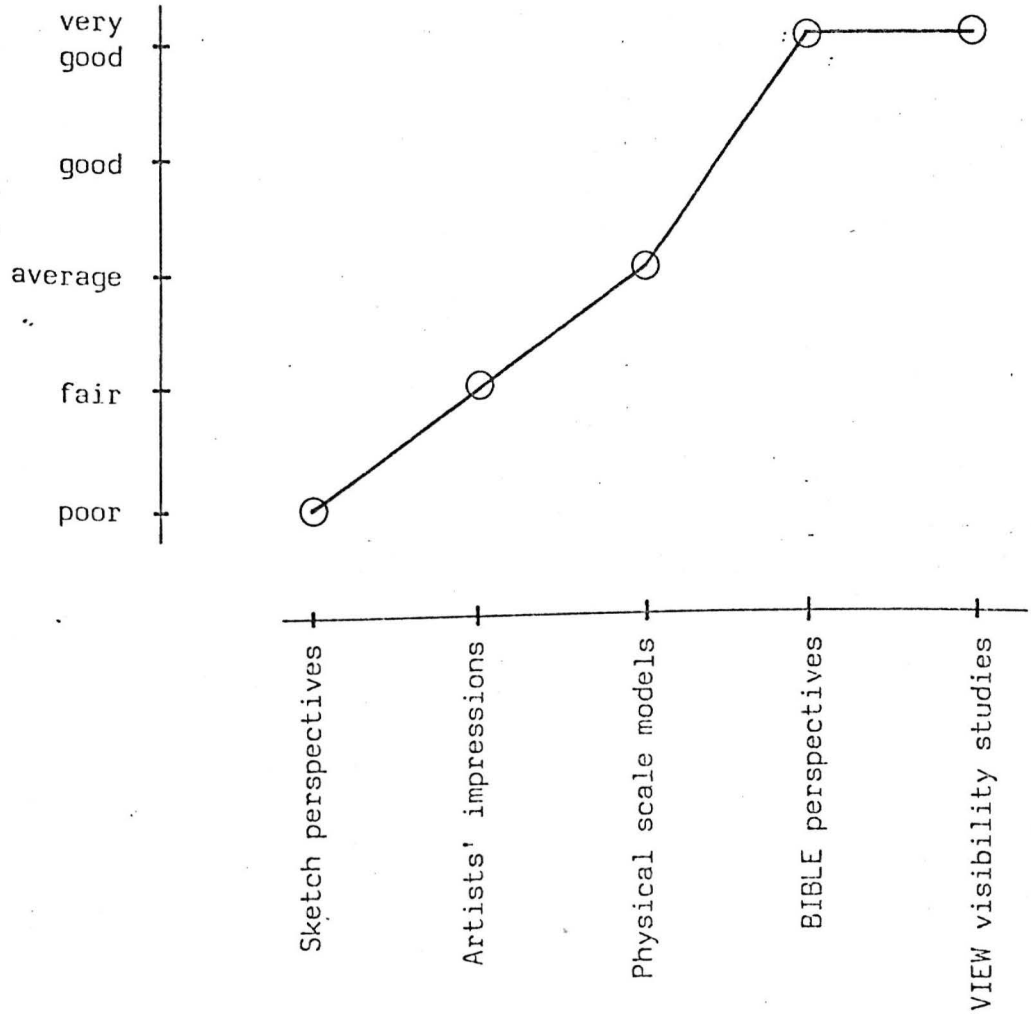
(G94) Comparative ordinal ranking of visual assessment techniques.
Criterion : Flexibility - builtform.



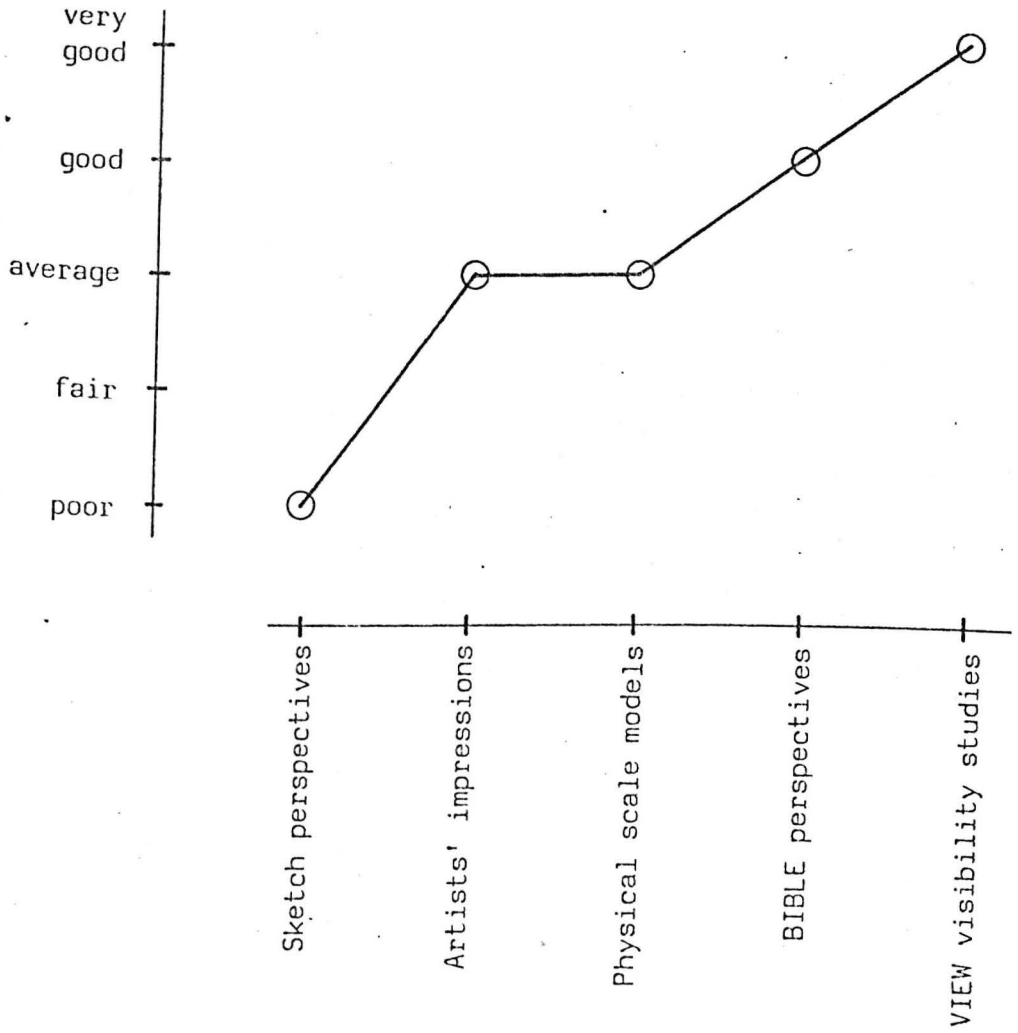
(G95) Comparative ordinal ranking of visual assessment techniques.
Criterion : Flexibility - context.



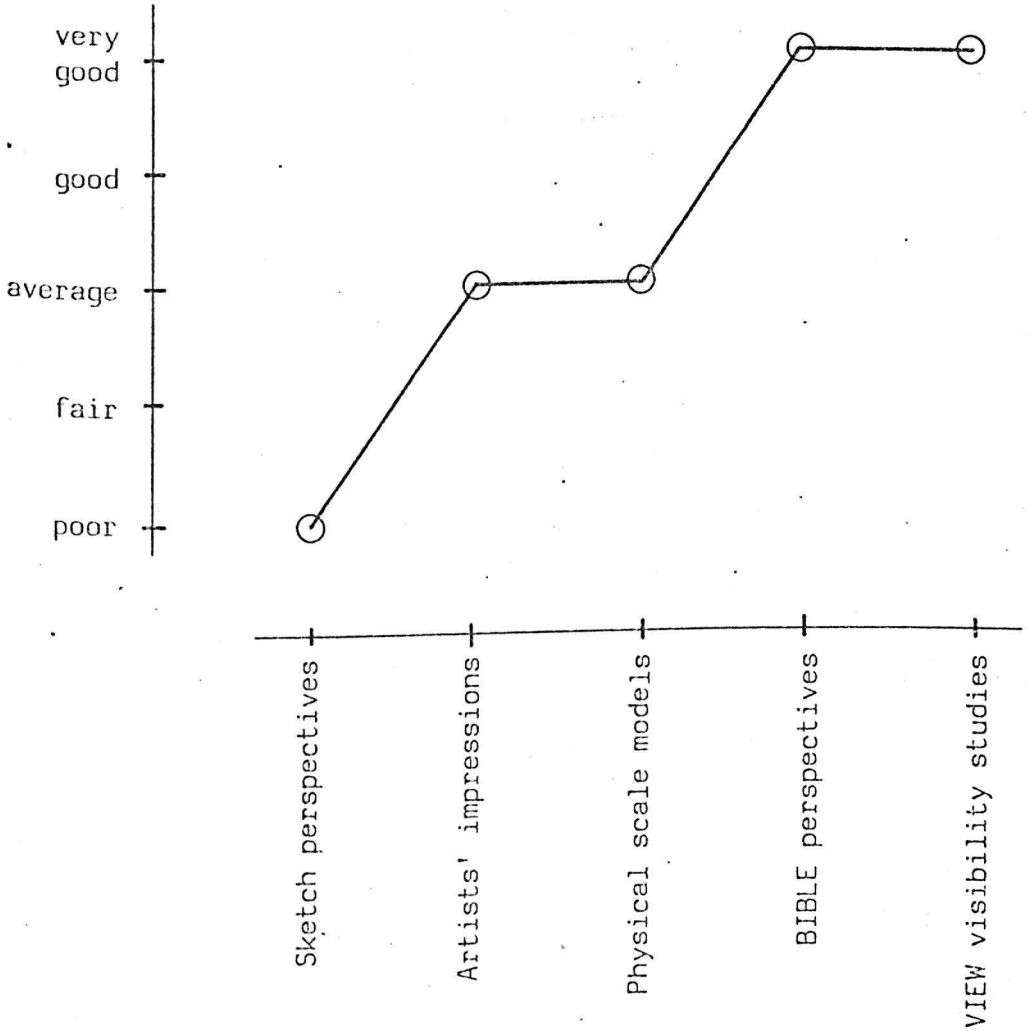
(G96) Comparative ordinal ranking of visual assessment techniques.
Criterion : Flexibility - environmental conditions.



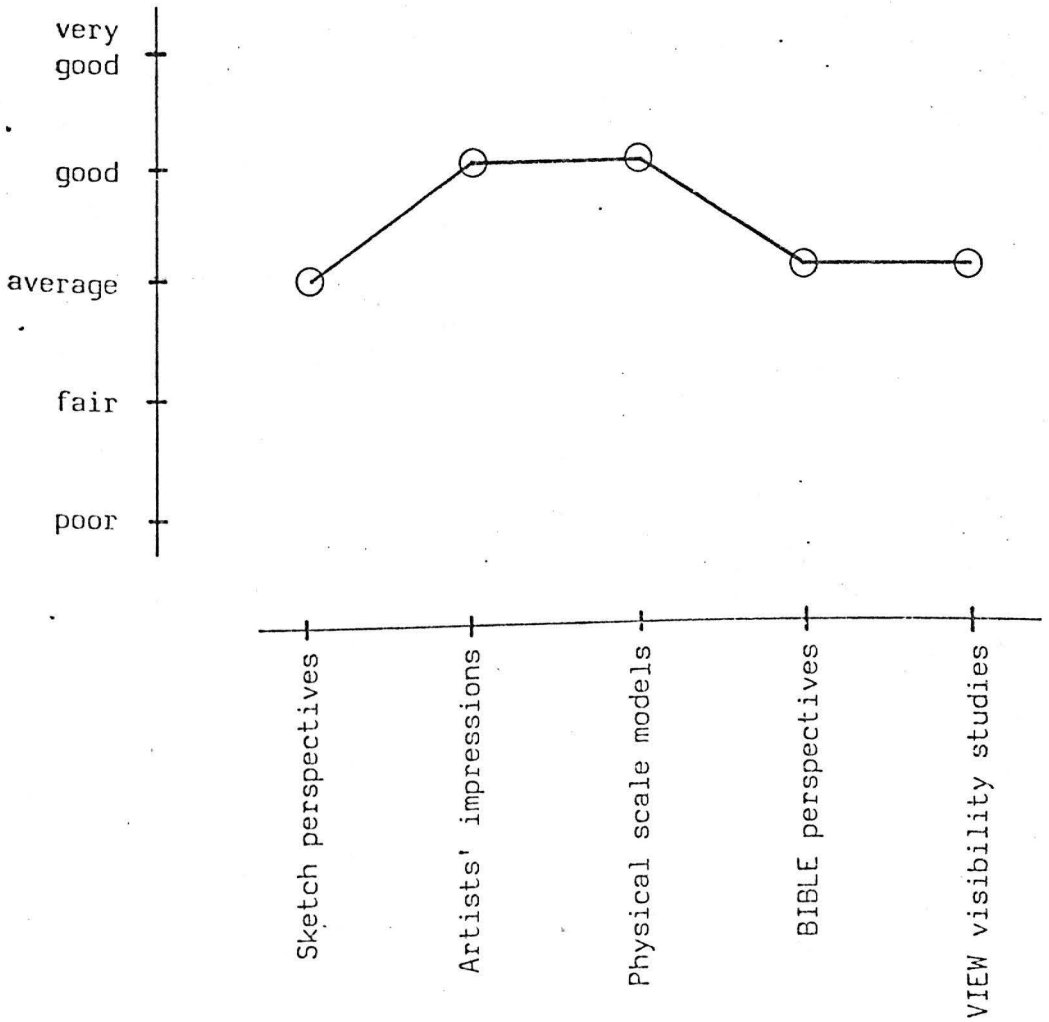
(G97) Comparative ordinal ranking of visual assessment techniques.
Criterion : Flexibility - multiple use.



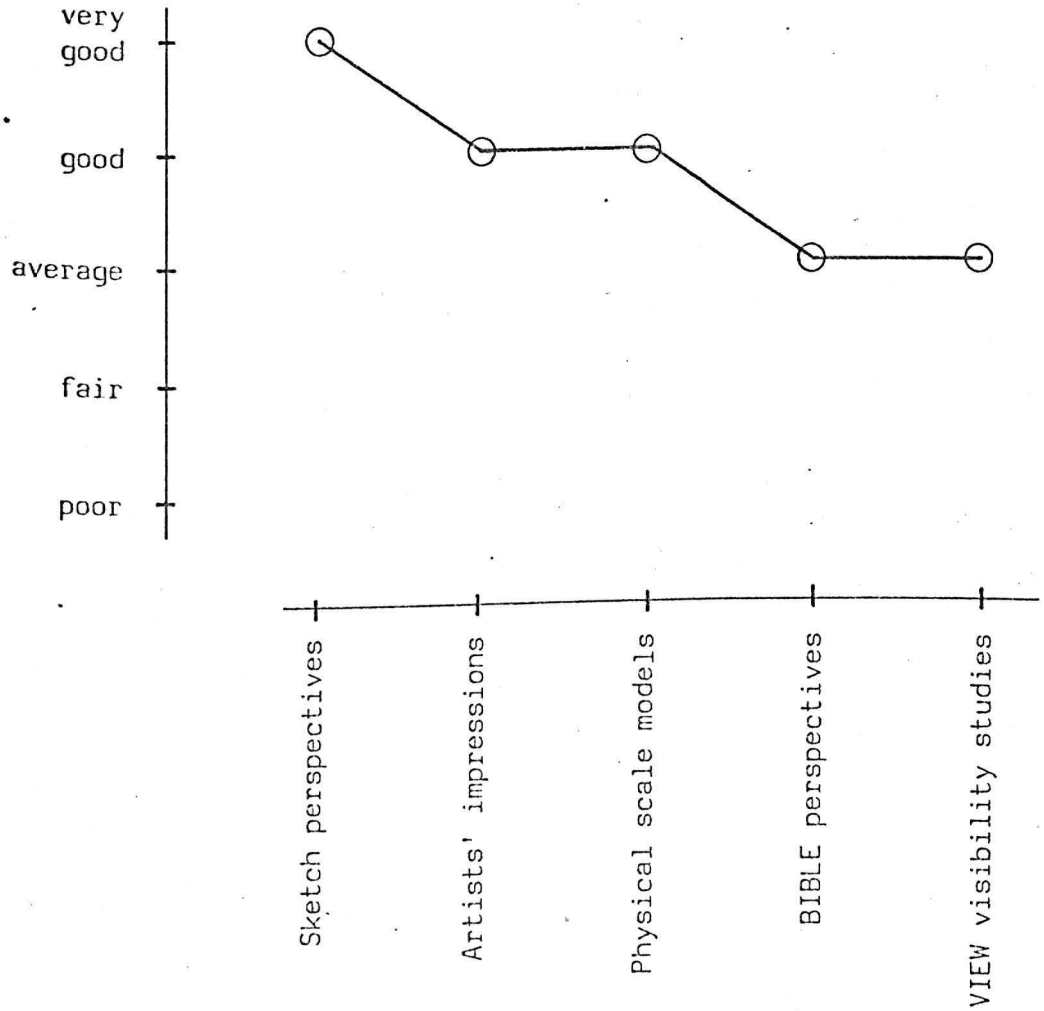
(G98) Comparative ordinal ranking of visual assessment techniques.
Criterion : Design value.



(G99) Comparative ordinal ranking of visual assessment techniques. Criterion : Accuracy.

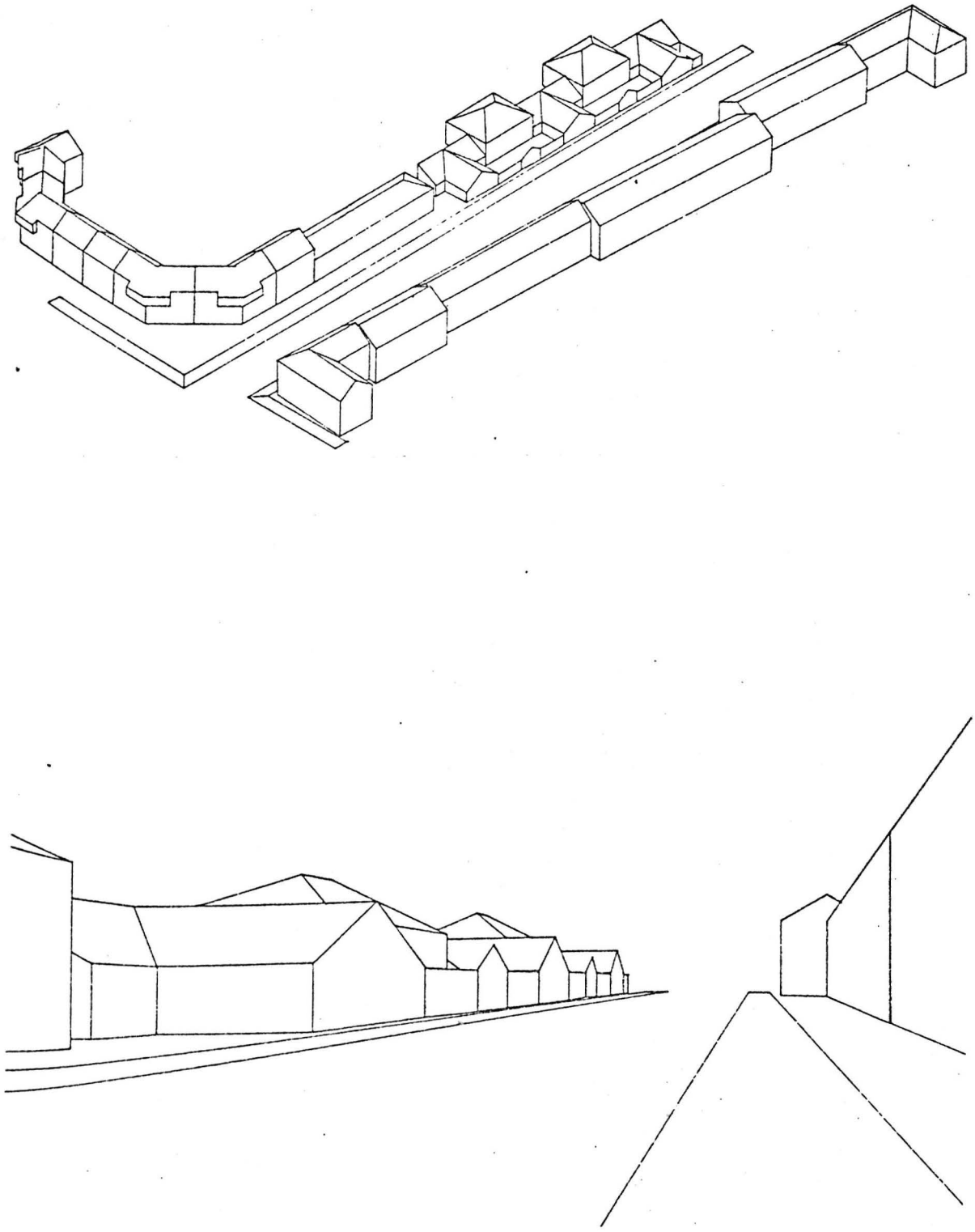


(G100) Comparative ordinal ranking of visual assessment techniques.
Criterion : Communicability.



(G101) Comparative ordinal ranking of visual assessment techniques.
Criterion : Accessibility.

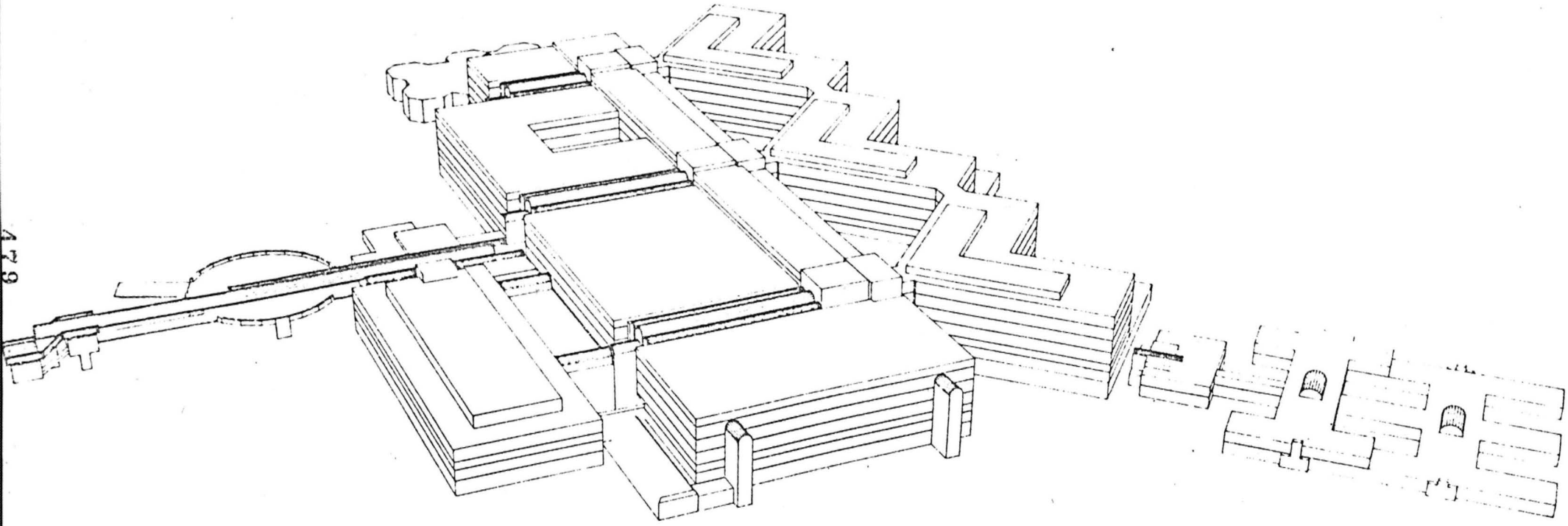
CHAPTER 4



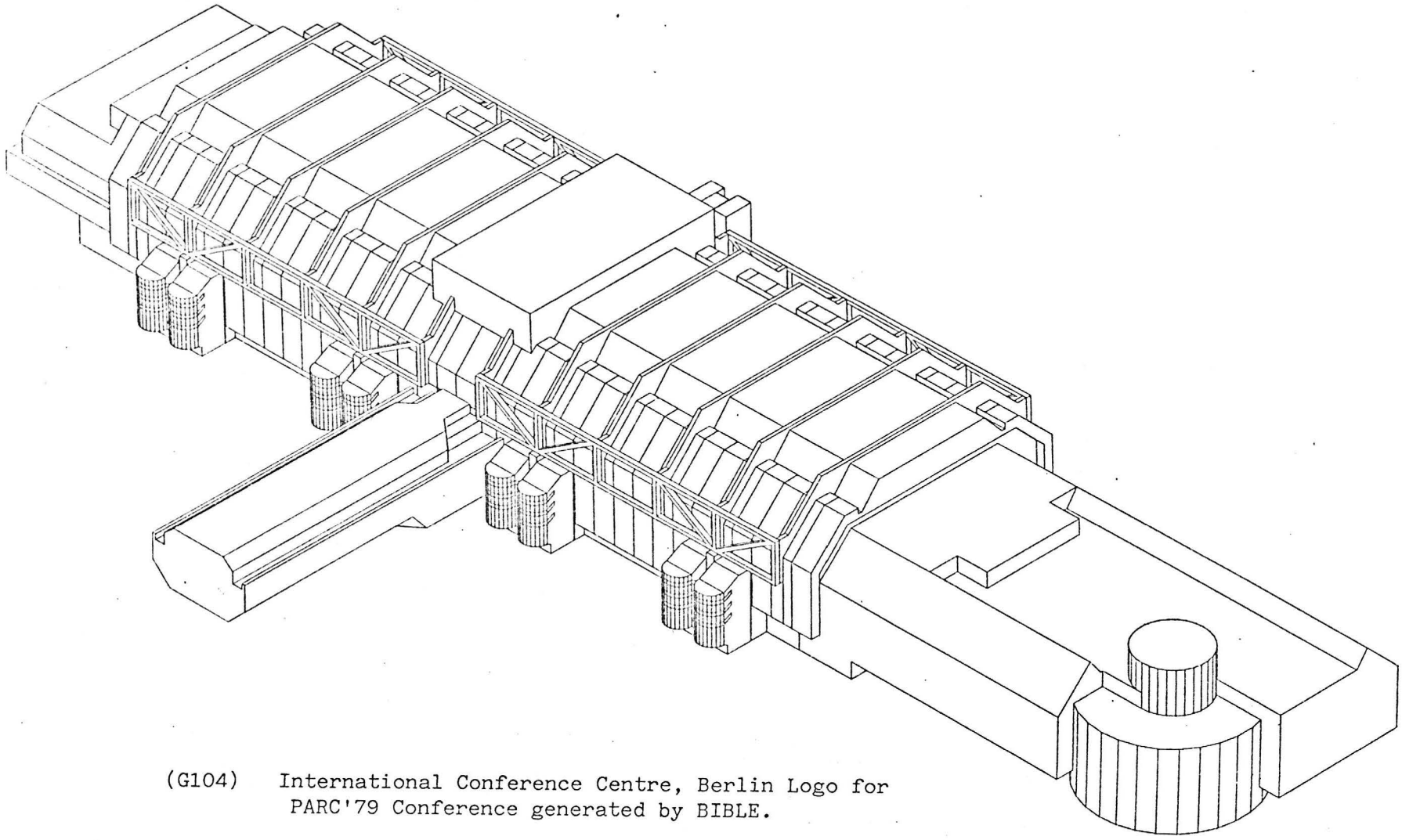
(G102) Proposed Public Housing, London Road, Calton, Glasgow.

a) aeriel view

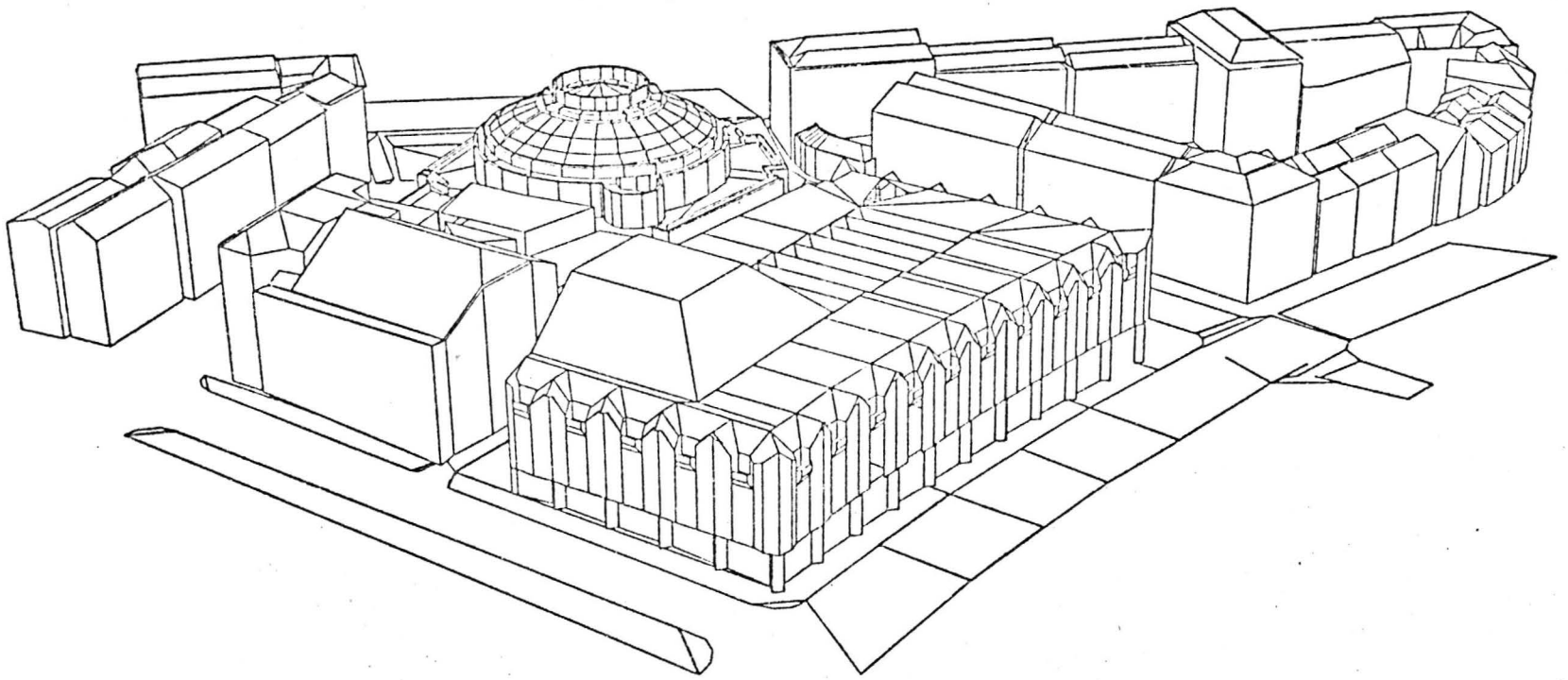
b) street frontage on London Road.



(G103) Proposed Hospital for the Dutch Government; BIBLE view by Eijkelenboom, Gerritse and Middelhock (Architects).

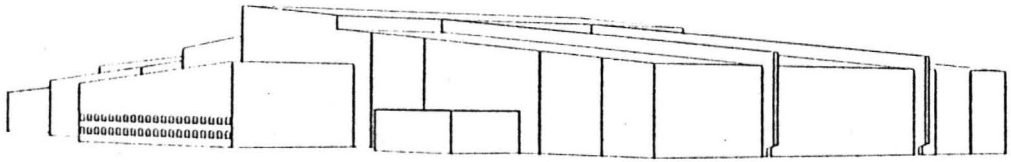


(G104) International Conference Centre, Berlin Logo for PARC'79 Conference generated by BIBLE.

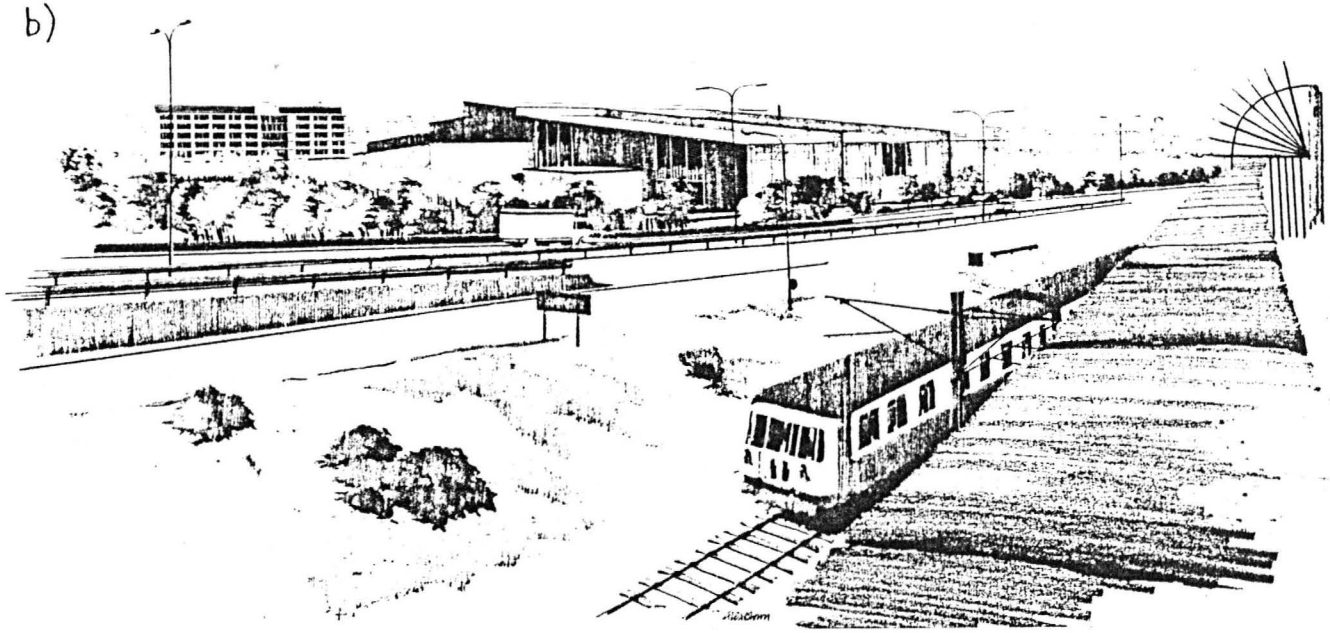


(G105) Hilton Hotel (unbuilt project) Edinburgh. Perspective from the Castle using BIBLE.

a)



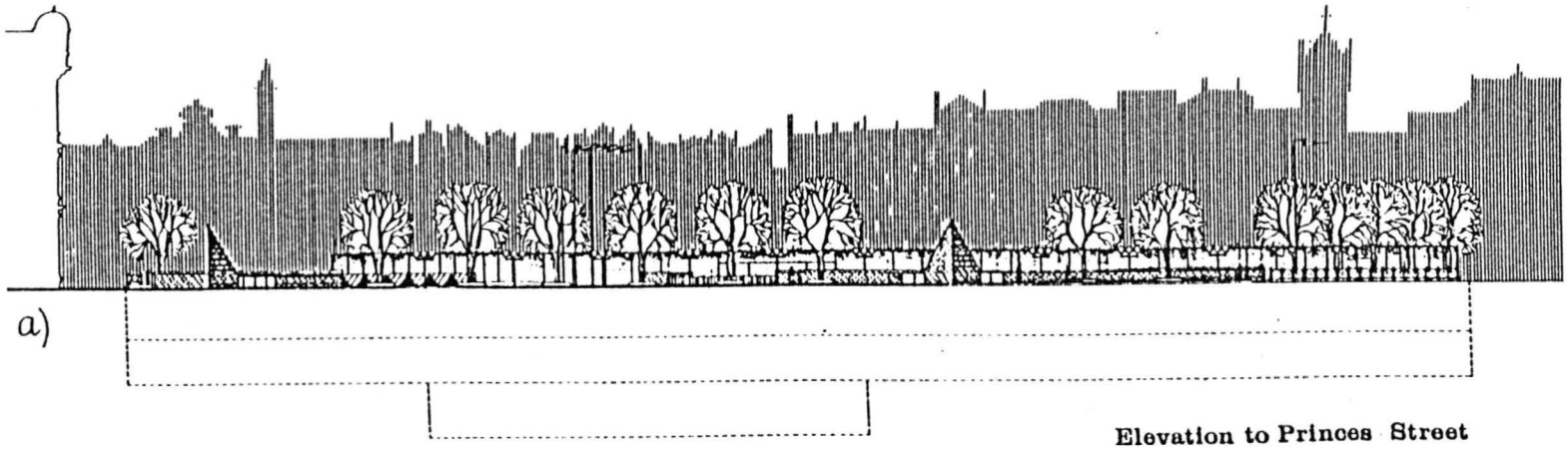
b)



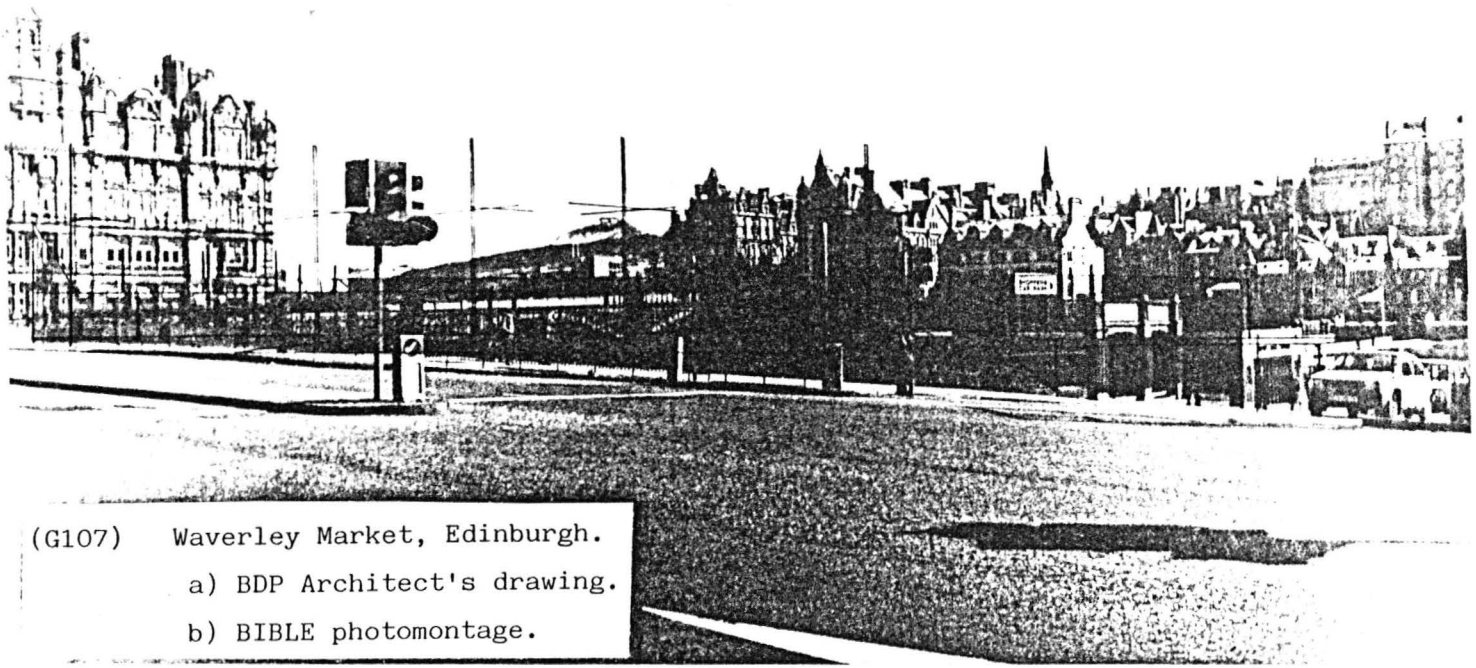
(G106) Scottish Exhibition Centre, Queens Dock, Glasgow.

a) BIBLE generated perspective

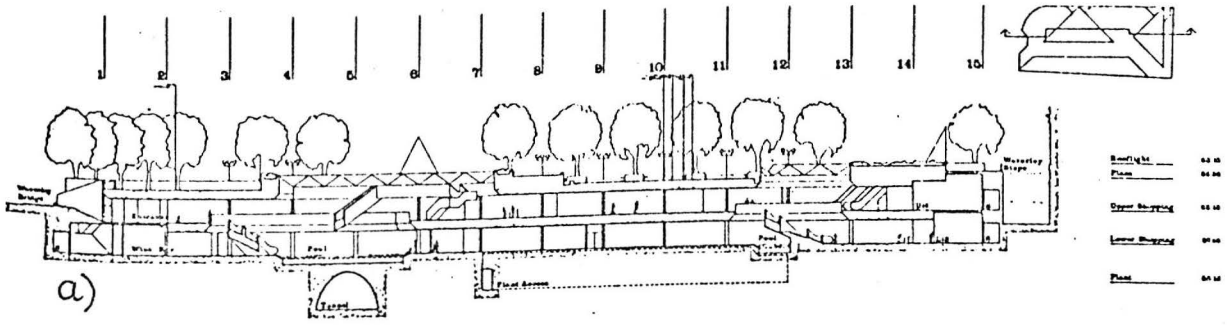
b) Finished artist's impression of the development.

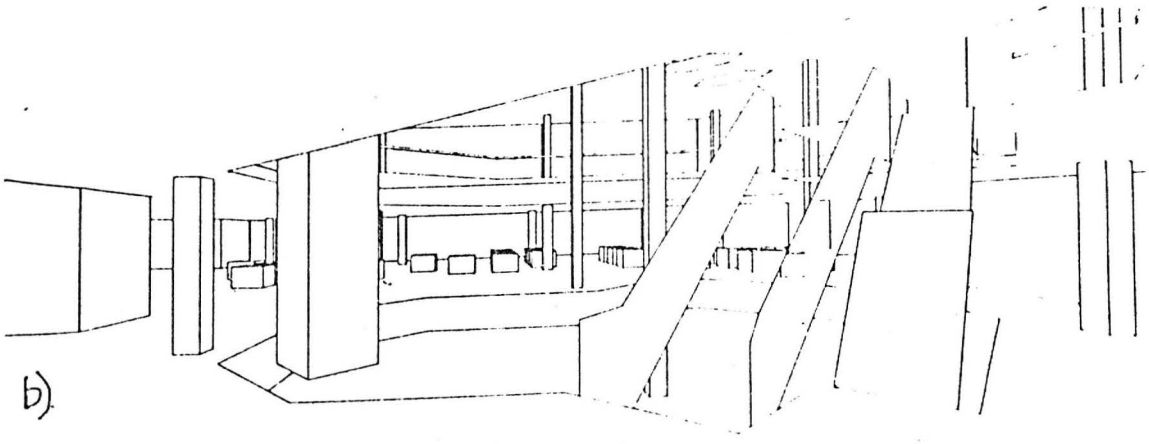


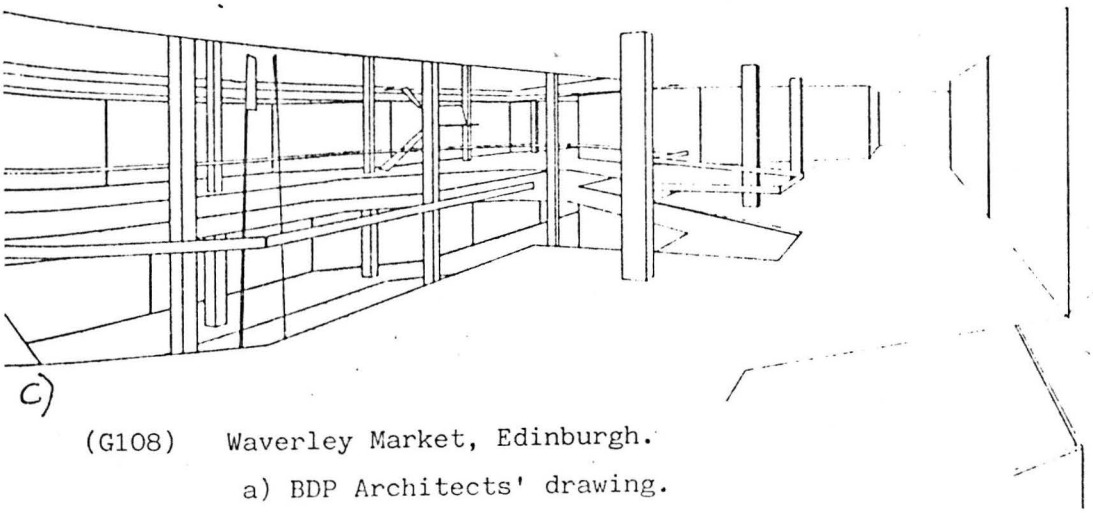
b)



(G107) Waverley Market, Edinburgh.
a) BDP Architect's drawing.
b) BIBLE photomontage.



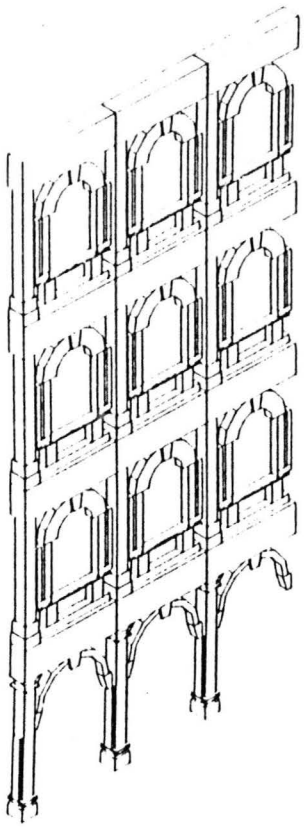


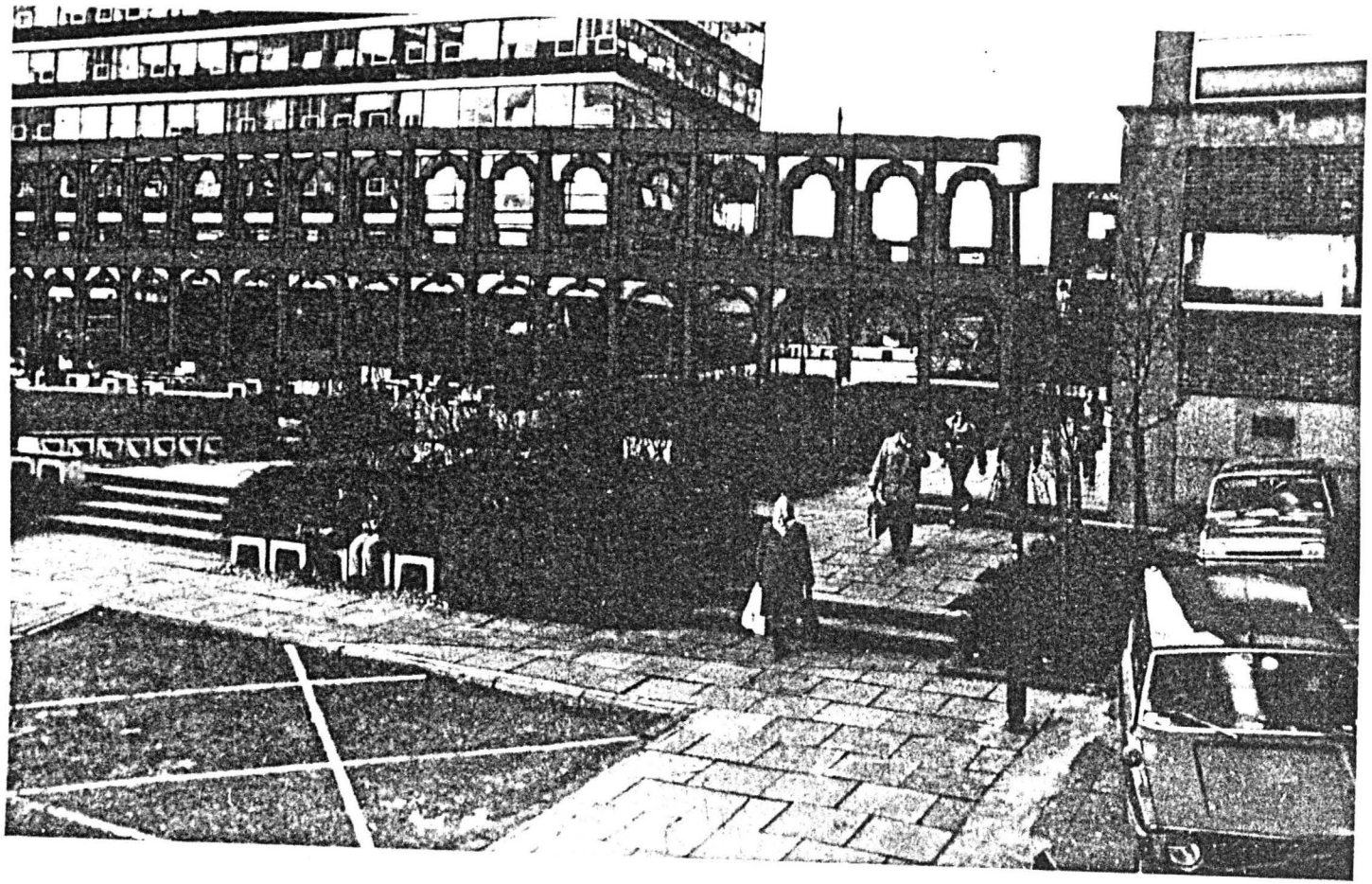


(G108) Waverley Market, Edinburgh.

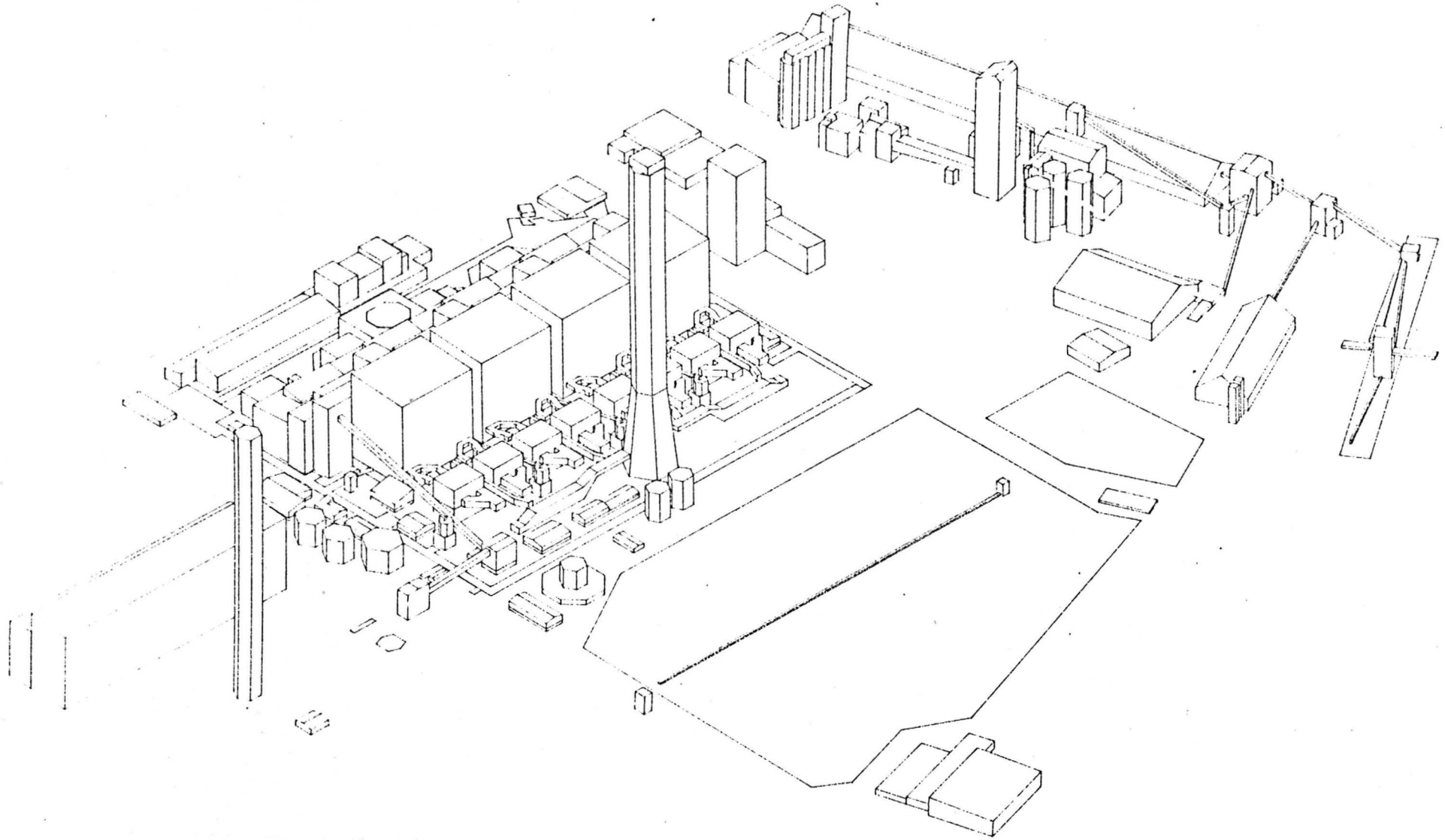
a) BDP Architects' drawing.

b) and c) BIBLE generated interior perspectives.



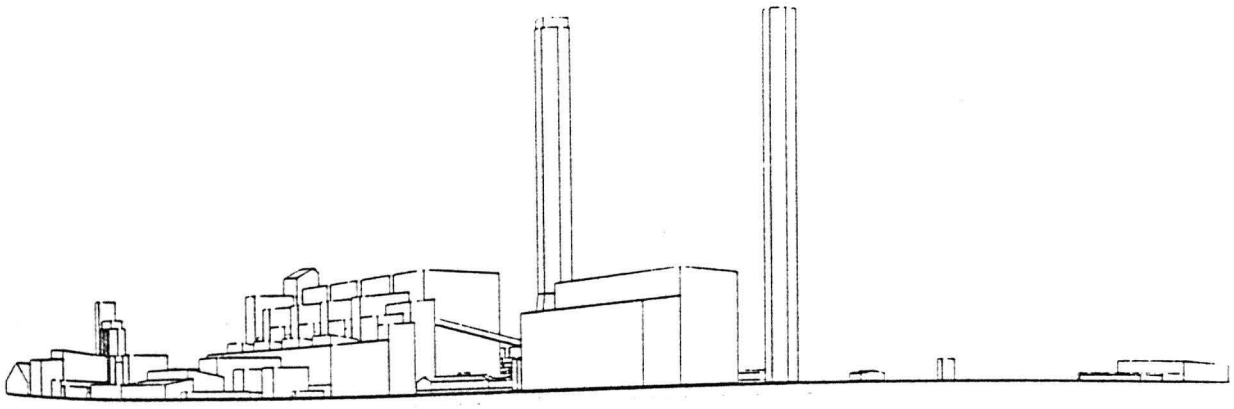


(G109) Arcades - Student design project, Dept. of Architecture, Strathclyde University. Perspectives by BIBLE.

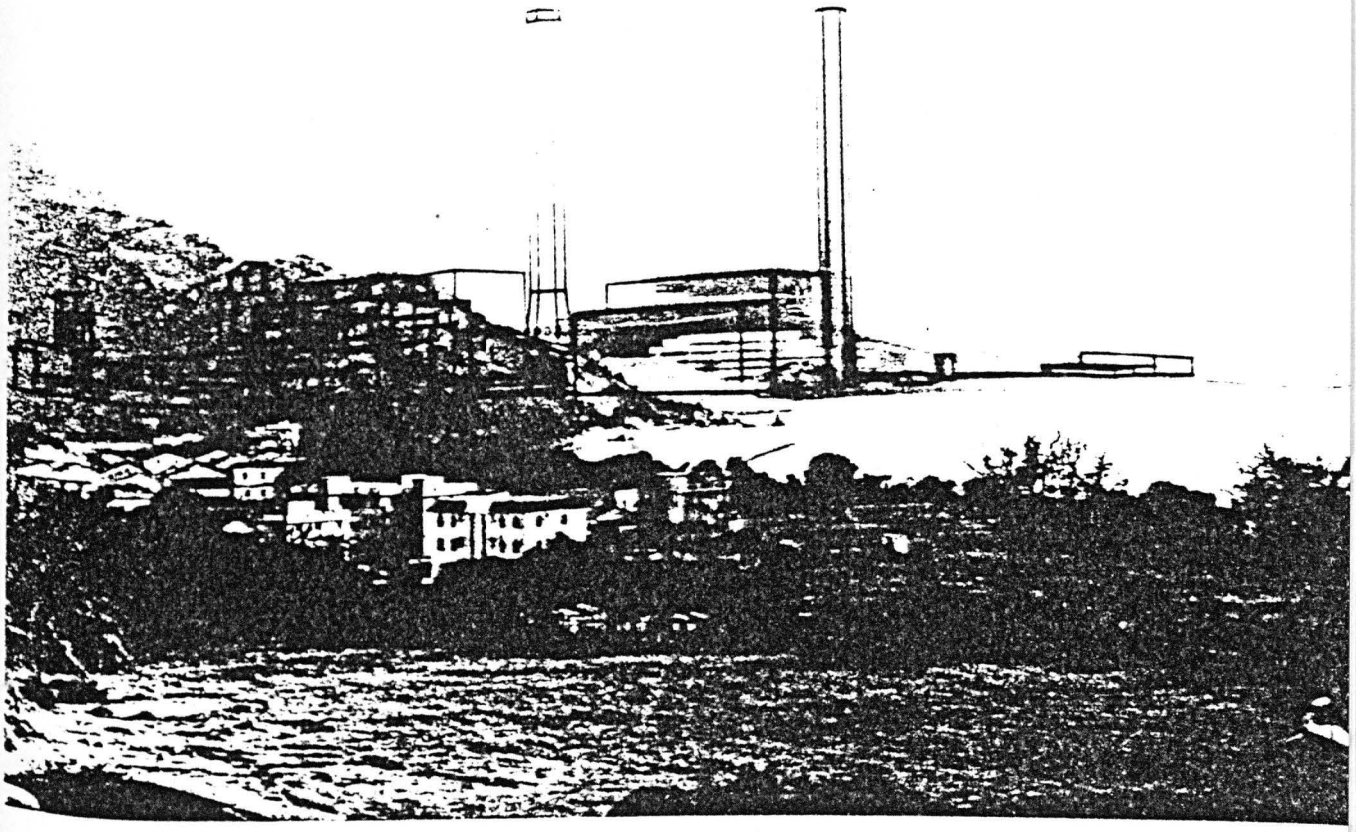


(G110) Castle Peak Power Station, Hong Kong. Visualisation study using BIBLE for the architects Robert Matthew, Johnson-Marshall.

a)



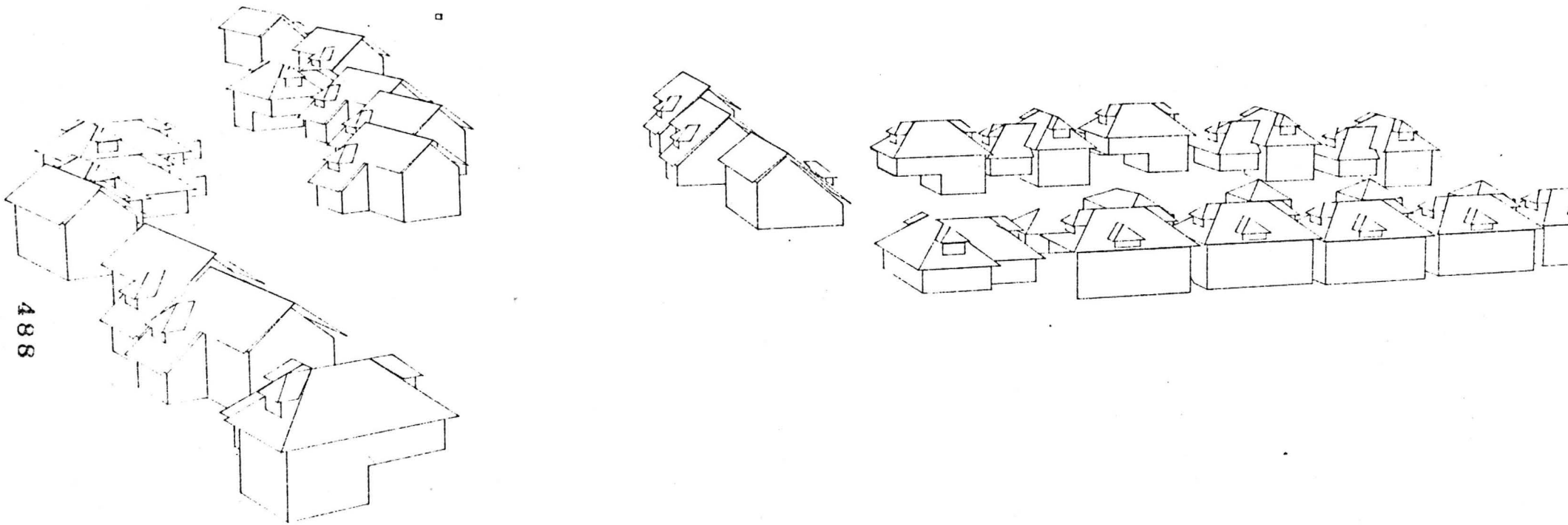
b)



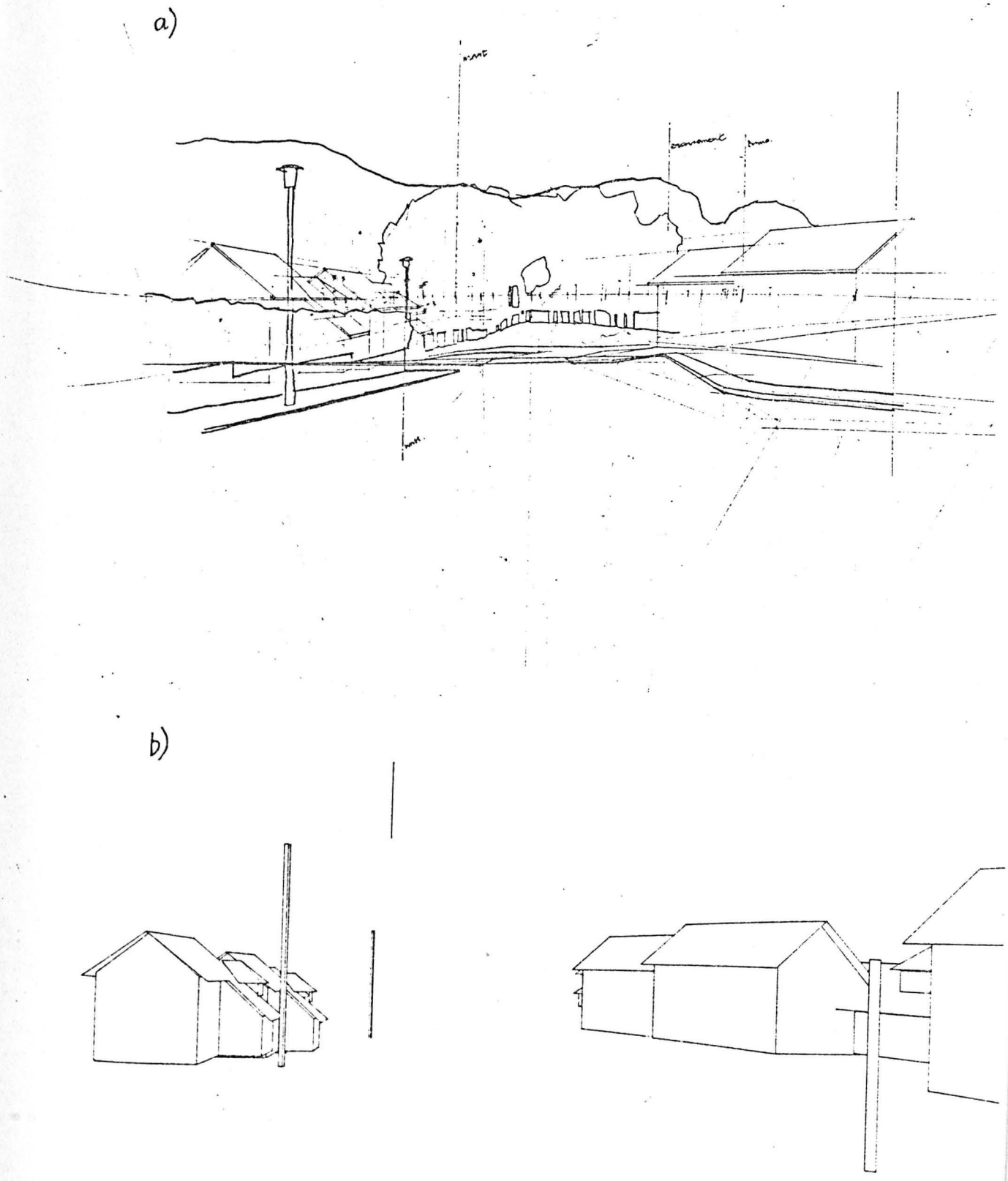
(G111) Castle Peak Power Station, Hong Kong.

a) BIBLE perspective

b) Photomontage.



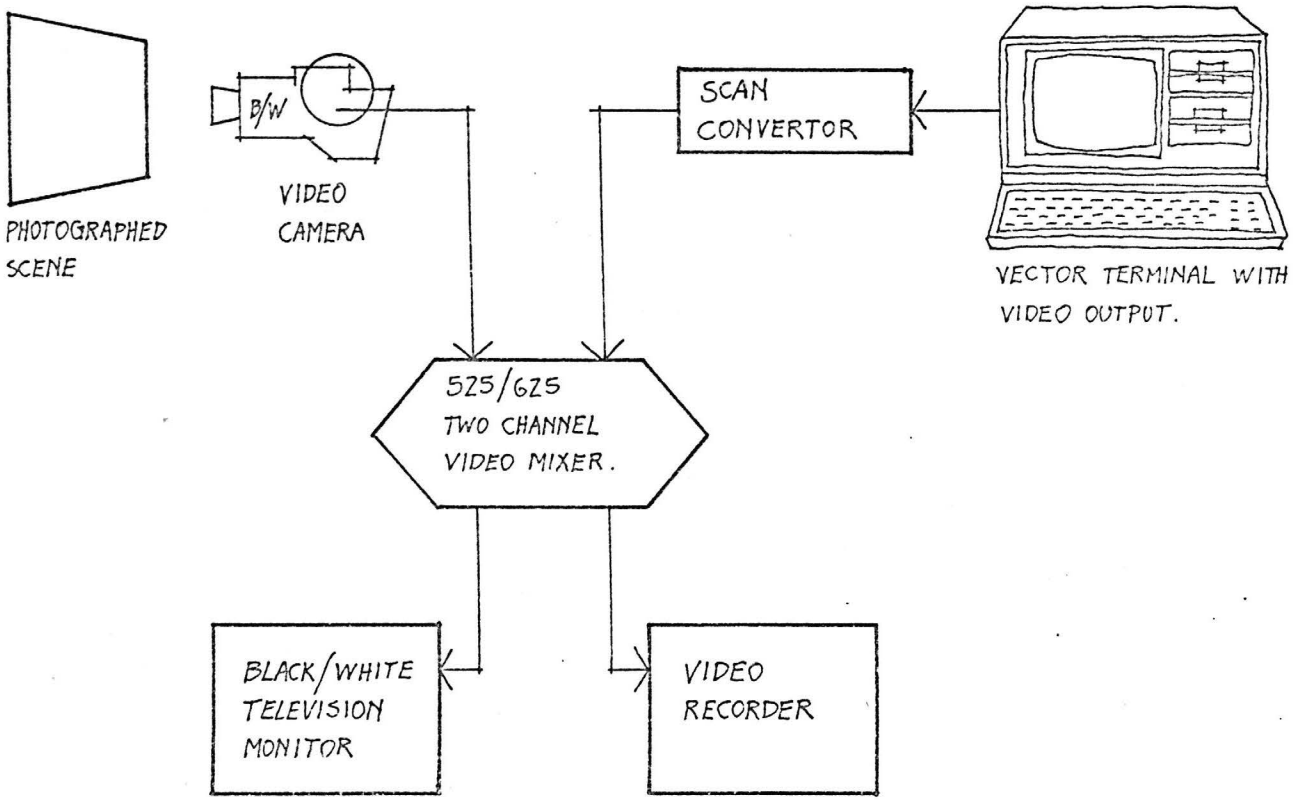
(G112) Midmar Housing Development, Edinburgh: Turnbull Jeffrey Partnership for City of Aberdeen Land Association (CALA) Homes. Aerial view generated by BIBLE.



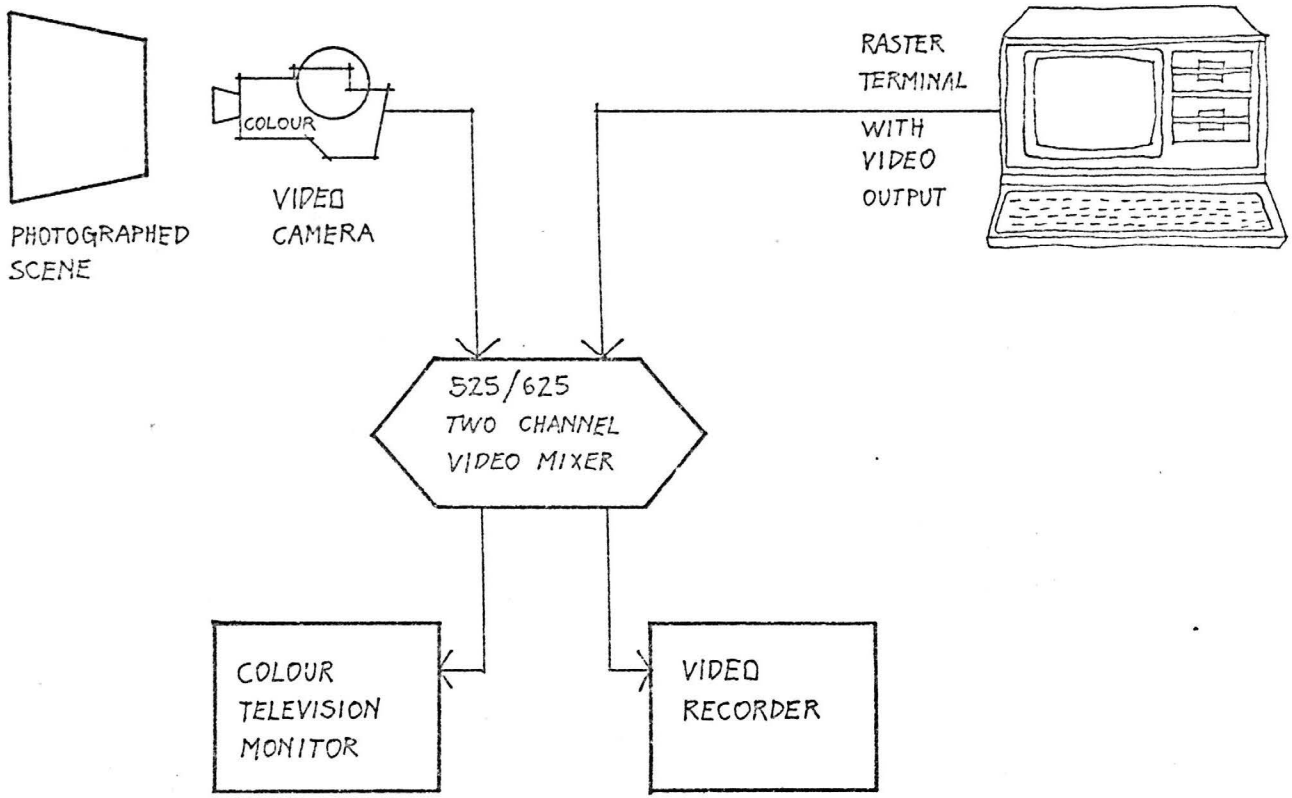
(G113) Comparison of artist's impression and BIBLE perspective.

a) artist's perspective construction

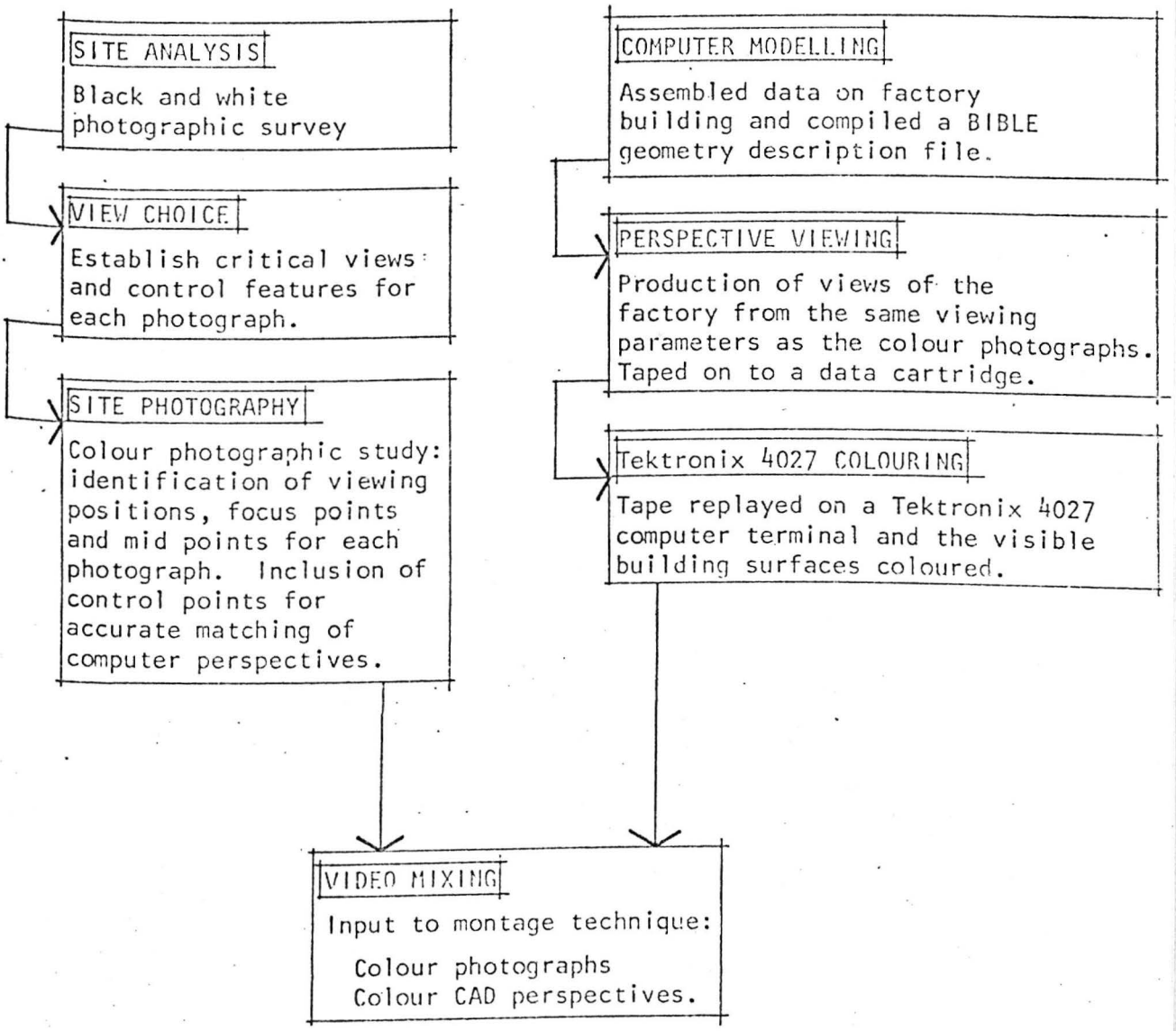
b) BIBLE view with similar parameters.



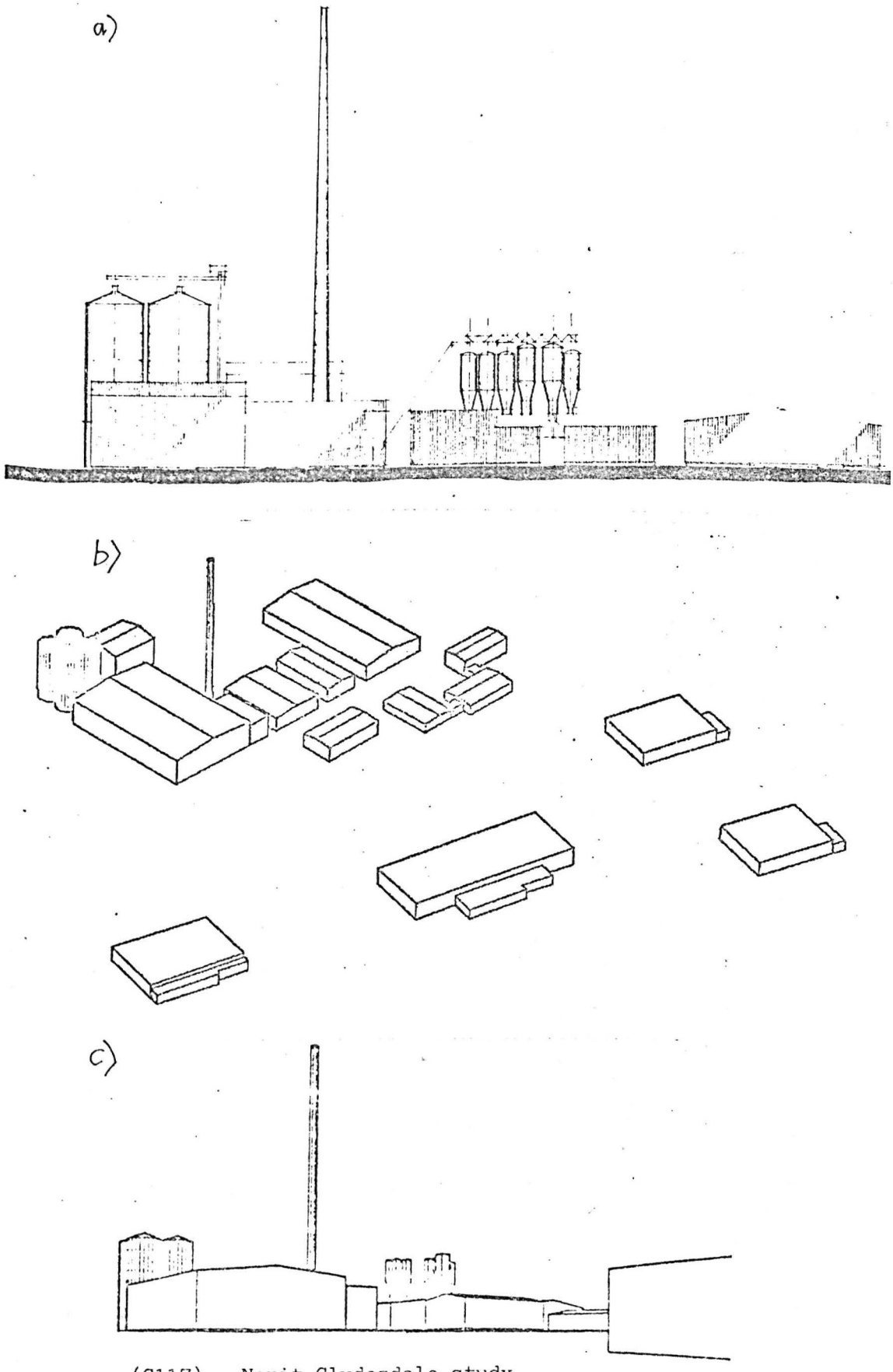
(G114) Monochromatic video mixing - system configuration.



(G115) Colour video mixing - system configuration.



(G116) Norit Clydesdale Study - methodology.

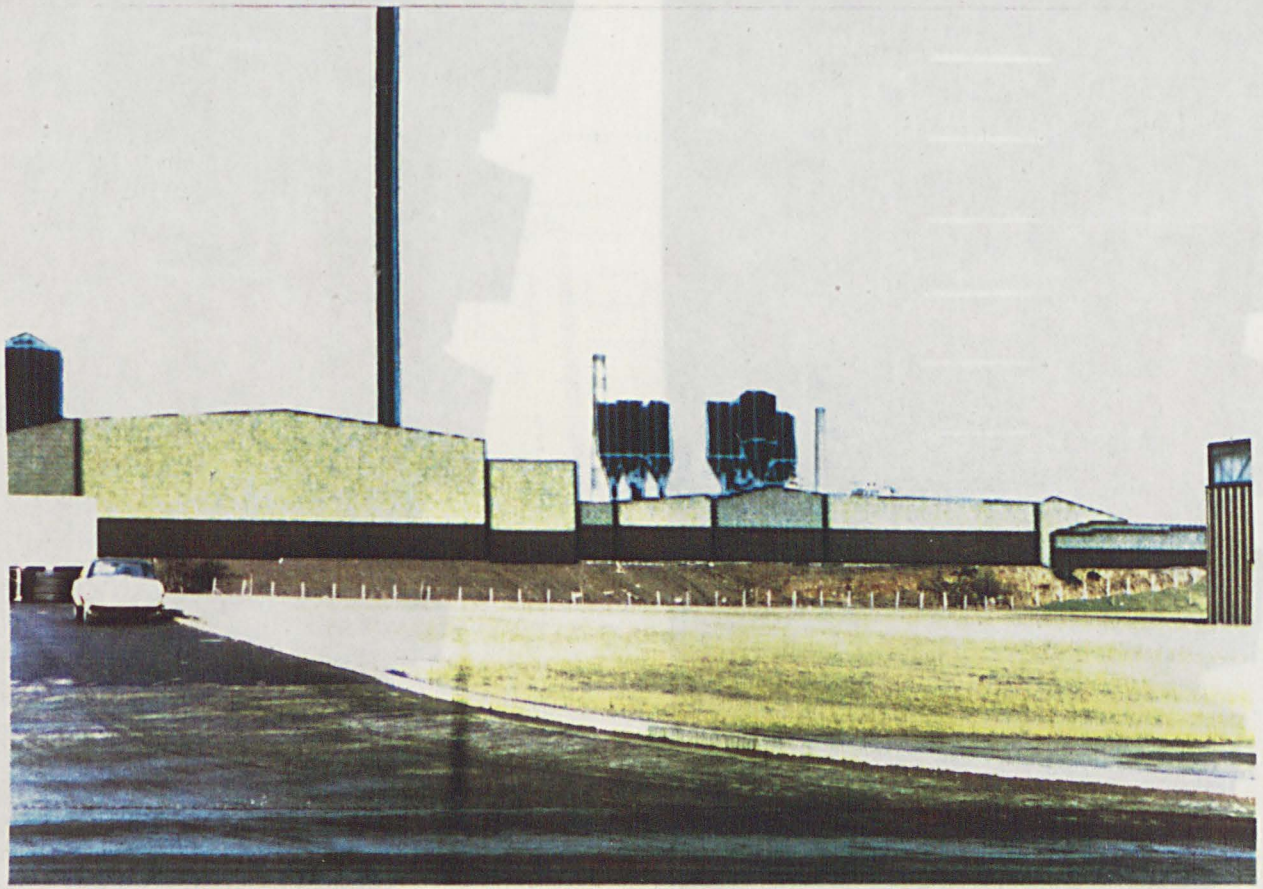


(G117) Norit Clydesdale study.

a) Architects' drawing of development.

b) Site layout perspective using BIBLE

c) BIBLE simulated view for montaging.



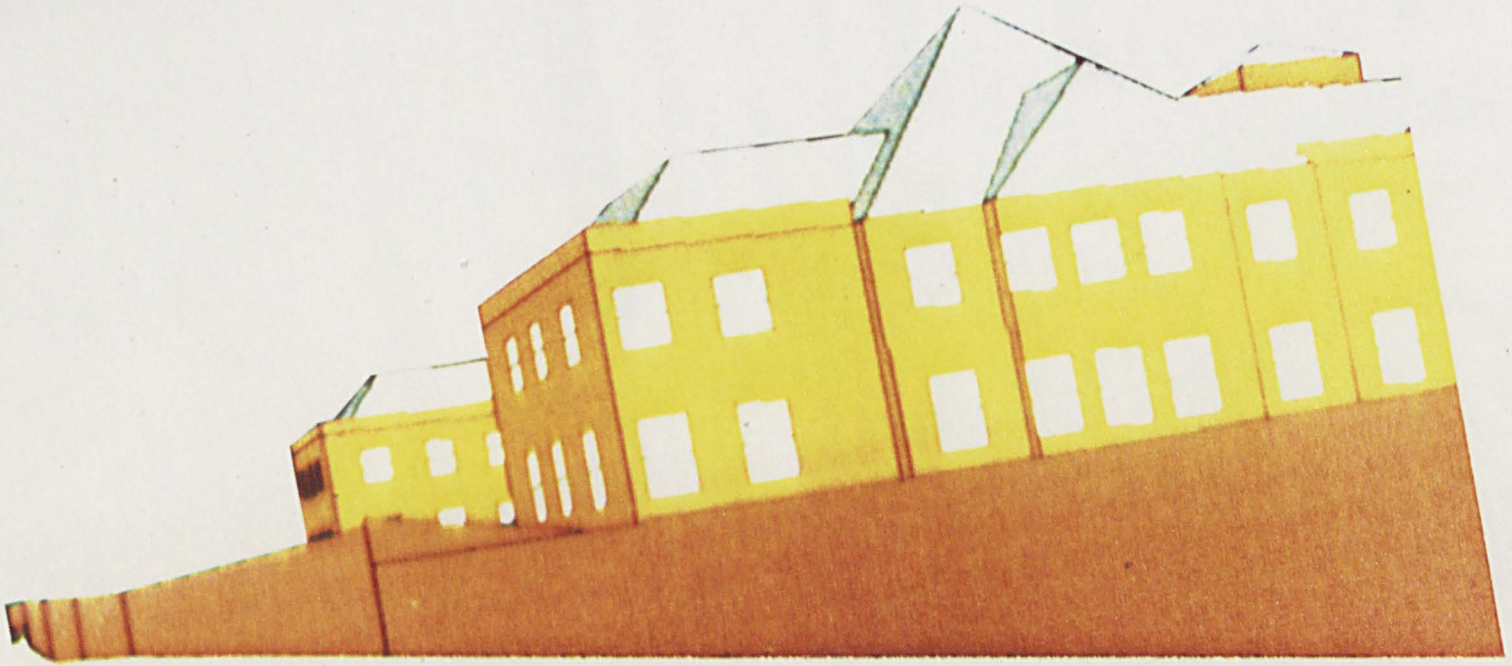
(G118) Norit Clydesdale Study - colour montage of factory development.

(G119) Architecture Building, Strathclyde University.

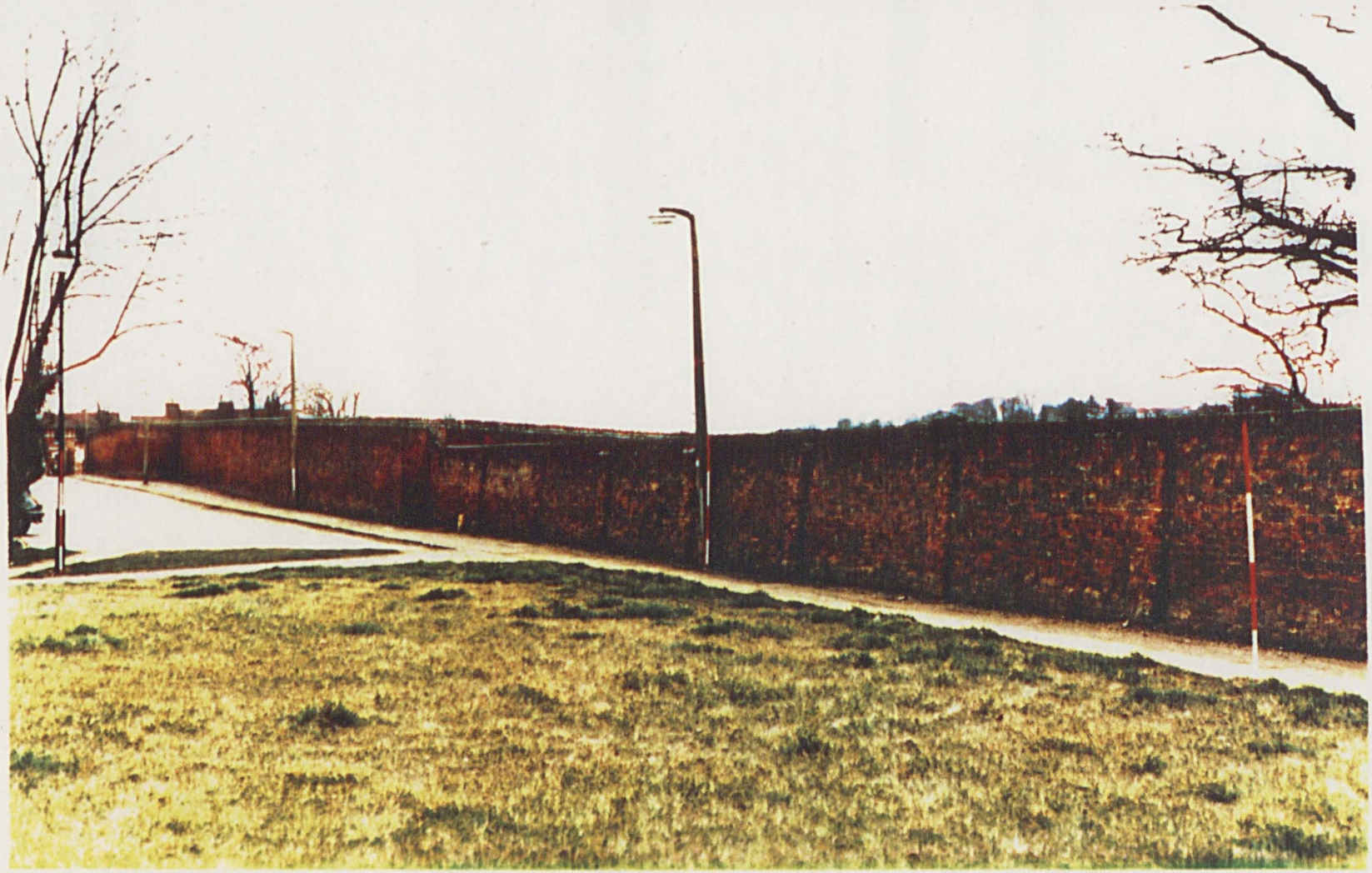
a) actual view.

b) VISTA generated view.

(G120) Hitchin Priory Development. BIBLE black and white montage.

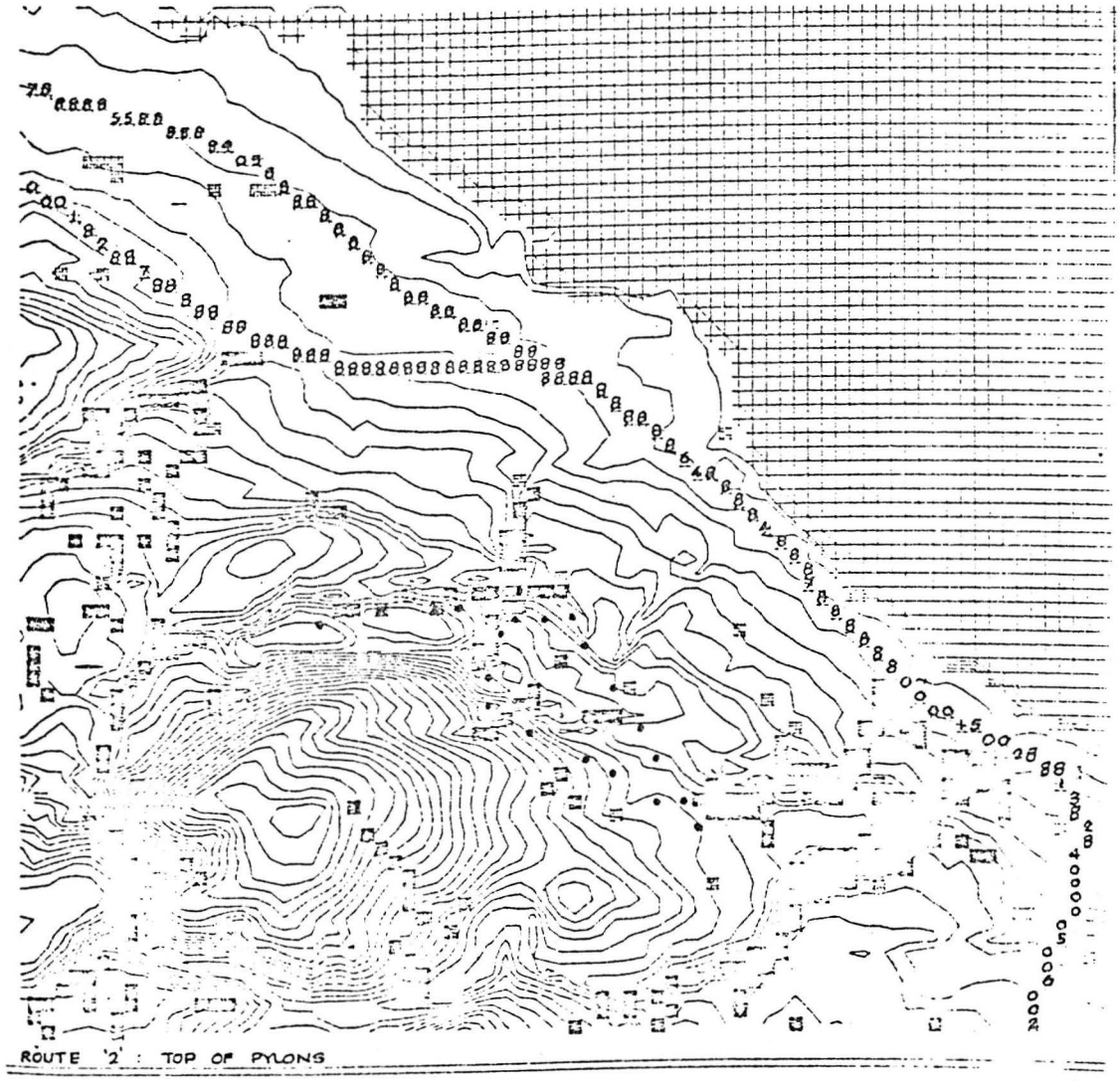


(G121) Hitchin Priory Development. VISTA colour view.



(G122) Hitchin Priory Development. Colour site view.

(G123) Hitchin Priory Development. Finished artist's impression.



(G124) Torness Pylon Study - SSEB

May of pylon visibility as seen from the A1 coast road.

VIEW 2

(G125) Torness Pylon Study - SSEB. Circuitous route.

VIEW 2

(G126) Torness Pylon Study - SSEB. Direct route.

VIEW 2a

v2a r1

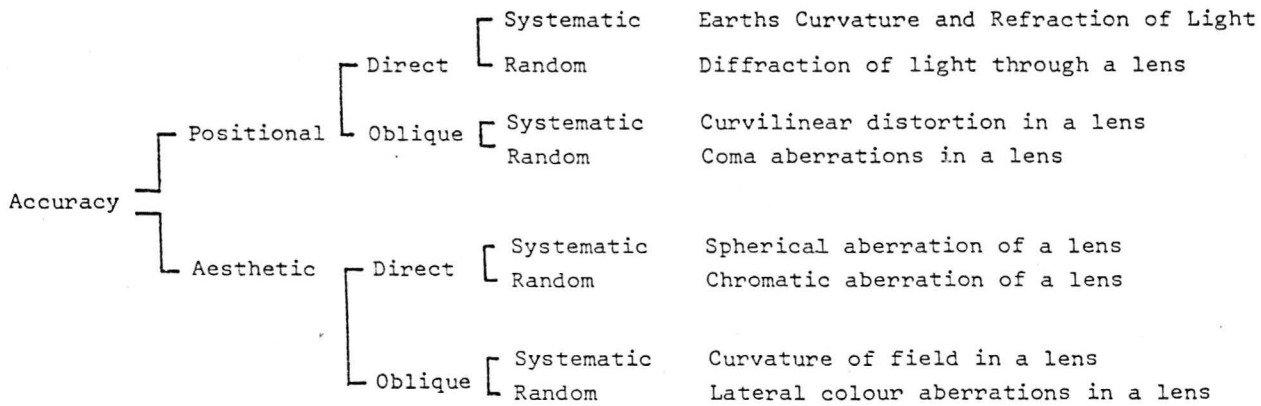
(G127) Torness Pylon Study - SSEB. North route.

VIEW 2a

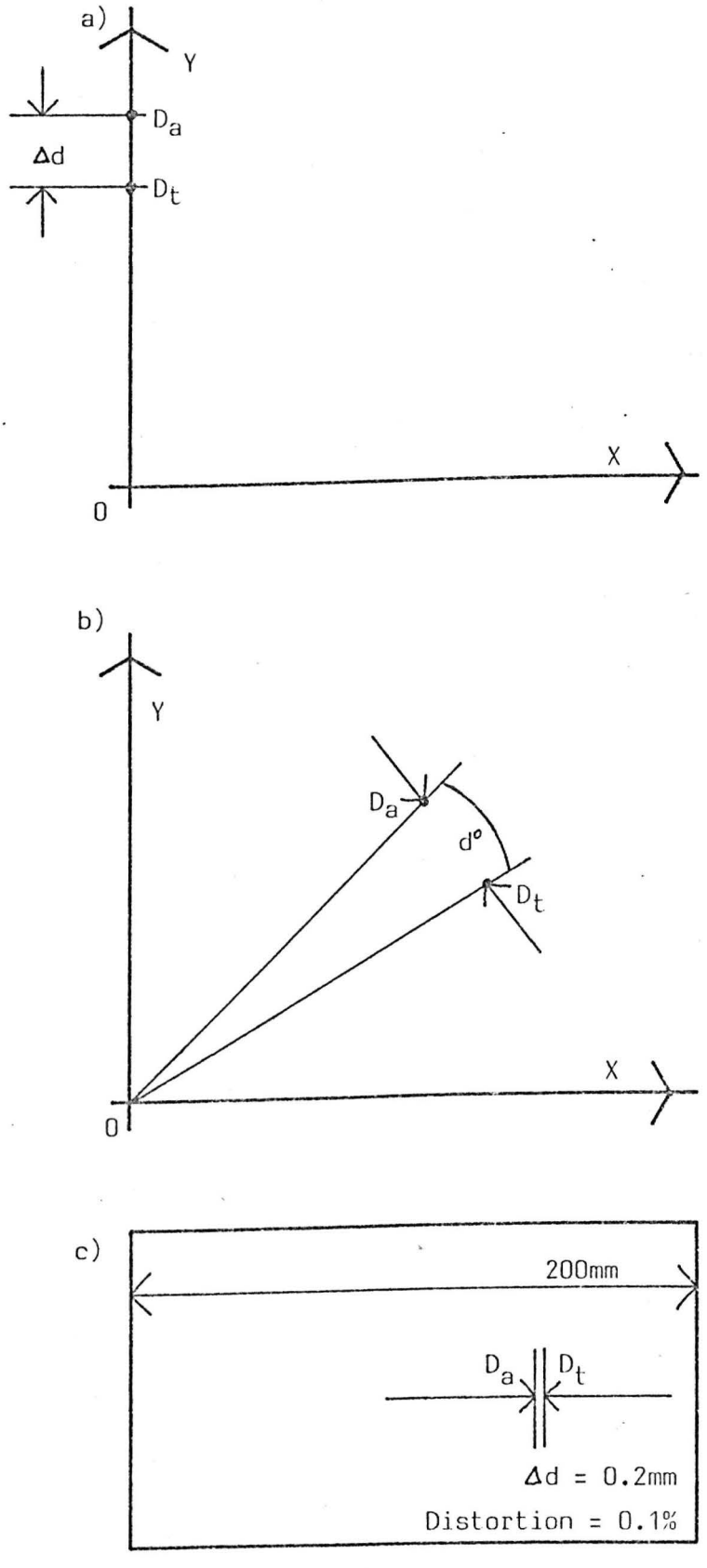
v2a r2

(G128) Torness Pylon Study - SSEB. South route.

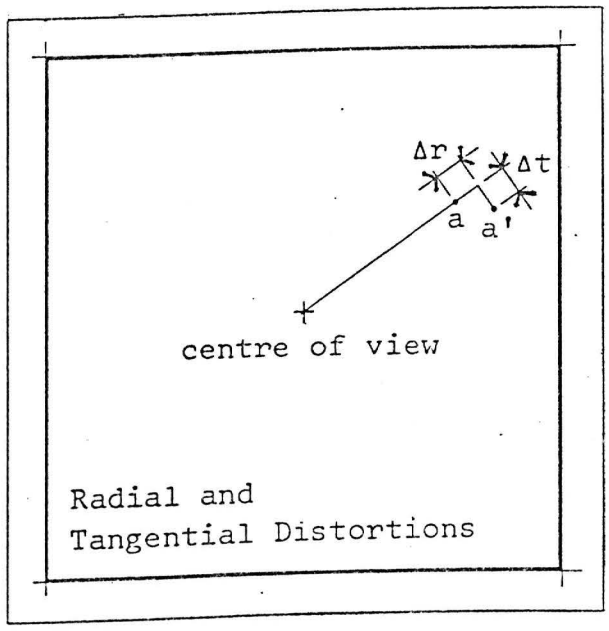
(G129) SSEB accuracy study. Study area, Innerwick, East Lothian.



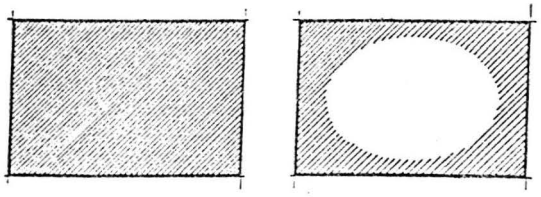
(G130) Error classification for computer based photomontaging.



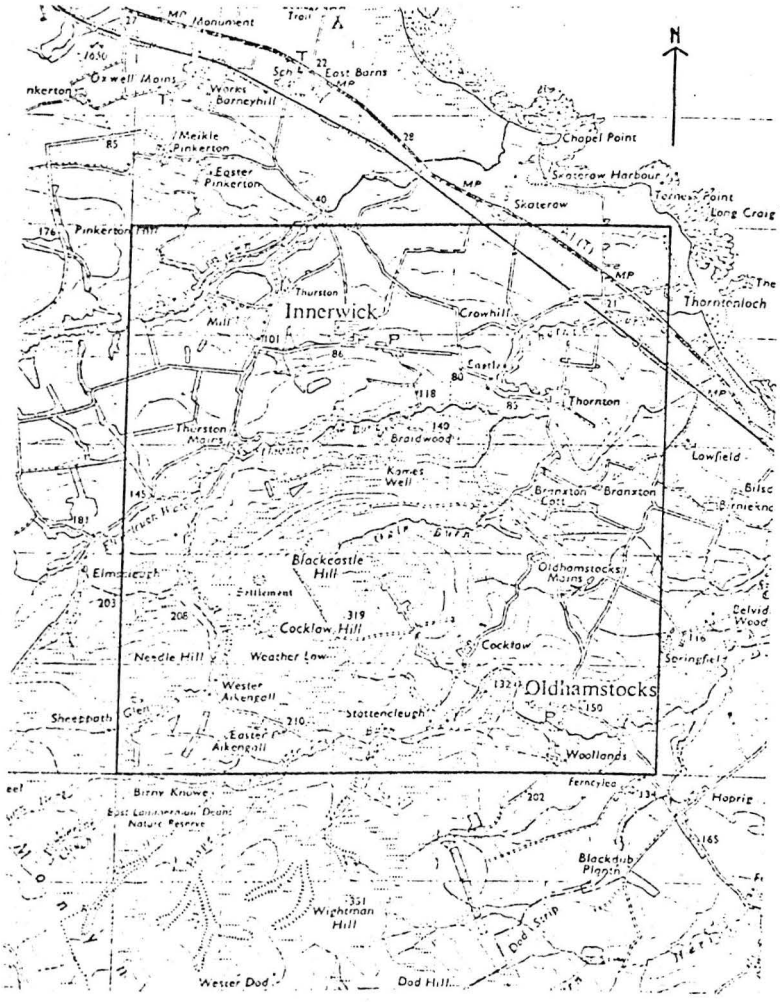
(G131) The measurement of positional distortion.
a) linear deviation.
b) angular deviation.
c) percentage deviation.



(G132) Radial and tangential distortions. The centre ofview or optical axis is the imaginary line between the observer's eye and the focus point of the scene.

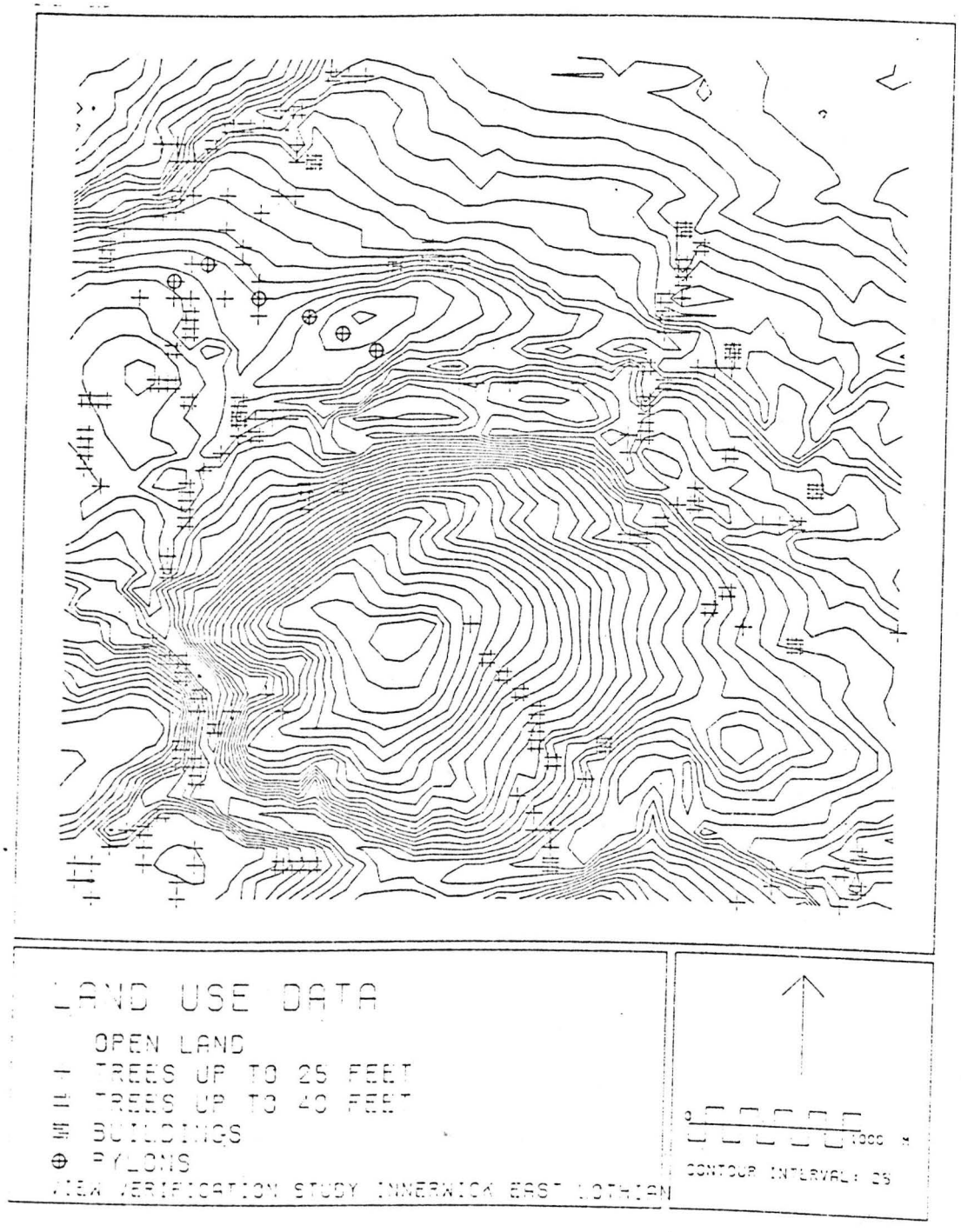


(G133) The effective area of distortion on the image.

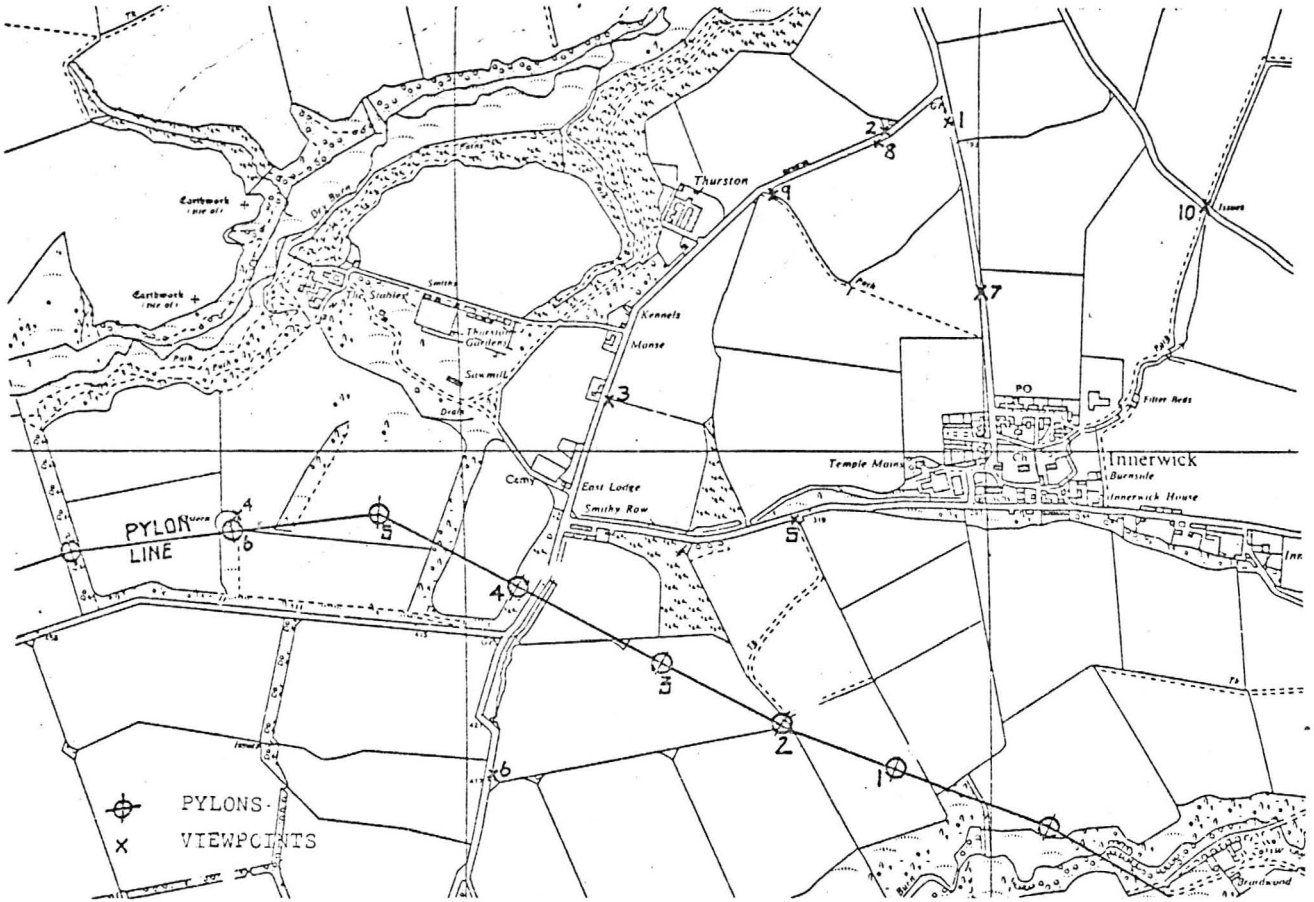


25Km^2 Data Base
(50x50 matrix of 100m grid cells)

(G134) VIEW topographic data set.



(G135) VIEW land use data overlay on contour map for SSEB accuracy study.

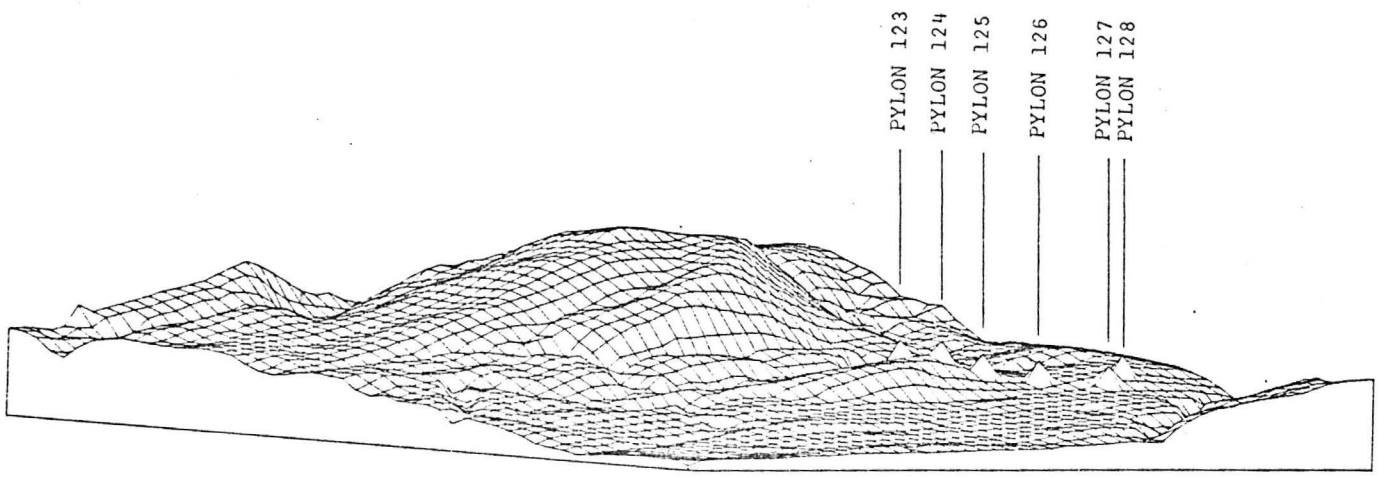


(G136) Pylon and viewpoint location map.

PYLON	DATA SET		Elevation height at base of pylon/ VIEW grid intersection value in feet	Actual height of pylon in feet
	I	J		
123	17	19	475	106
124	16	17	494	84
125	15	15	423	96
126	14	12	386	106
127	12	9	390	84
128	13	7	426	96

VIEWPOINT	DATA SET		Actual elevation height of viewpoint/ VIEW grid intersection values in feet.	Eye height in feet
	I	J		
1	5	21	192	5
2	5	19	202	5
3	10	14	311	5
4	12	7	425	5
5	12	17	315	5
6	17	11	415	5
7	8	21	220	5
8	5	19	212	5
9	6	17	237	5
10	6	25	168	5

(G137) Pylon and viewpoint data.



(G138) Pylon height additions and locations in the DTM of the study area.

View 1

Visibility comparison Table 1

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	5	80	90	60	95	85
VIEW2 % visible	38	96	100	100	96	99
Difference	+33	+16	+10	+40	+1	+14
Actual % visible above horizon	0	80	90	60	55	85
VIEW2 % visible above horizon	22	96	100	66	77	82
Difference	+22	+16	+10	+6	+22	-3

(G139) Visibility comparison - View 1

View 2

Visibility comparison Table 2

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	10	85	95	90	100	100
VIEW2 % visible	39	99	100	97	97	99
Difference	+29	+14	+5	+7	-3	-1
Actual % visible above horizon	0	40	95	90	70	90
VIEW2 % visible above horizon	2	87	100	97	79	83
Difference	+2	+47	+5	+7	+9	-7

(G140) Visibility comparison - View 2

View 3

Visibility comparison Table 3

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	25	95	100	80	0	0
VIEW2 % visible	34	100	100	86	94	97
Difference	+9	+5	0	+6	+94	+97
Actual % visible above horizon	25	60	25	80	0	0
VIEW2 % visible above horizon	34	76	41	86	93	97
Difference	+9	+16	+16	+6	+93	+97

(G141) Visibility comparison - View 3

View 4

Visibility comparison Table 4

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	60	100	80	65	45	100
VIEW2 % visible	64	100	100	96	100	100
Difference	+4	0	+20	+31	+55	0
Actual % visible above horizon	60	95	35	30	45	90
VIEW2 % visible above horizon	64	100	43	30	68	77
Difference	+4	+5	+8	0	+23	-13

(G142) Visibility comparison - View 4

View 5

Visibility comparison Table 5

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	0	60	70	100	95	95
VIEW2 % visible	5	92	100	100	95	93
Difference	+5	+32	+30	0	0	-2
Actual % visible above horizon	0	60	70	75	90	95
VIEW2 % visible above horizon	5	92	100	75	83	93
Difference	+5	+32	+30	0	-7	-2

(G143) Visibility comparison - View 5

View 6

Visibility comparison Table 6

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	60	100	70	35	40	50
VIEW2 % visible	58	100	95	71	42	57
Difference	-2	0	+25	+36	+2	+7
Actual % visible above horizon	60	95	70	35	40	50
VIEW2 % visible above horizon	58	100	95	71	42	57
Difference	-2	+5	+25	+36	+2	+7

(G144) Visibility comparison - View 6

View 7

Visibility comparison Table 7

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	4	60	95	95	95	95
VIEW2 % visible	24	89	100	93	96	95
Difference	+20	+29	+5	-2	+1	0
Actual % visible above horizon	4	60	95	90	80	95
VIEW2 % visible above horizon	24	89	100	91	90	95
Difference	+20	+29	+5	+1	+10	0

(G145) Visibility comparison - View 7

View 8

Visibility comparison Table 8

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	15	85	100	80	60	80
VIEW2 % visible	38	99	100	78	56	57
Difference	+23	+14	0	-2	-4	-23
Actual % visible above horizon	0	45	100	80	60	80
VIEW2 % visible above horizon	7	94	100	78	0	57
Difference	+7	+49	0	-2	-60	-23

(G146) Visibility comparison - View 8

View 9

Visibility comparison Table 9

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	20	90	100	90	45	0
VIEW2 % visible	43	100	100	92	94	95
Difference	+23	+10	0	+2	+49	+95
Actual % visible above horizon	0	10	100	90	40	0
VIEW2 % visible above horizon	2	39	100	79	3	84
Difference	+2	+29	0	-11	-37	+84

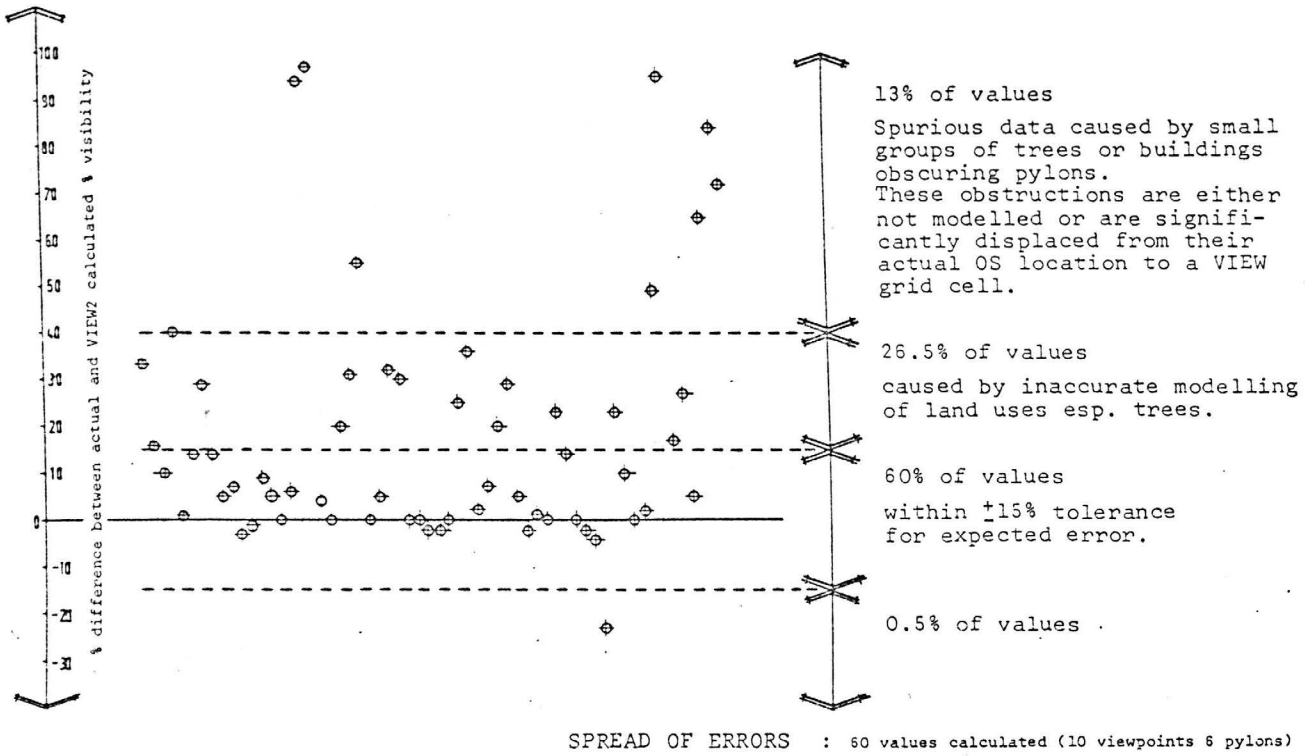
(G147) Visibility comparison - View 9

View 10

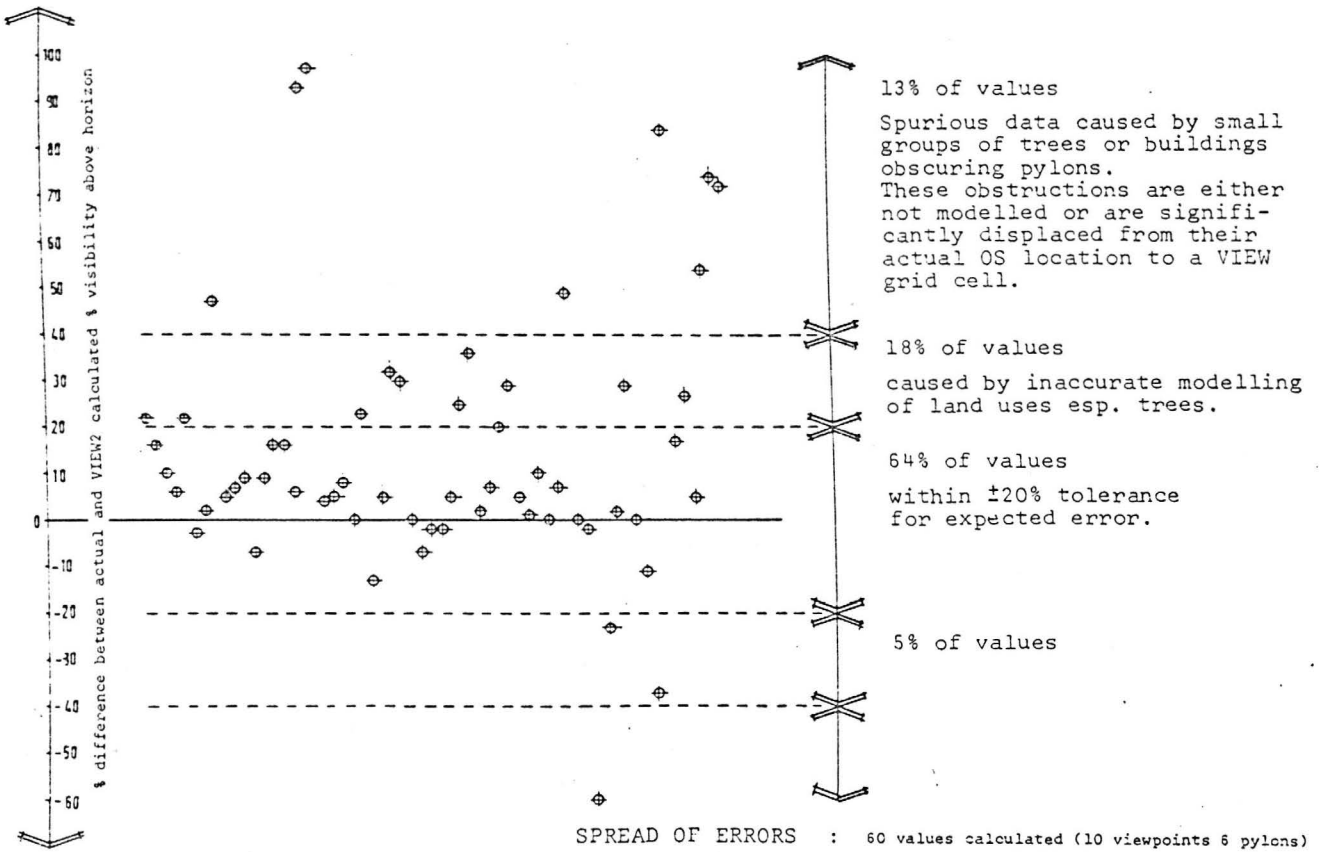
Visibility comparison Table 10

	Pylon 123	Pylon 124	Pylon 125	Pylon 126	Pylon 127	Pylon 128
Actual % visible	5	60	95	30	15	25
VIEW2 % visible	22	87	100	95	99	97
Difference	+17	+27	+5	+65	+84	+72
Actual % visible above horizon	5	60	95	30	15	25
VIEW2 % visible above horizon	22	87	100	84	89	97
Difference	+17	+27	+5	+54	+74	+72

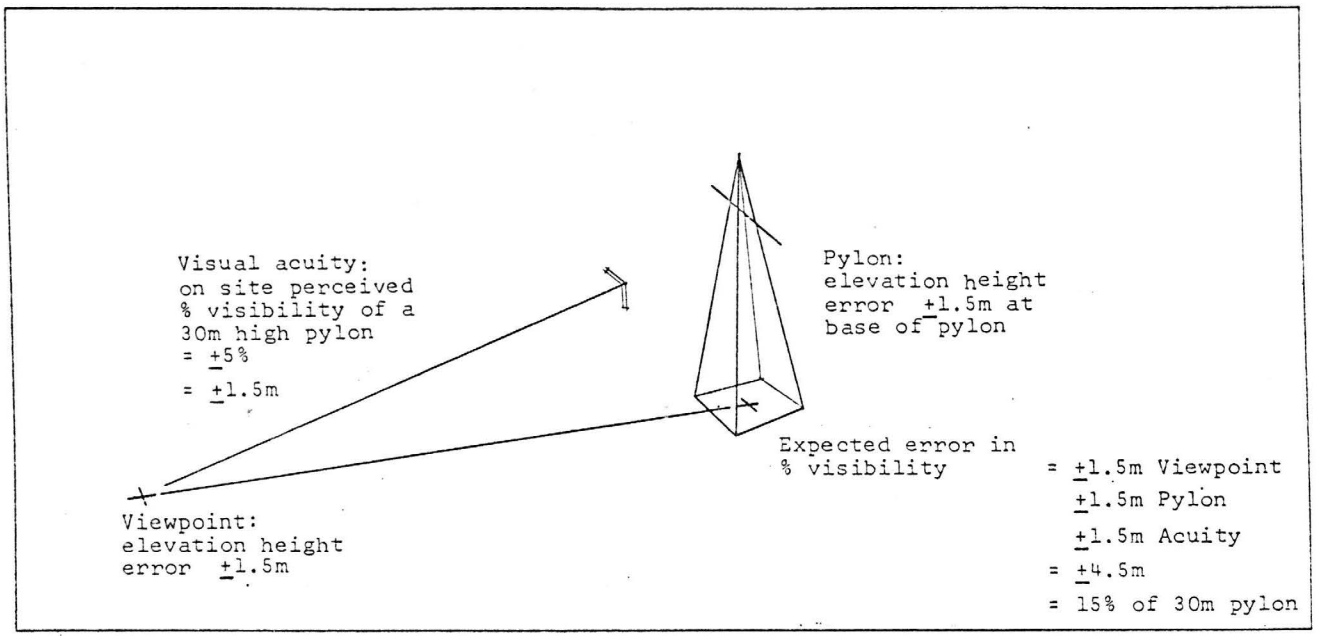
(G148) Visibility comparison - View 10



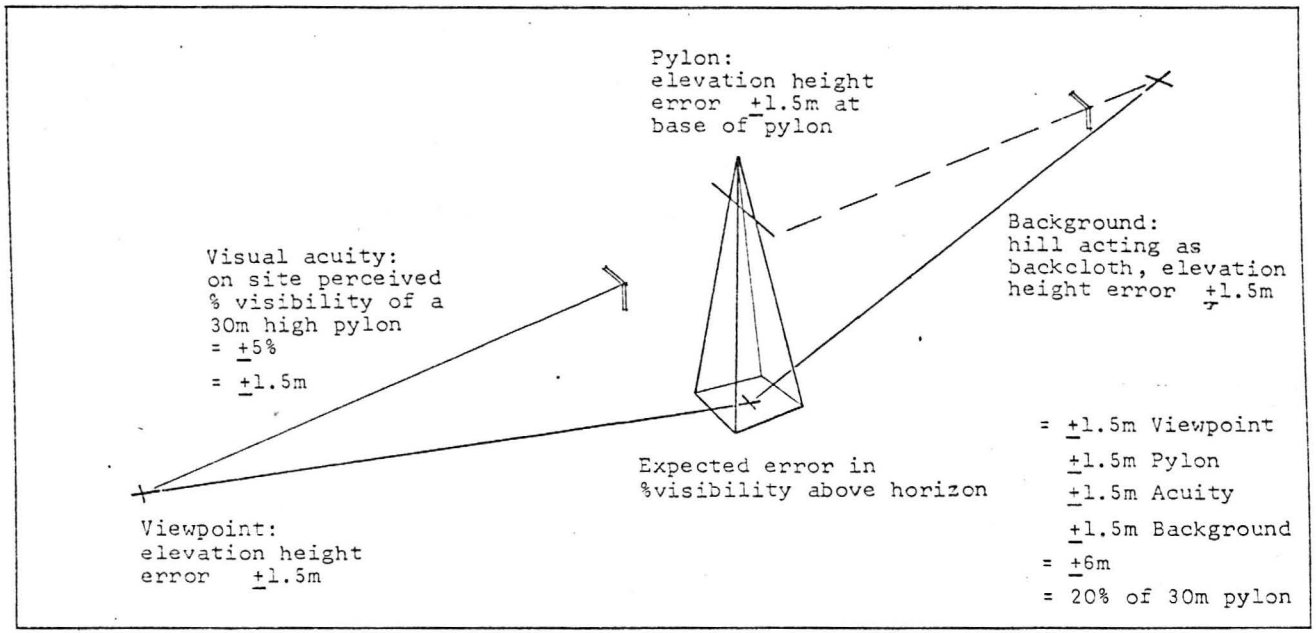
(G149) % Visibility of pylons - the spread of errors.



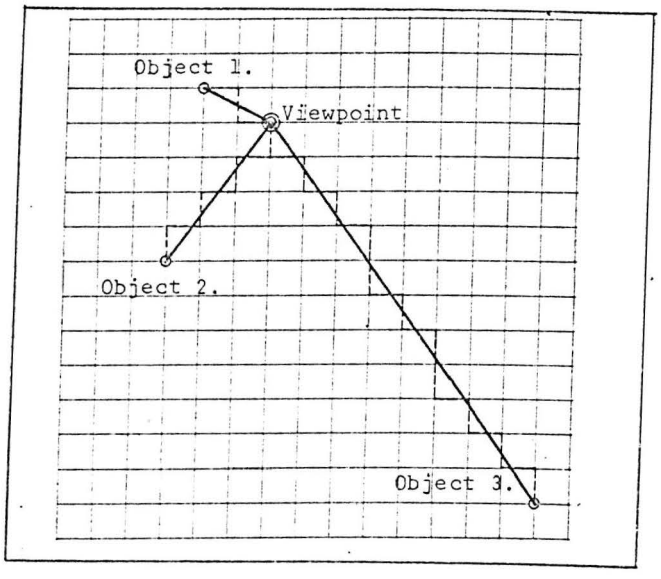
(G150) % visibility of pylons seen above horizon - the spread of errors.



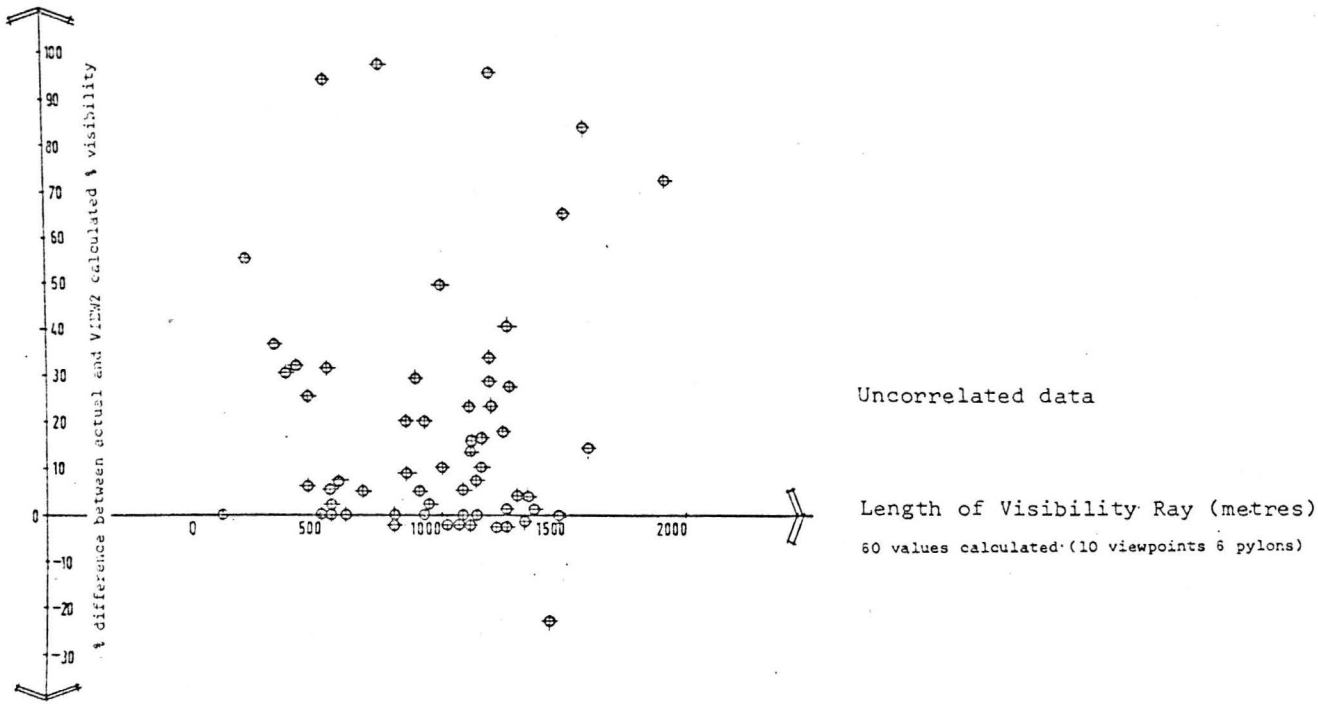
(G151) Expected error in calculating % visibility of a 30m high pylon.



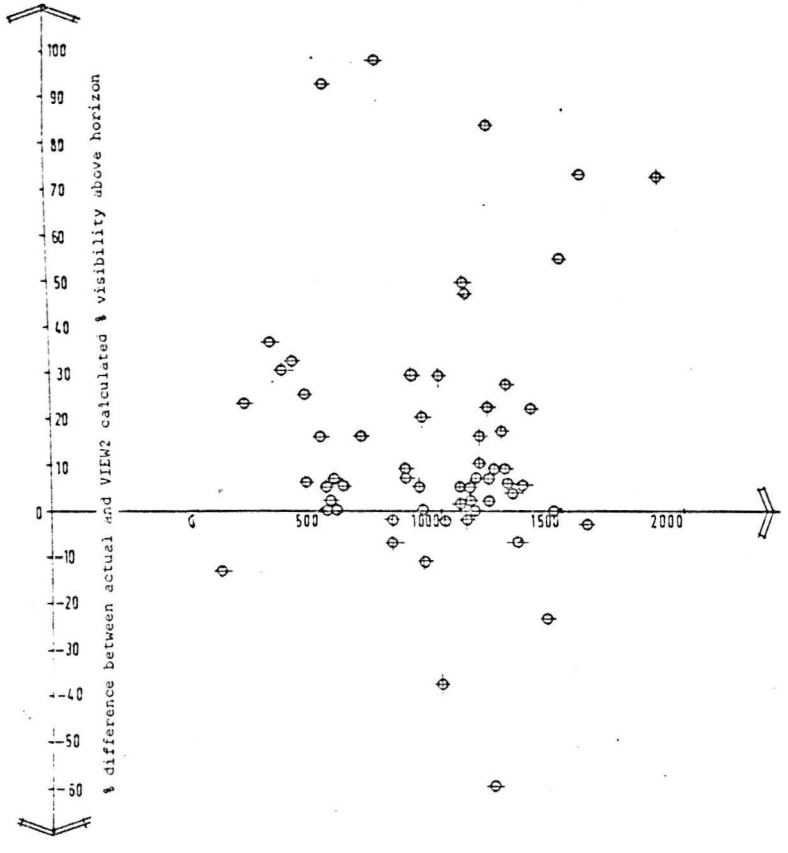
(G152) Expected error in calculating % visibility of a 30m high pylon seen above the horizon.



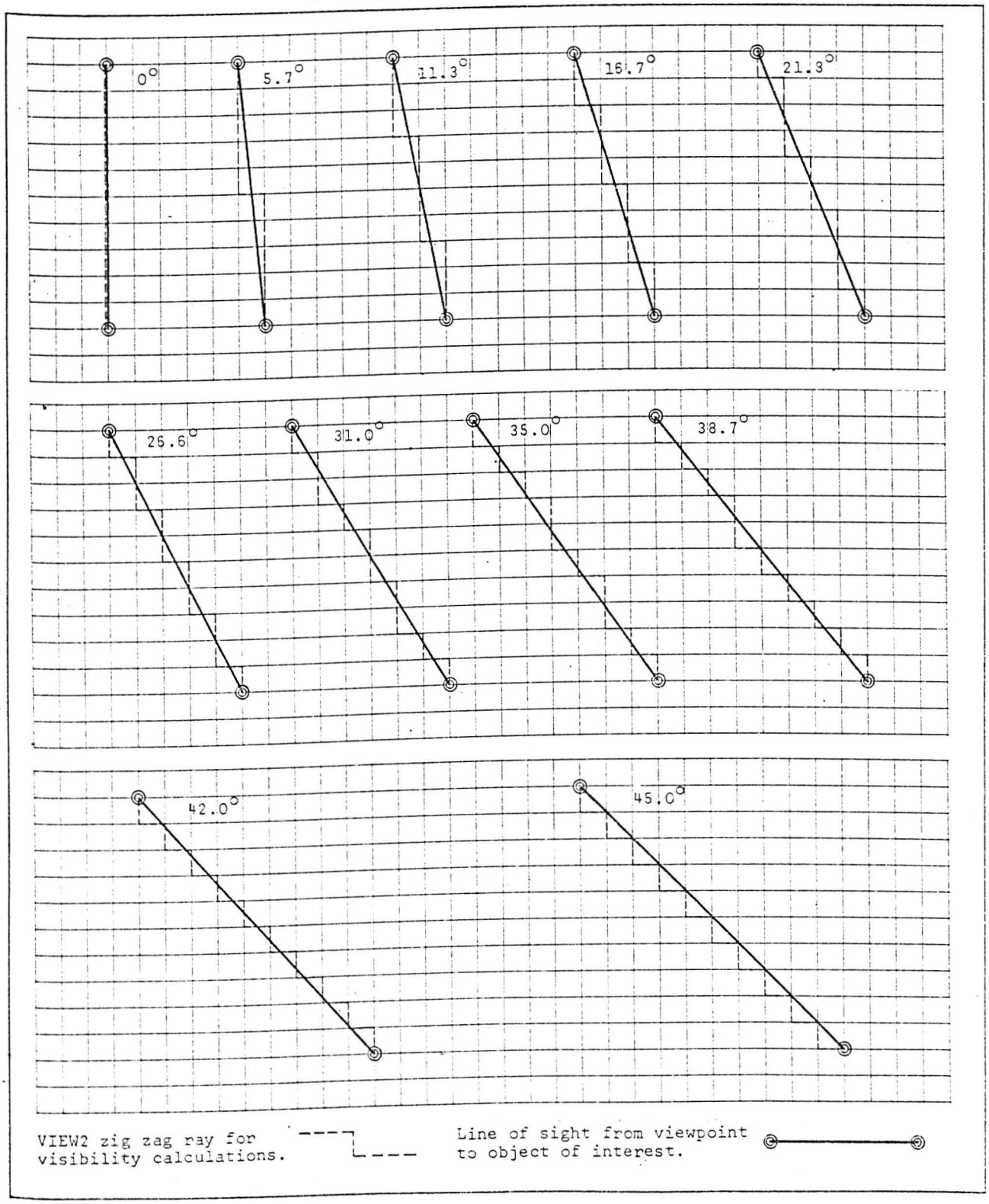
(G153) Visibility ray length.



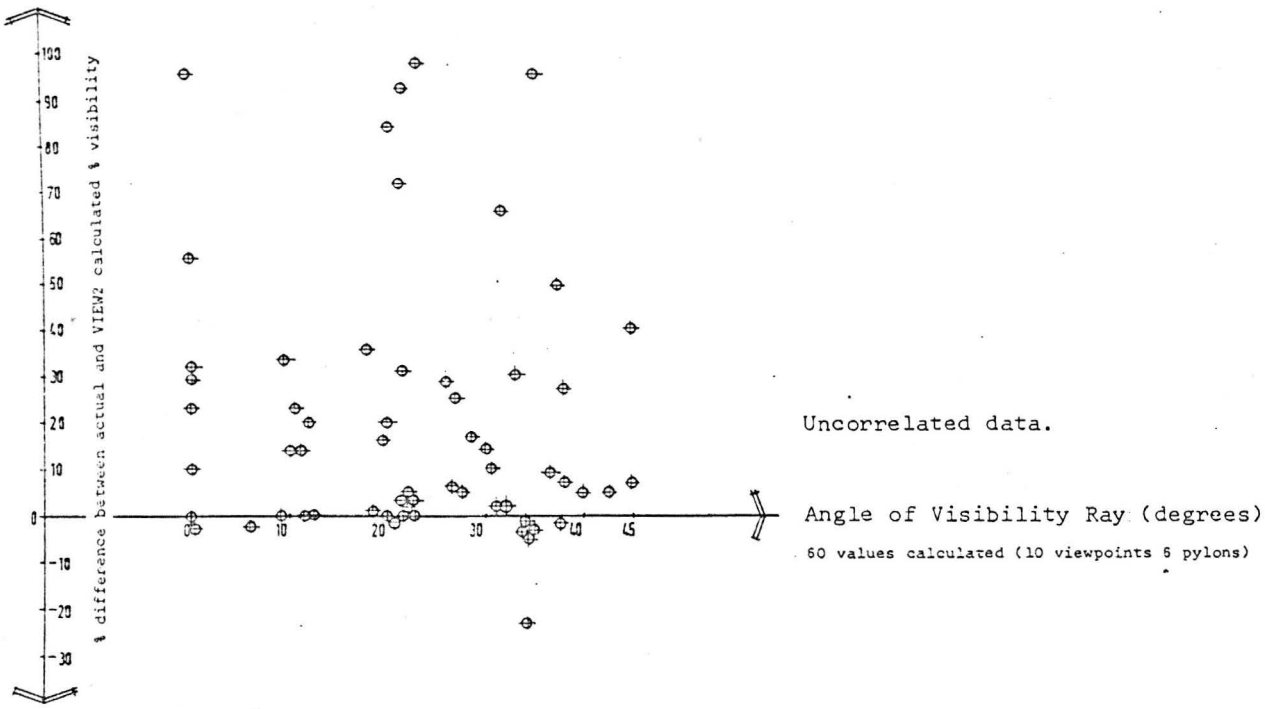
(G154) Graph of visibility ray length against % error difference between the actual and VIEW2 calculated visibility.



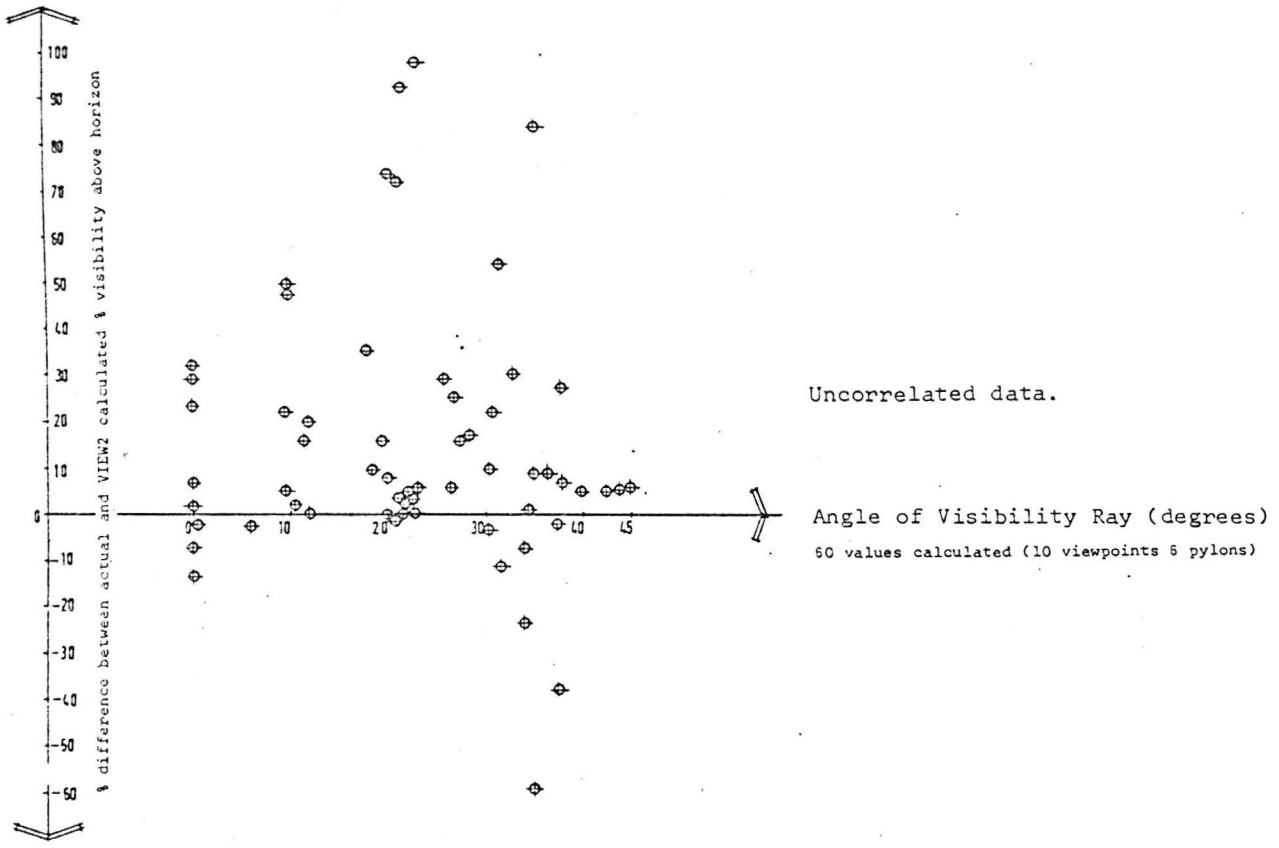
(G155) Graph of visibility ray length against % error difference between the actual and VIEW2 calculated visibility above horizon.



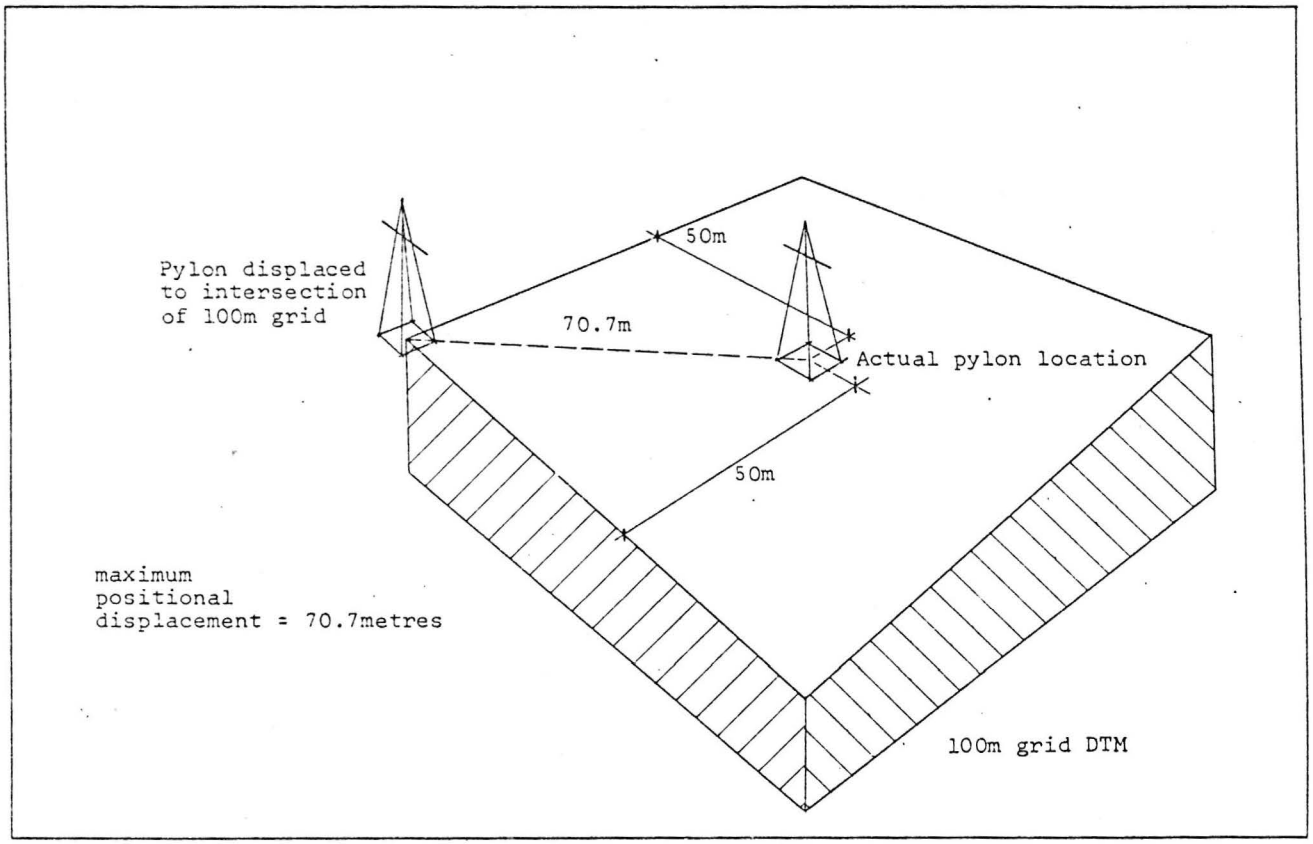
(G156) Variations of visibility ray interpolations between angles 0° and 45°.



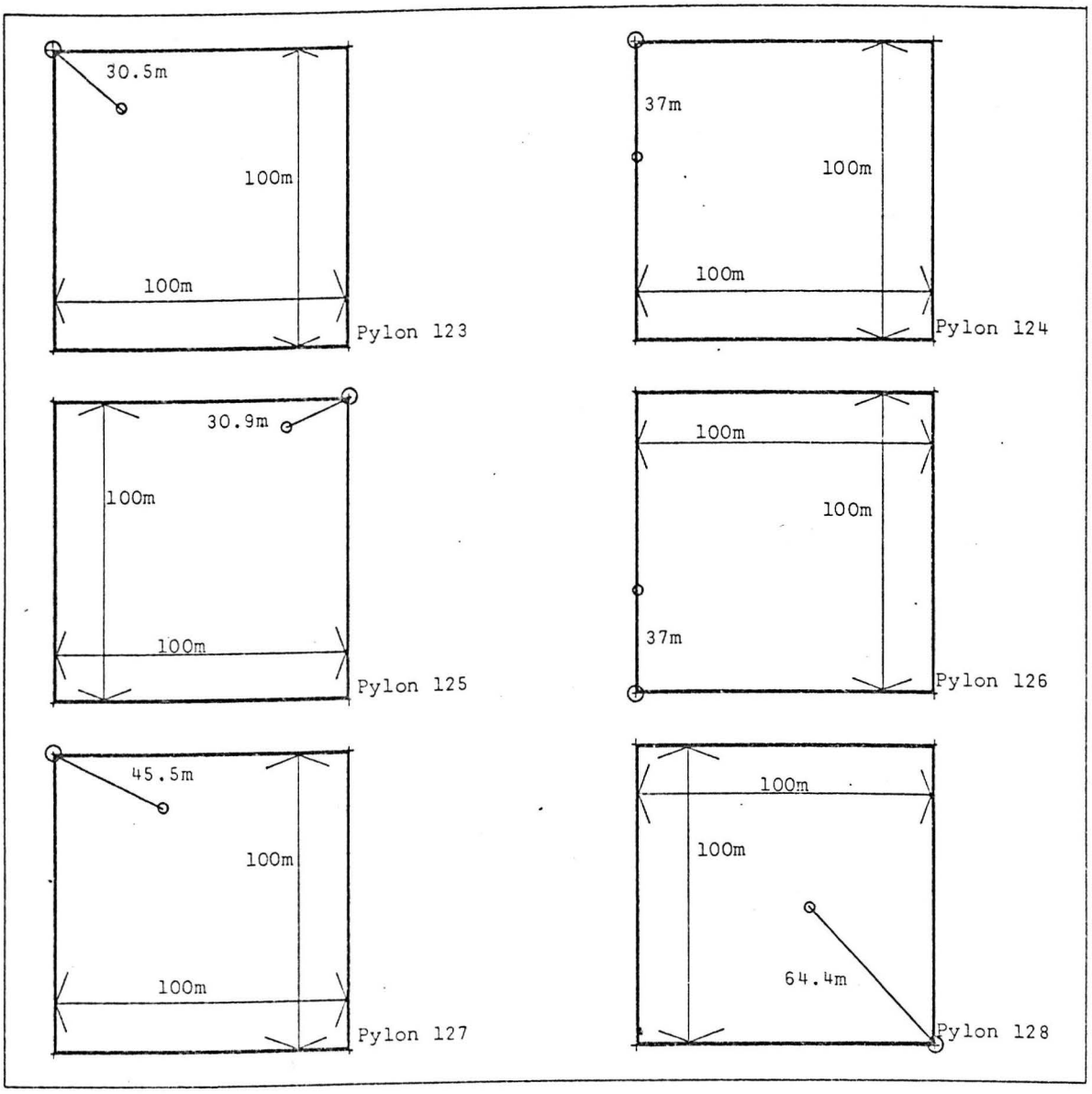
(G157) Graph of visibility ray angle against % error difference between the actual and VIEW2 calculated visibility.



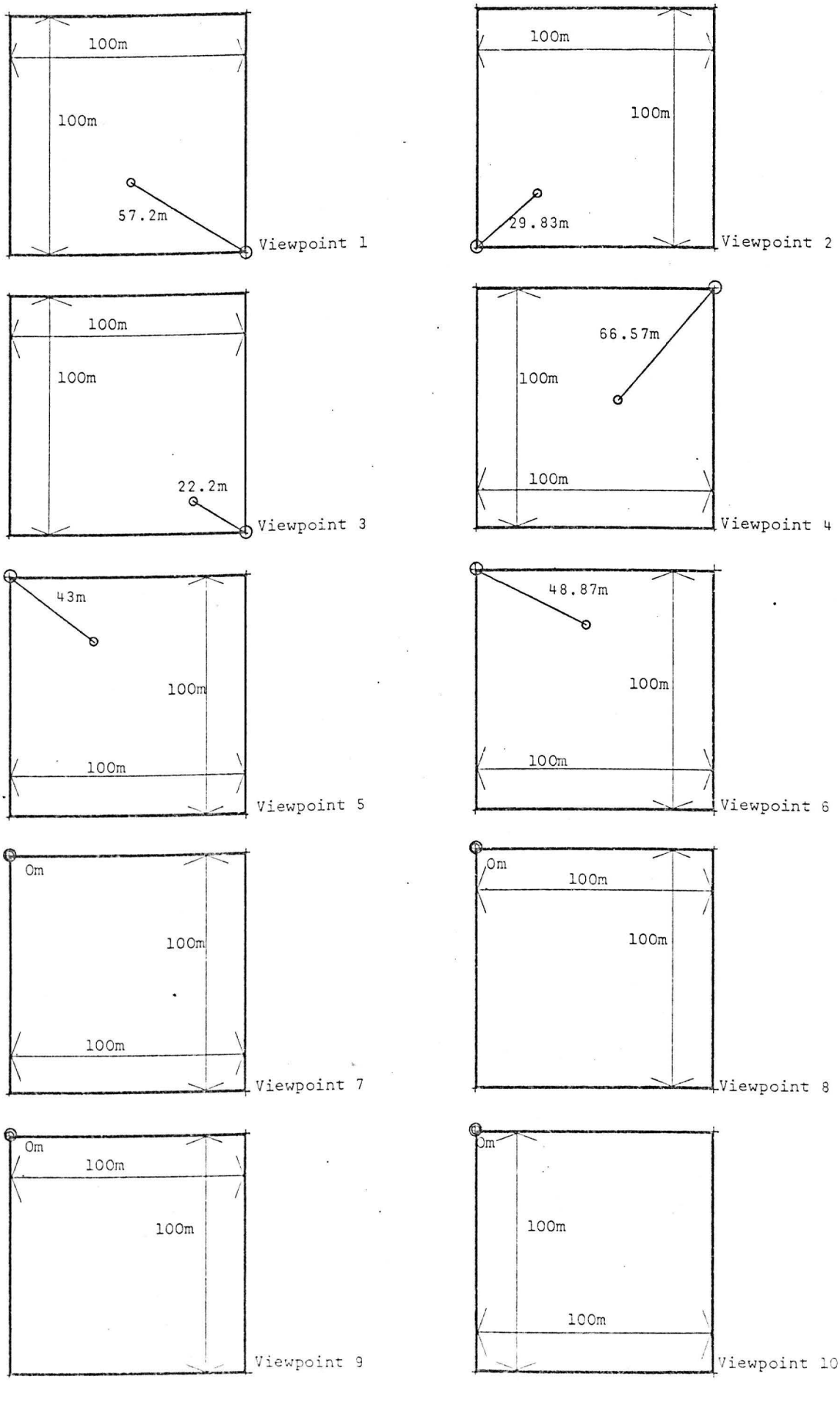
(G158) Graph of visibility ray angle against % error difference between the actual and VIEW2 calculated visibility above horizon.



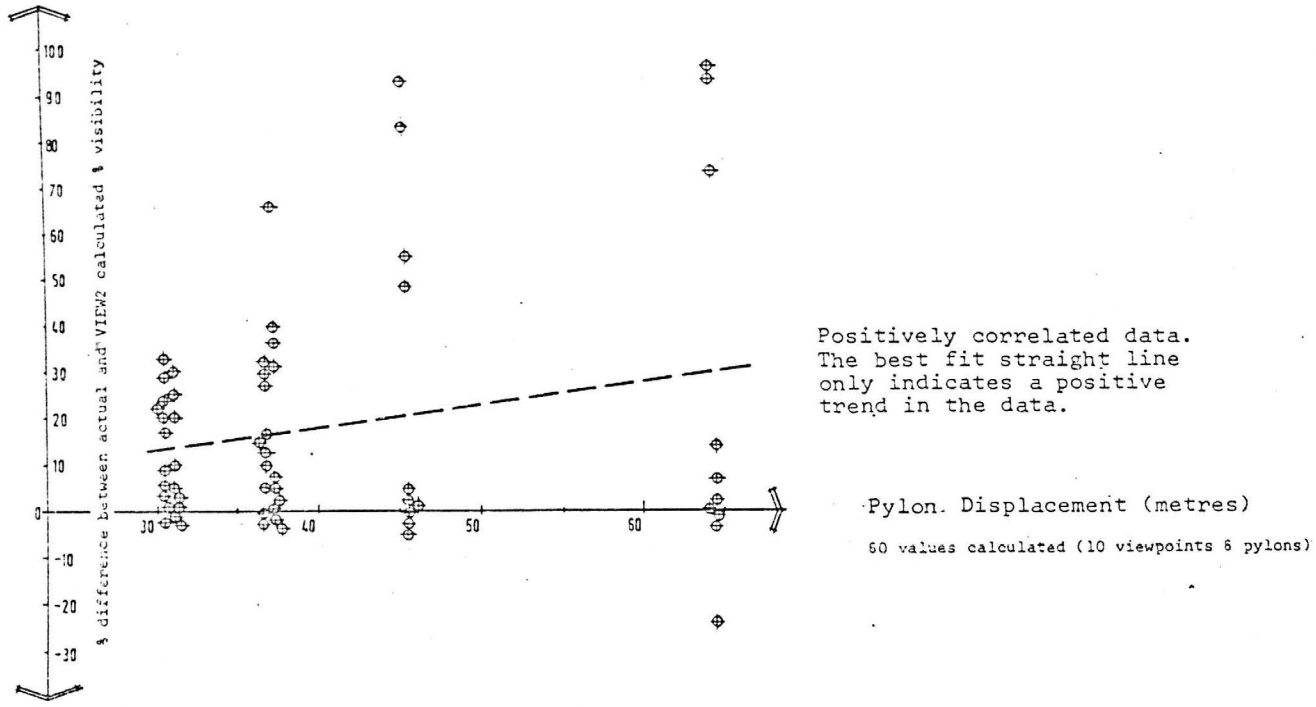
(G159) Maximum pylon displacement on a 100m square grid cell.



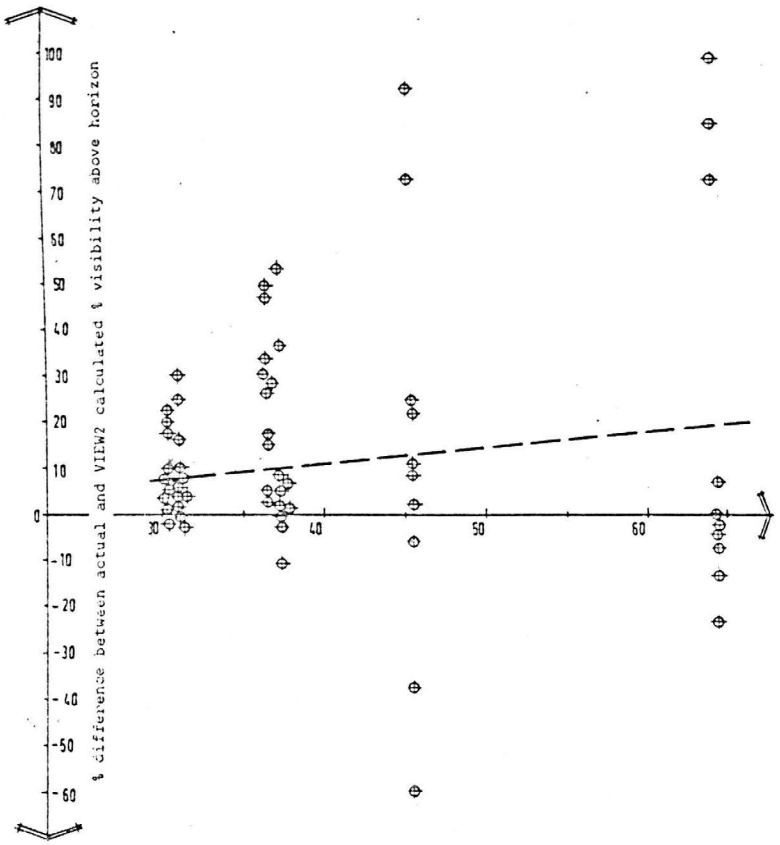
(G160) Pylon displacement data.



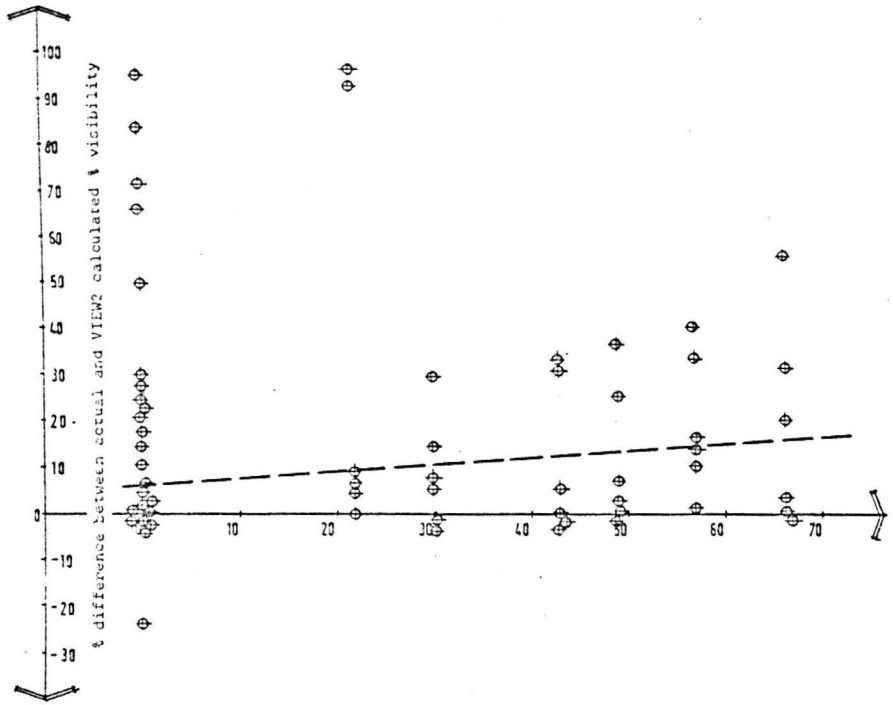
(G161) Viewpoint displacement data.



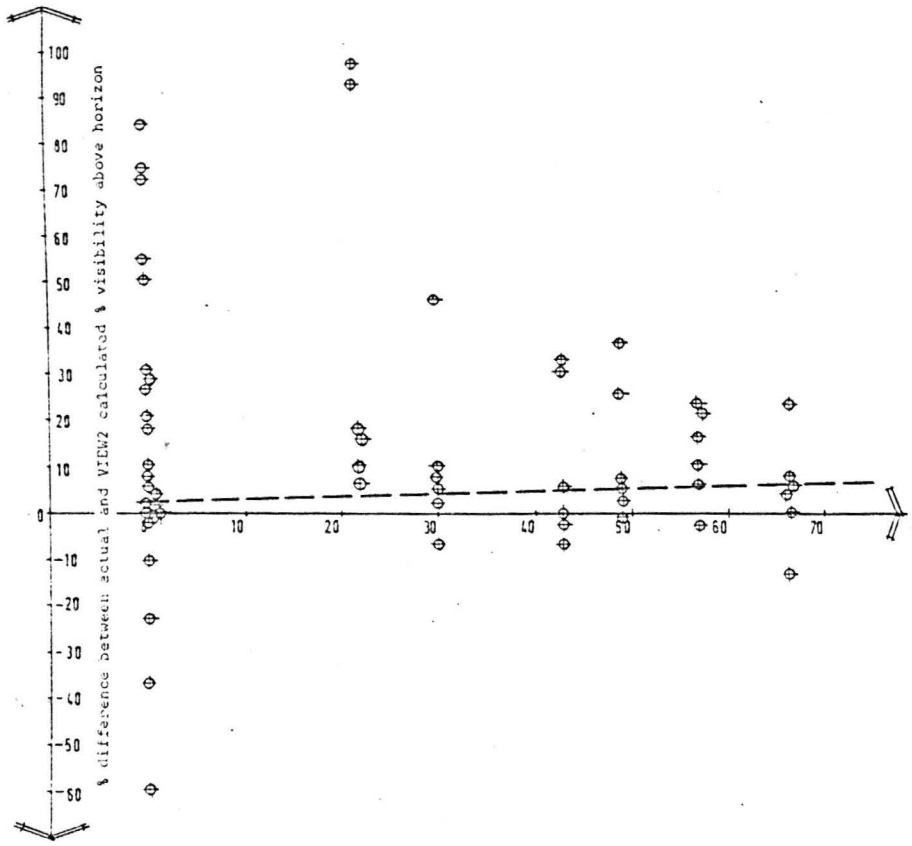
(G162) Graph of pylon displacement against % error difference between the actual and VIEW2 calculated visibility.



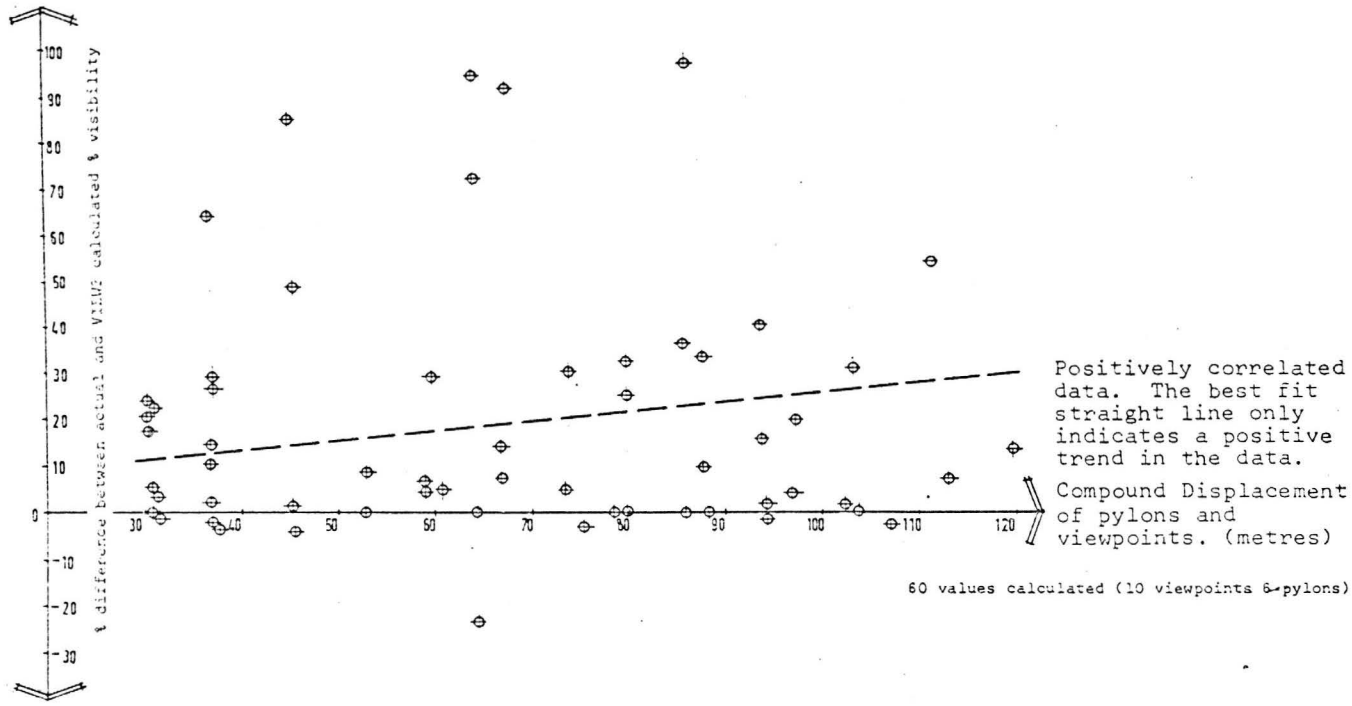
(G163) Graph of pylon displacement against % error difference between the actual and VIEW2 calculated visibility above horizon.



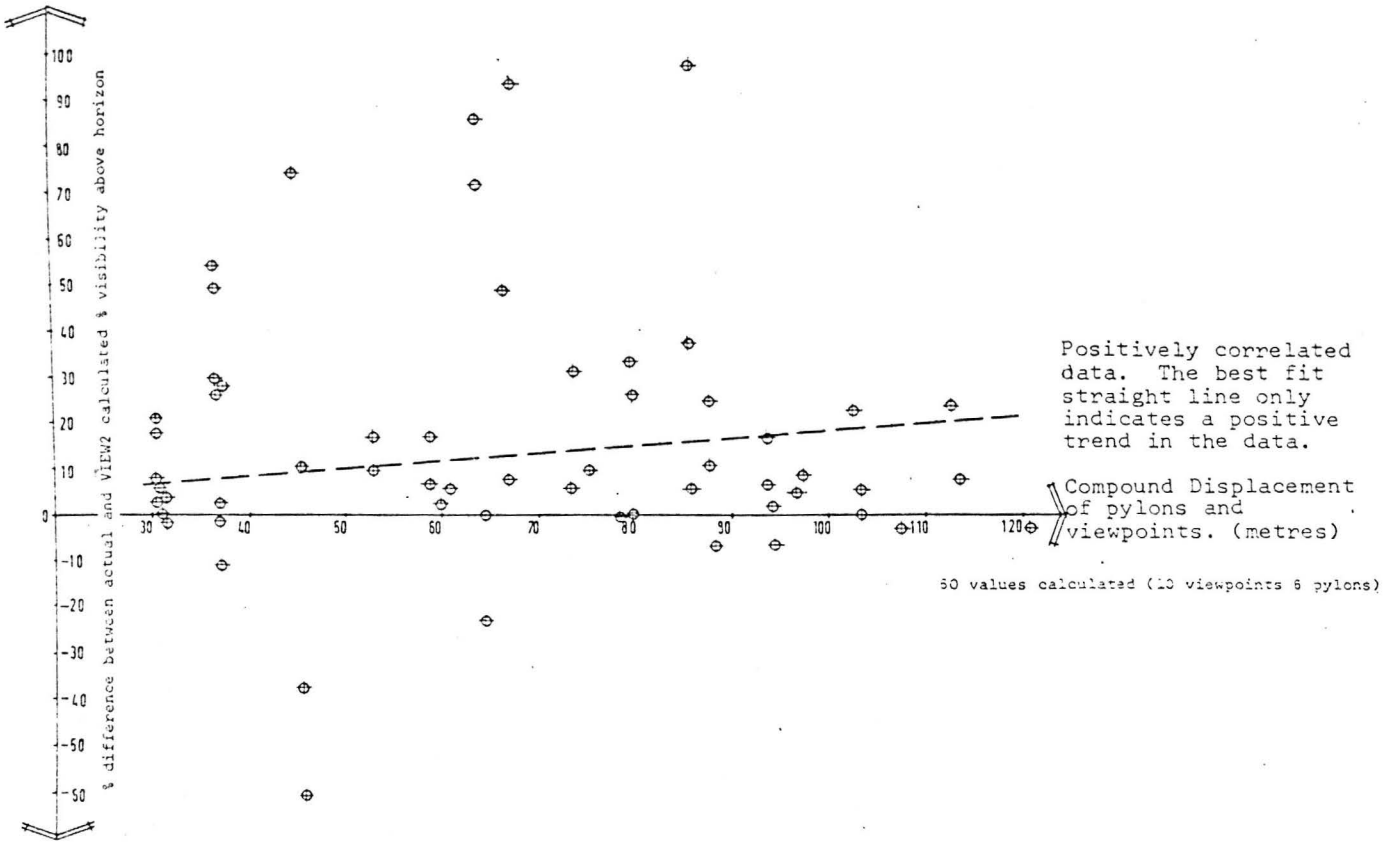
(G164) Graph of viewpoint displacement against % error difference between the actual and VIEW2 calculated visibility.



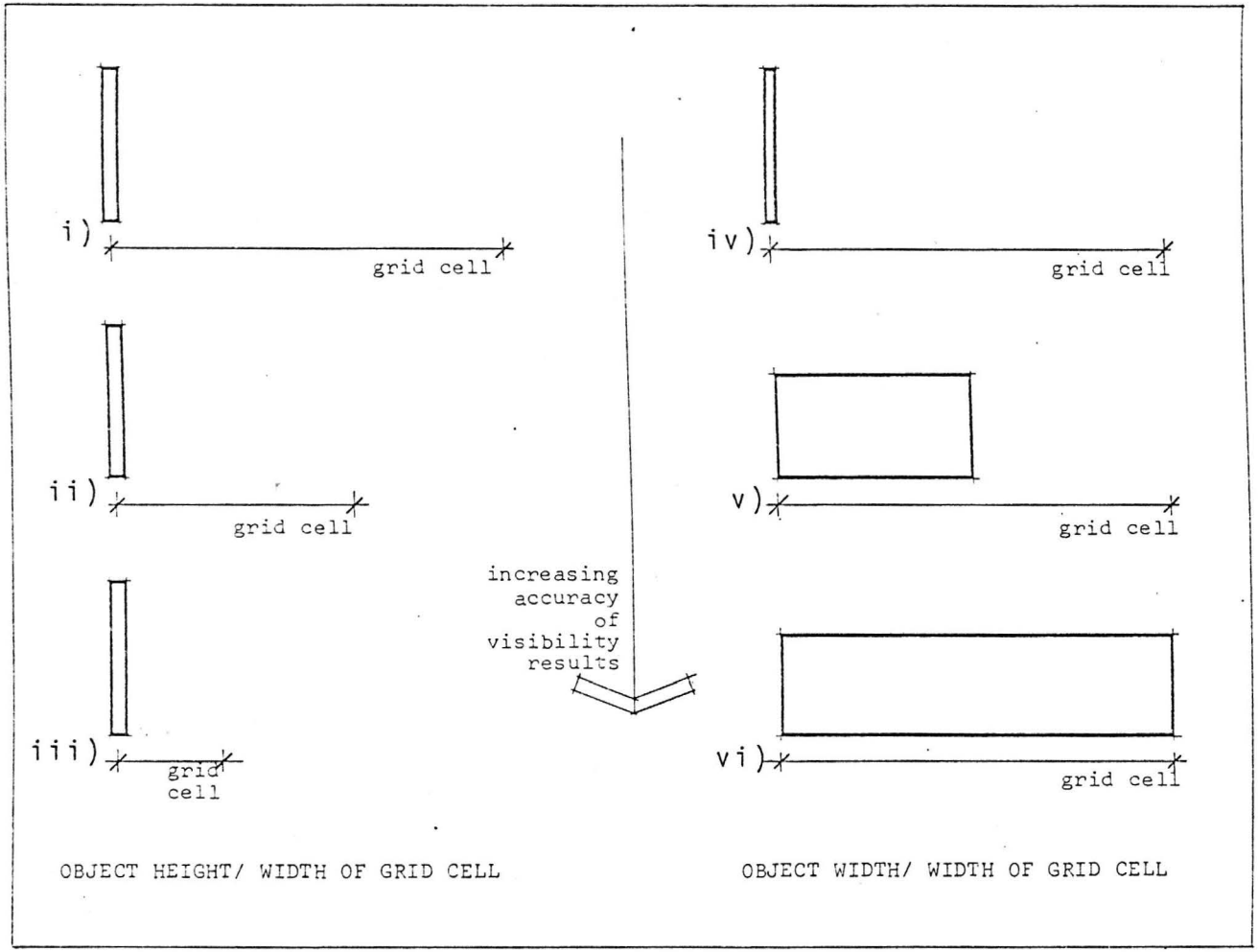
(G165) Graph of view point displacement against % error difference between the actual and VIEW2 calculated visibility above horizon.



(G166) Graph of compound displacement (pylons and viewpoints) against % error difference between the actual and VIEW2 calculated visibility.



(G167) Graph of compound displacement (pylons and viewpoints) against % error difference between the actual and VIEW2 calculated visibility above horizon.



(G168) Object/Grid cell size proportions.

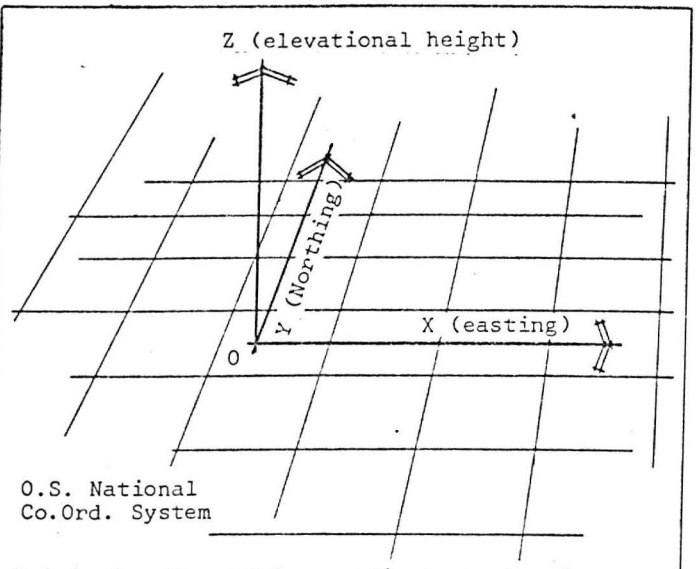
Pylon locations and orientation in the model co-ordinate system

PYLON	X (Easting)	Y (Northing)	Z (Elevation)	Orientation
123	1821	3380	144.6m	69.34°
124	1598	3464	150.6m	65.5 °
125	1377	3587	128.7m	61.67°
126	1103	3733	117.6m	61.67°
127	838	3877	118.8m	79.39°
128	558	3844	129.9m	97.1 °
ERRORS	±5m	±5m	±1m	±2 °
	Manual interpolation from O.S. maps.		Data supplied by SSEB.	Manual interpolation from O.S. maps. Anticlockwise from north

(G169) Pylon location and orientation data.

Control Point	X (Easting)	Y (Northing)	Z (Elevation)	Height of Control Pt.
Cottage near Thurston Gardens	1275	4121	97.5m	0m
Blackcastle Hill Mast	1730	2160	302.36m	98.755m
Innerwick Church	2060	3970	87.0m	5.5m
Templemains Farmhouse	1866	3980	91.6m	5.0m
ERRORS	±5m	±5m	±2m	
	Manual interpolation from O.S. maps.		Photogrammetric interpolation	

(G170) Control point location and orientation data.

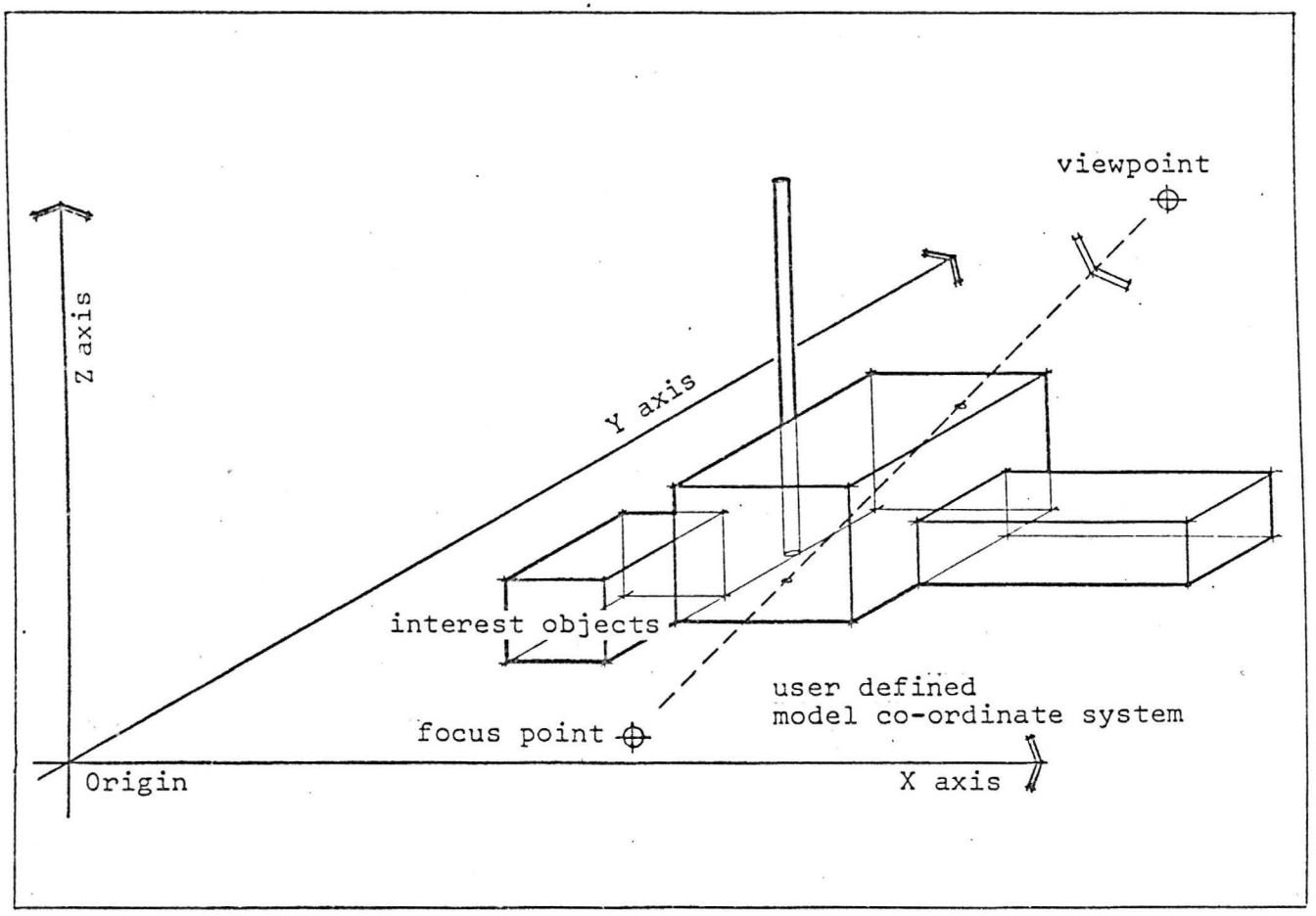


Origin for the model co-ordinate system in this study is:

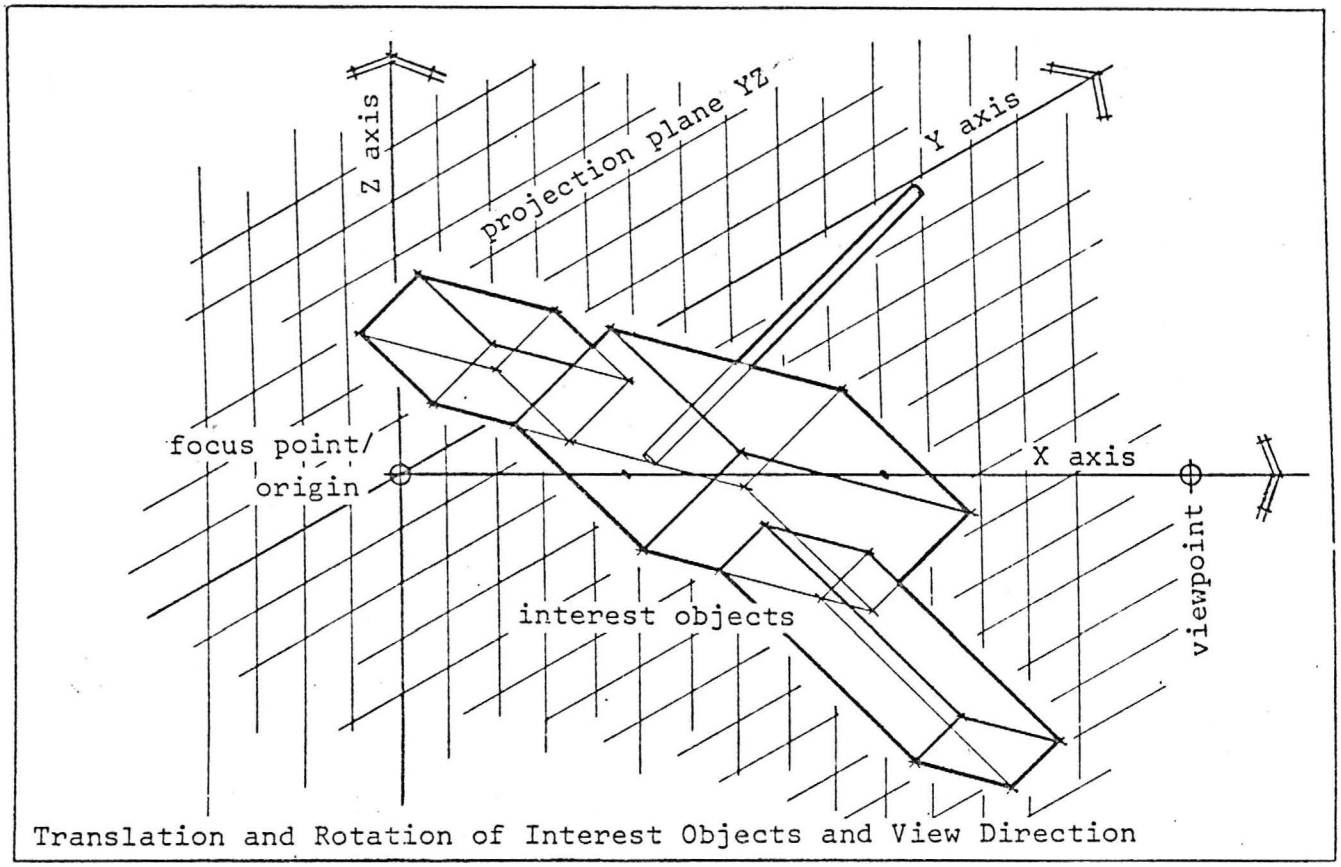
NT 370000670000 (1 metre reference)

The model co-ordinate system is a local (XYZ) system defined for a specific project within the national O.S. co-ordinate system.

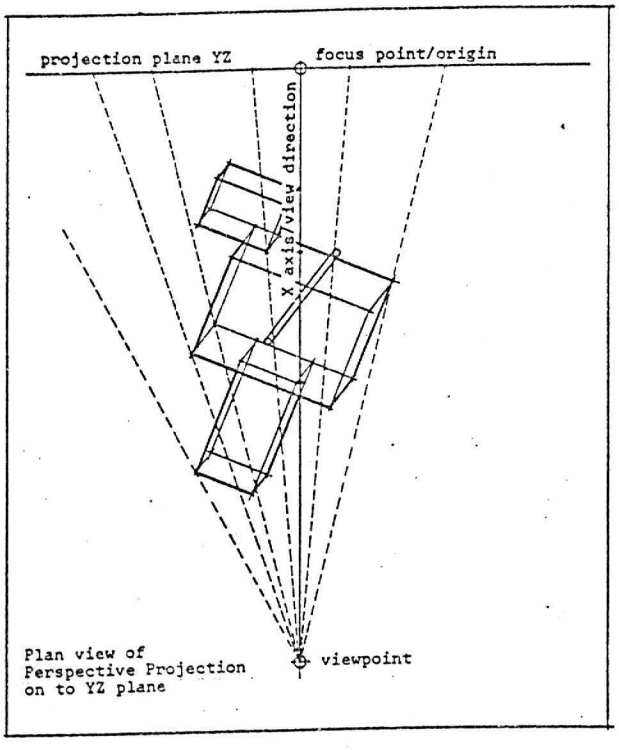
(G171) Model Co-ordinate System.



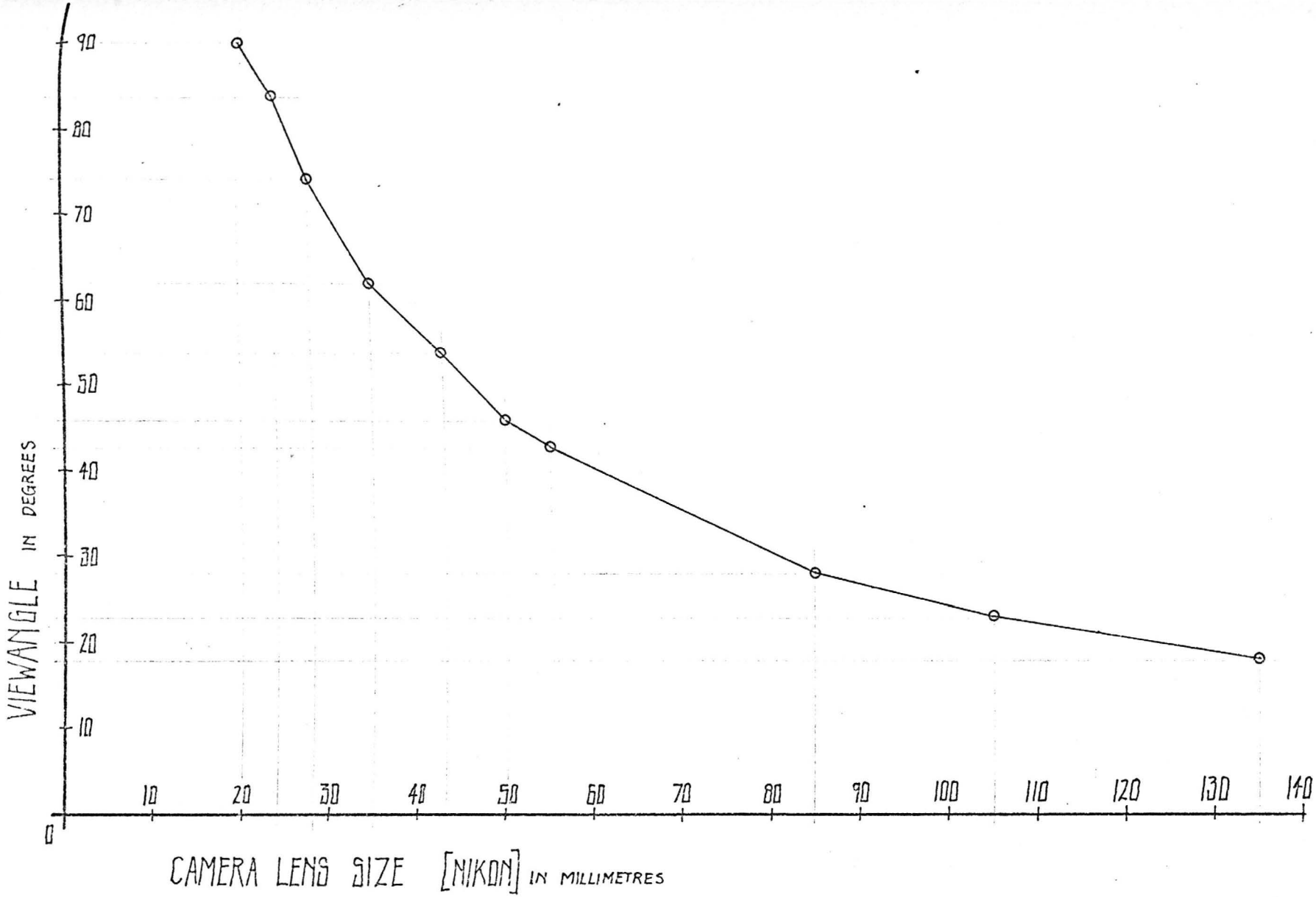
(G172) User specified viewpoint and focus point in the model co-ordinate system.



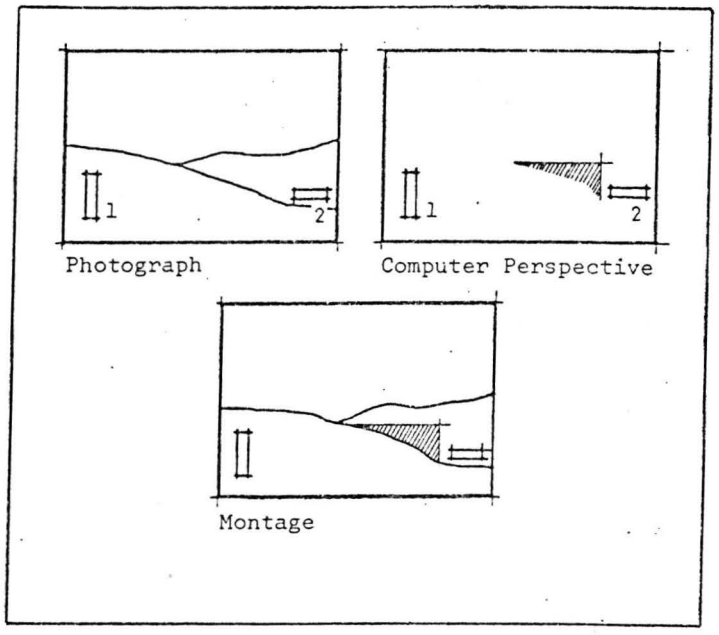
(G173) The translation of modelled objects such that the viewing direction lies along the X axis.



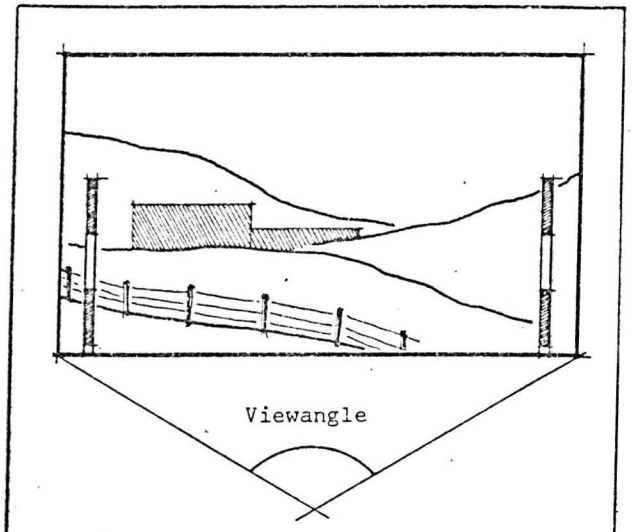
(G174) Perspective projection on to the YZ plane.



(G175) Graph of camera lens size against the viewangle. (Nikon series lenses).

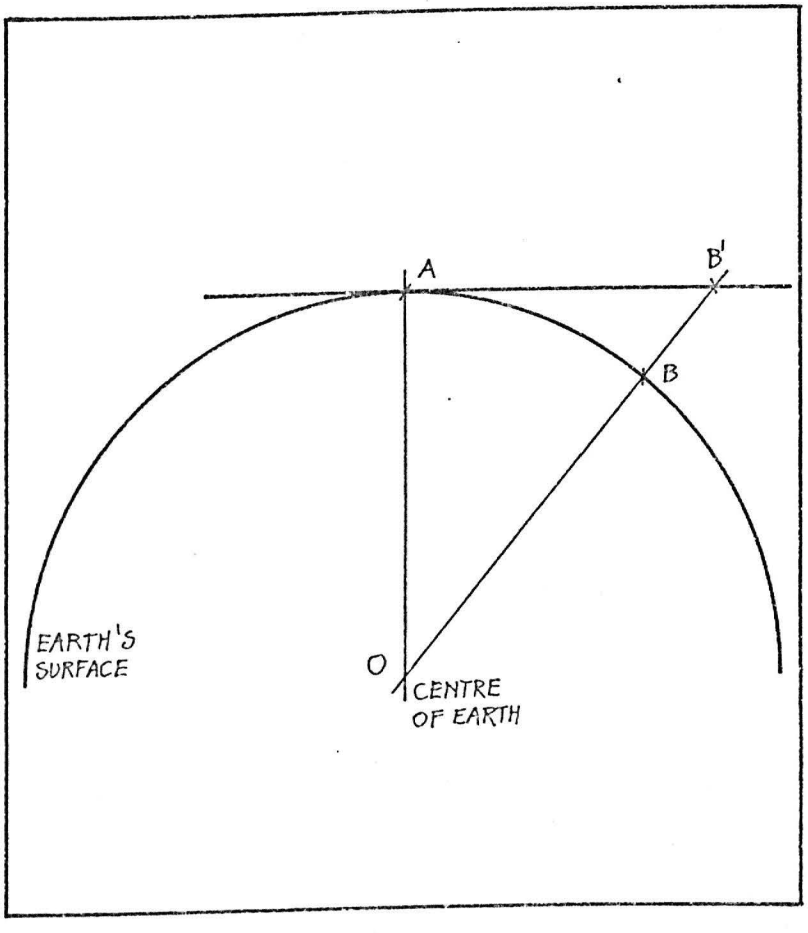


(G176) Control points, 1 and 2, matching the photograph and computer perspective.

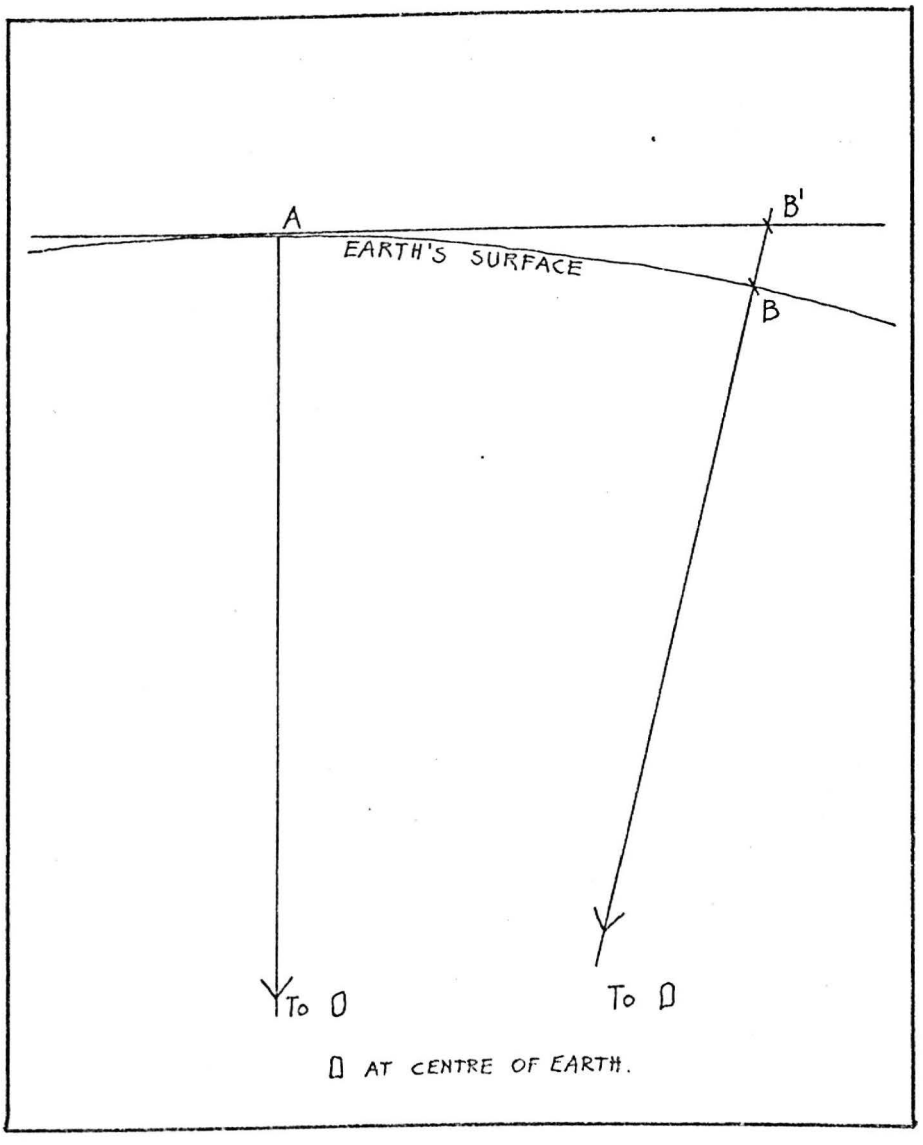


Surveying poles placed in camera view to help determine the enlargement factor from the negative to the print.

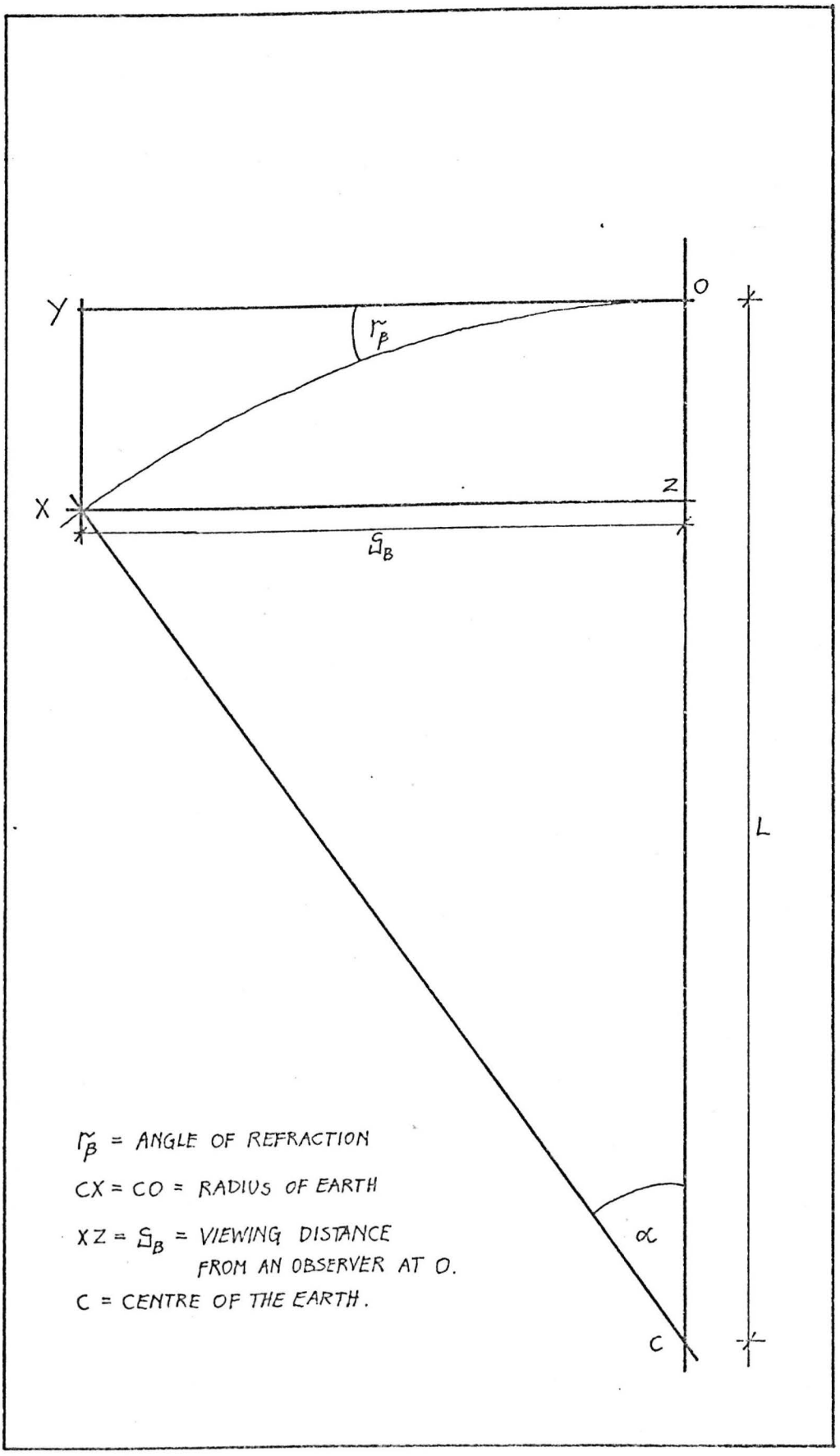
(G177) Determining the enlargement factor in BIBLE.



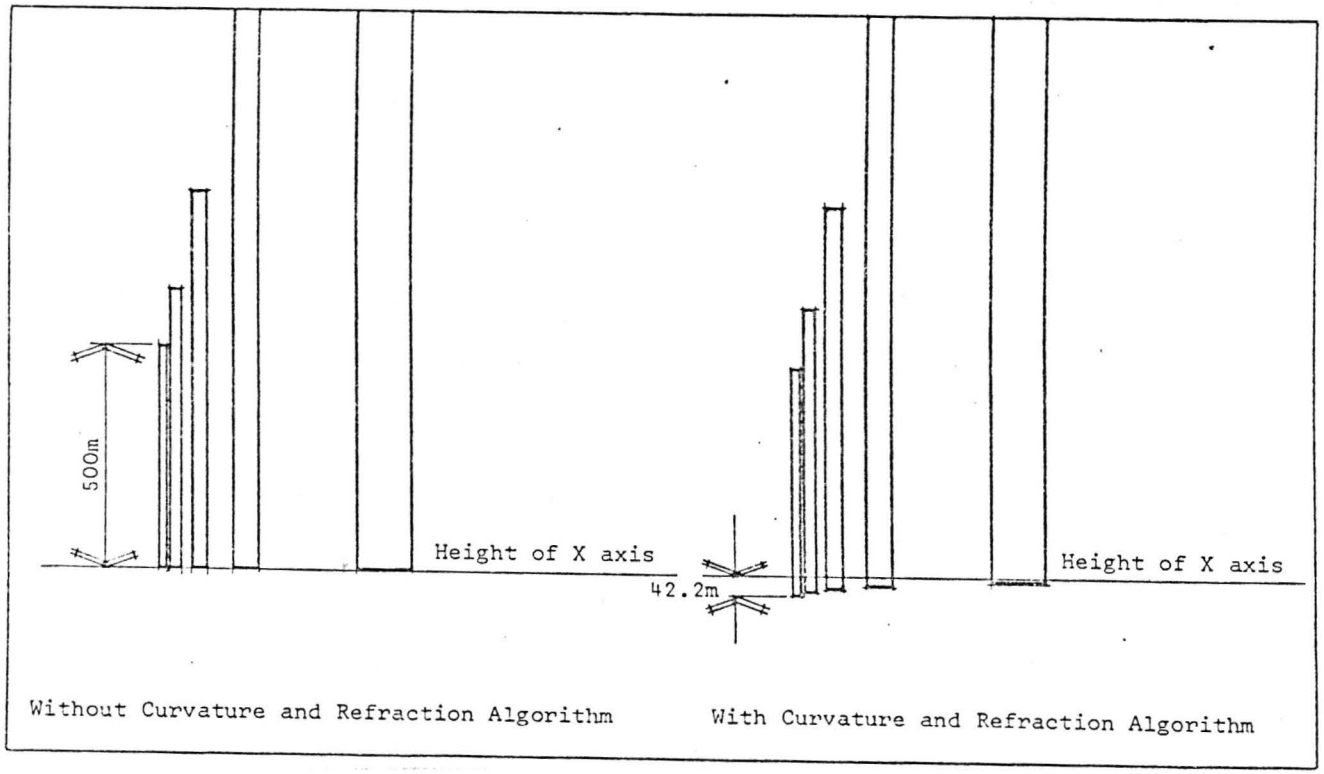
(G178) Earth's curvature - geometry, on a small scale.



(G179) Earth's curvature - geometry, on a large scale.



(G180) Light refraction - geometry.



d = Height reduction of object 5
(25km from viewpoint)

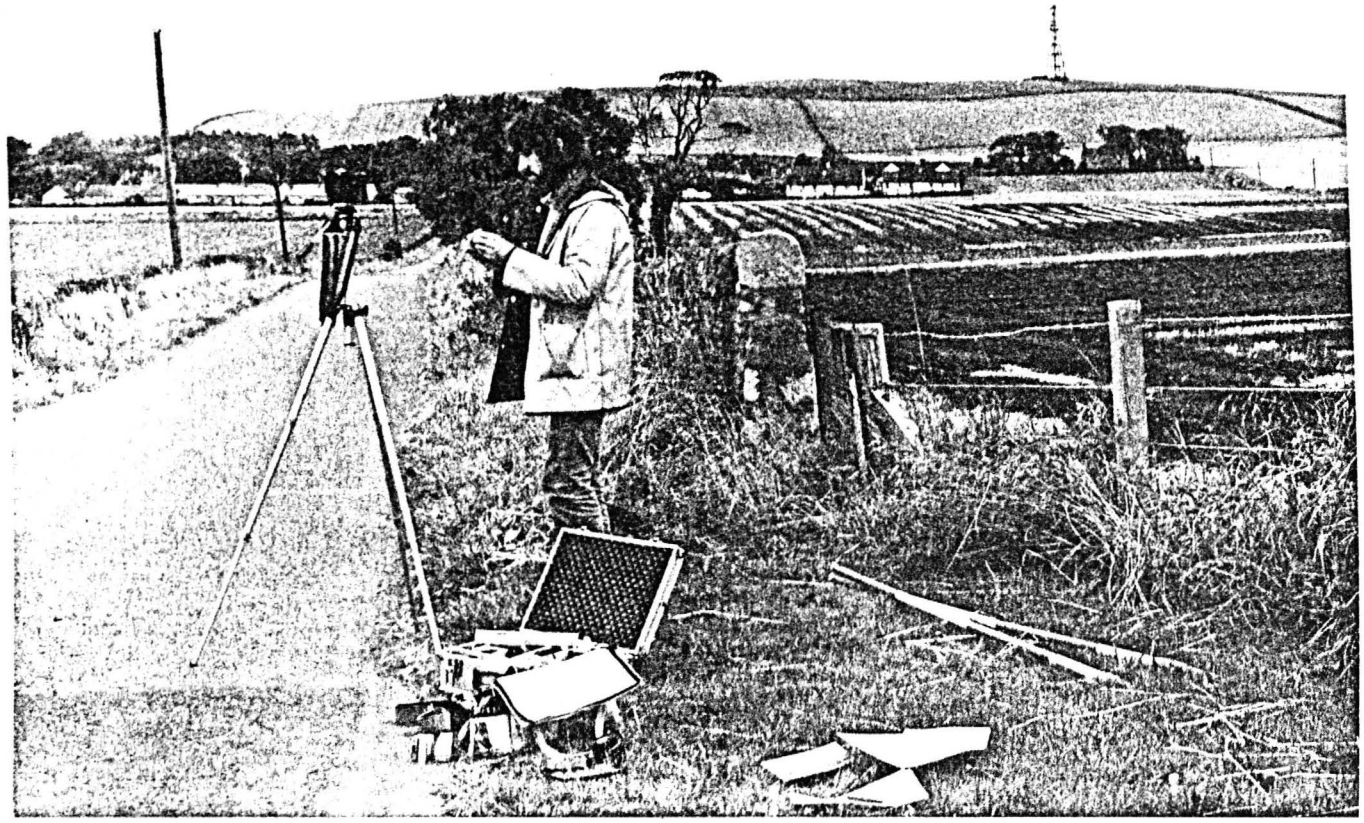
$$= \frac{C^2\ (1 - 2k)}{2R} \text{ miles}$$

$$= \frac{(15.625)^2(0.85)}{7916}$$

$$= \frac{207.5}{7916}$$

= 0.0262 miles
= 138.34 feet or 42.2 metres

(G181) Validation of BIBLE subroutine to calculate earth's curvature and light refraction.

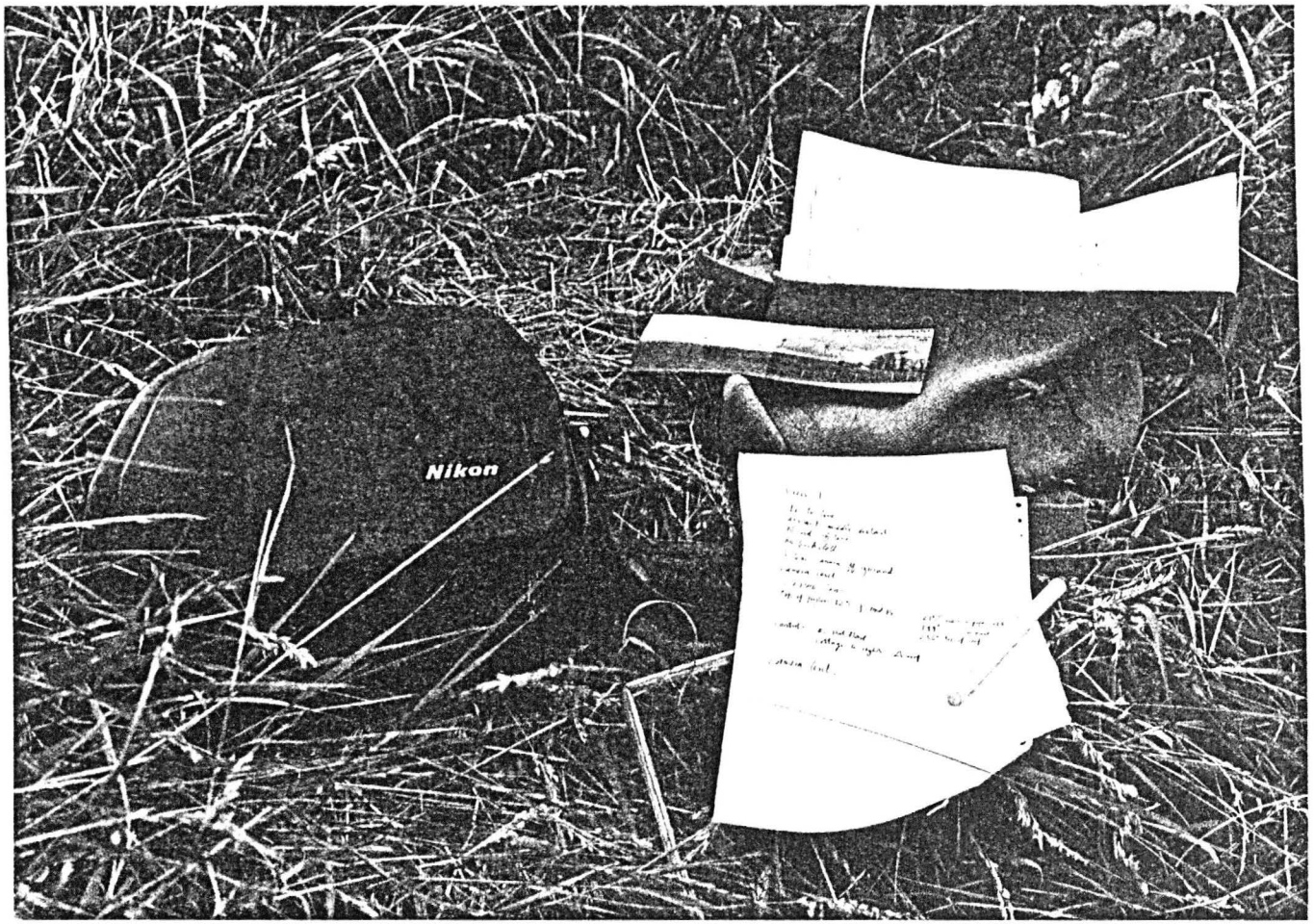


(G182) Photographic site procedure.

- select viewpoint at known location.

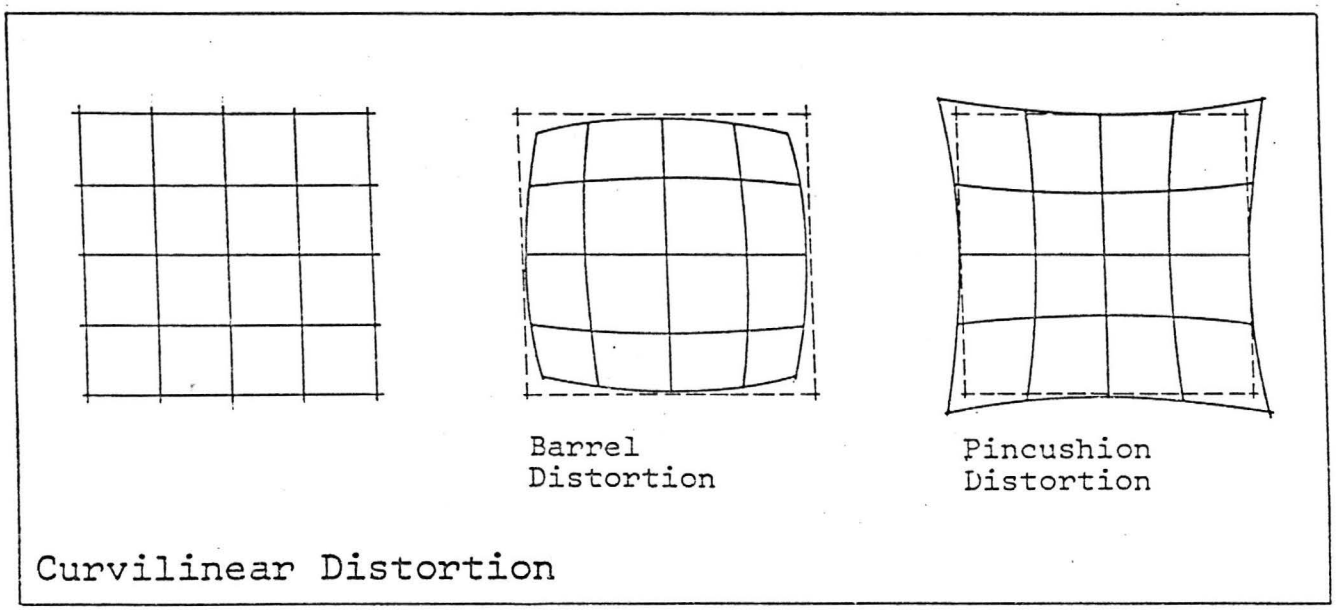
(G183) Photographic site procedure.

- ensure sufficient control points in the view.

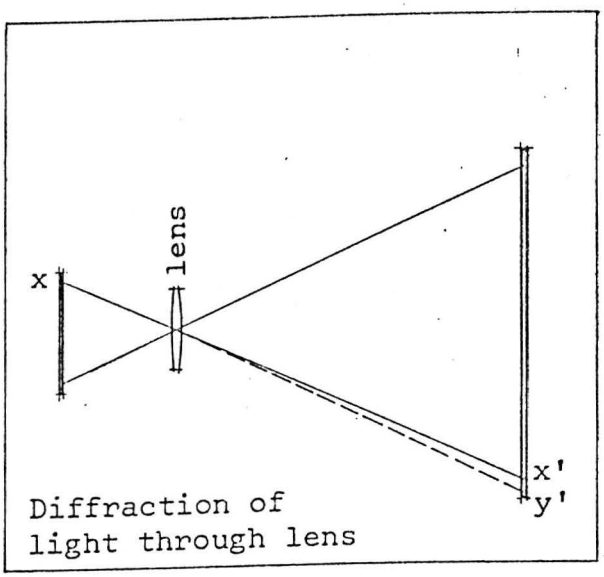


(G184) Photographic site procedures.

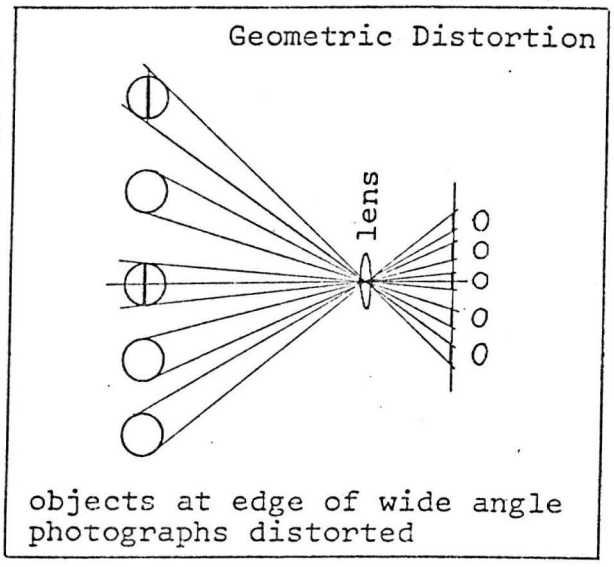
- set and note camera viewing parameters.



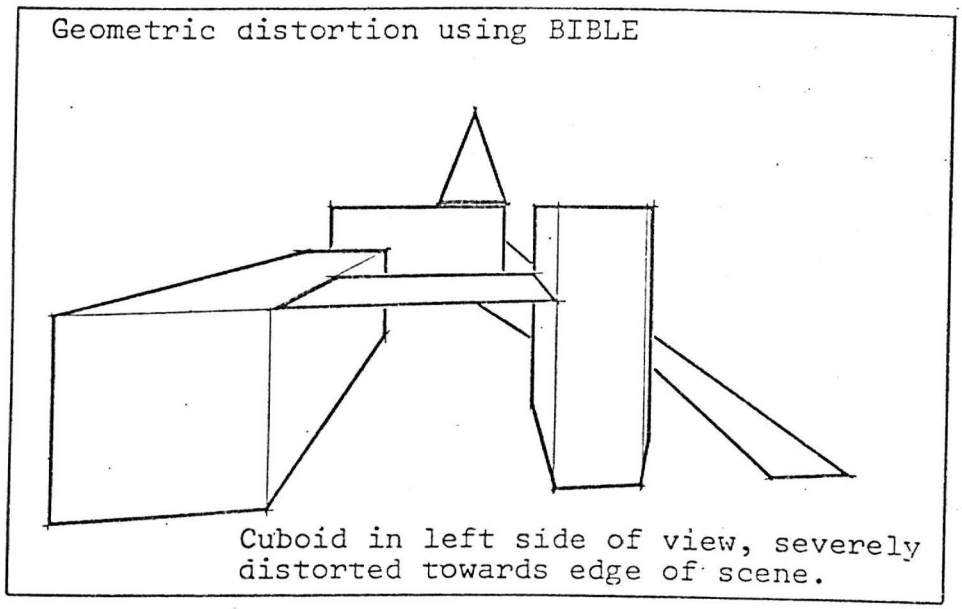
(G185) Curvilinear distortion



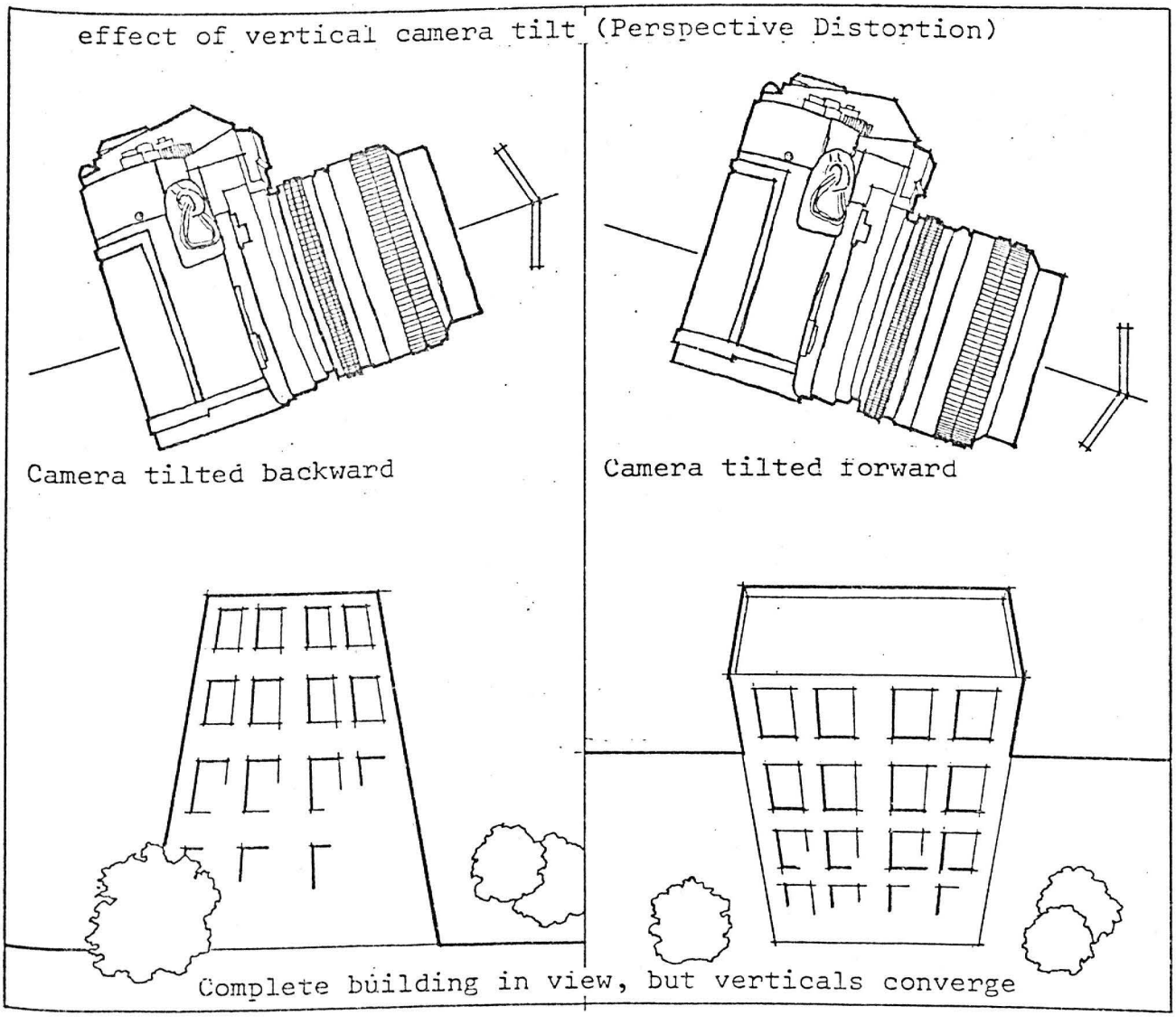
(G186) Lens diffraction



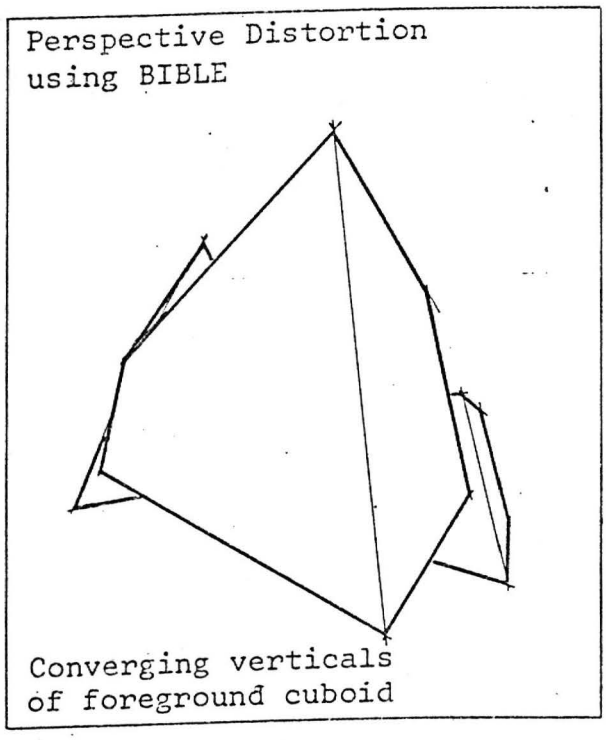
(G187) Geometric distortion



(G188) Geometric distortion in BIBLE

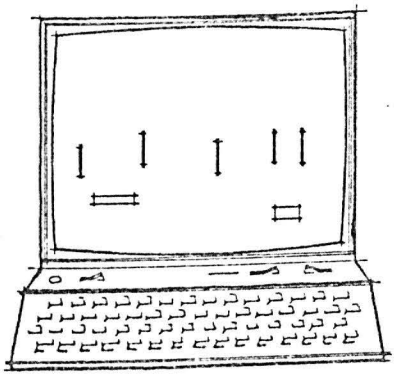


(G189) Perspective distortion

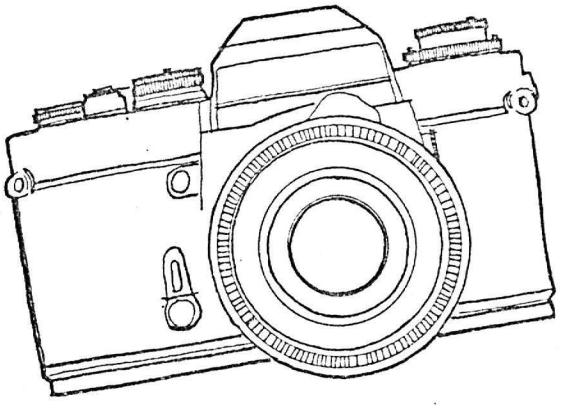


(G190) Perspective distortion in BIBLE

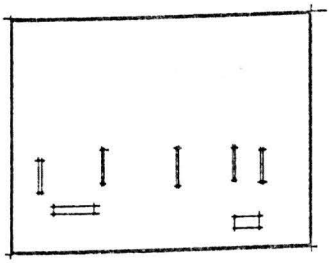
Horizontal camera tilt (exaggerated case)

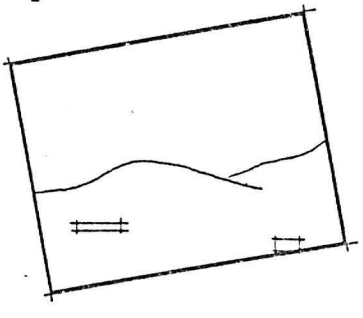


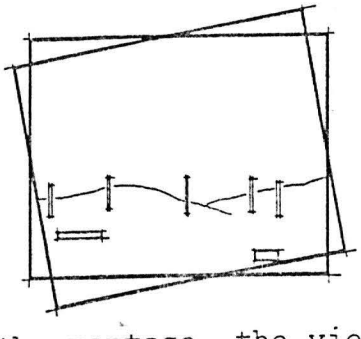
CAD perspective - level;
two control points included



Photograph at same angle as camera tilt; includes two control points in scene.

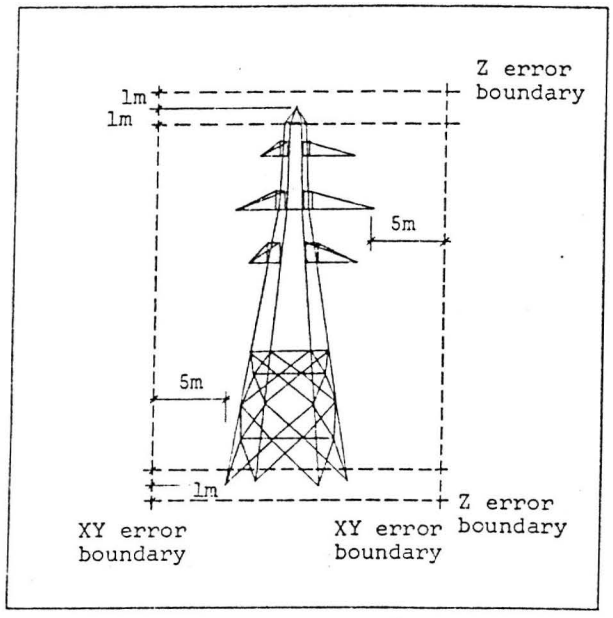






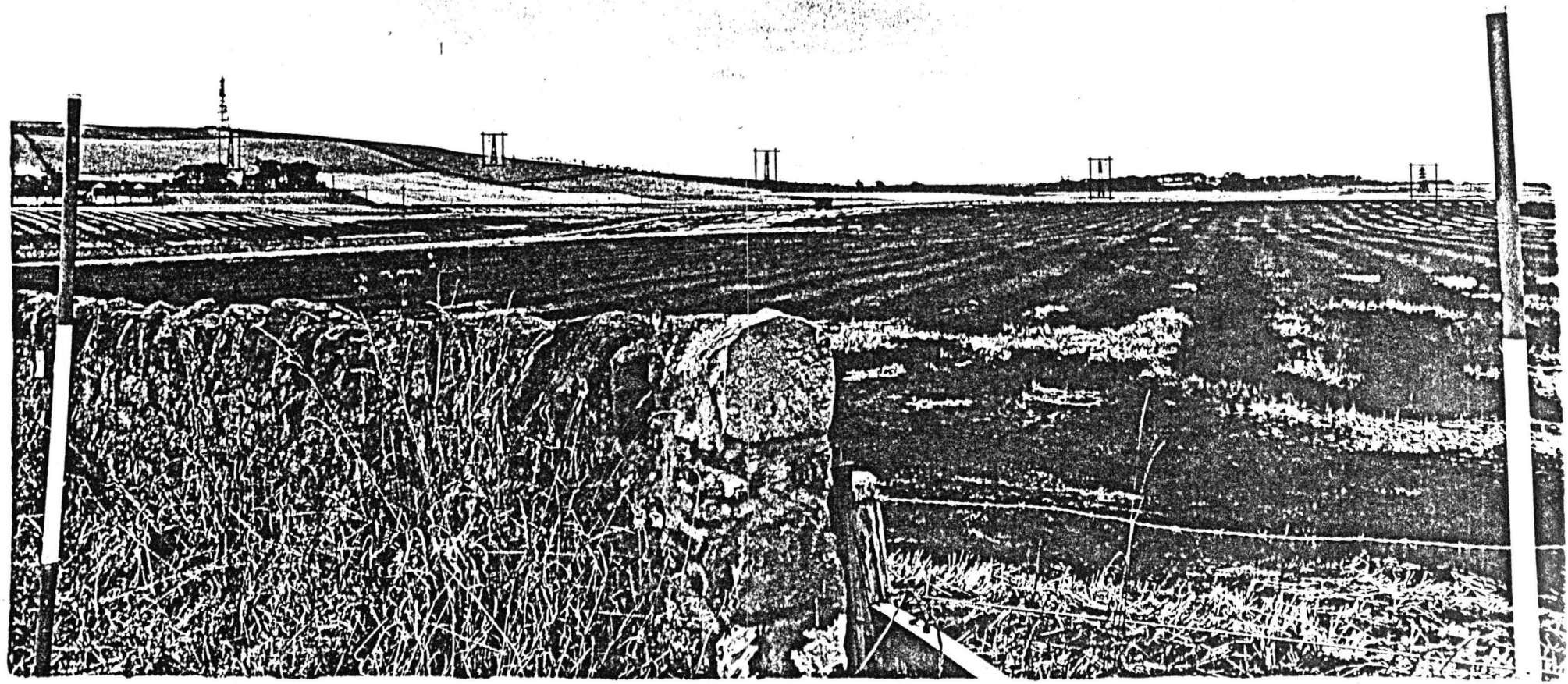
In the montage, the views will match, but the photograph will be at an angle.

(G191) The effect of horizontal camera tilt on montaging



The expected positional inaccuracy of the pylons due to the method of map interpolation can be represented as above. On overlay (c), for each view, the pylons are shown with a rectangle around them. This rectangle represents the maximum predictable locational error in X,Y and Z.

(G192) Boundaries of maximum expected error in montaging using BIBLE. - see (G193) to (G196).



VIEW 1

OVERLAY c

(6193)

Boundaries of predicted error in pylon location

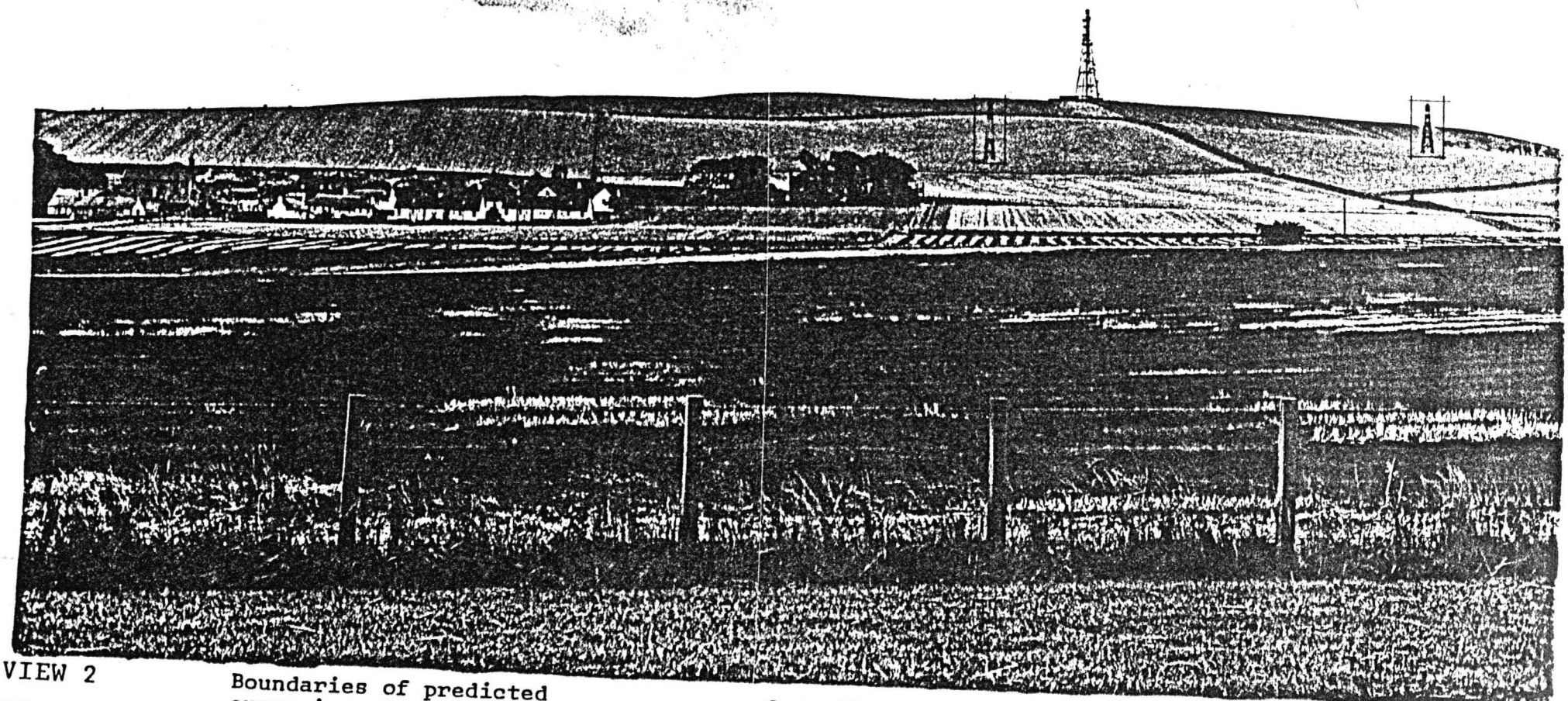
Control Points : Cottage roof near Thurston Gardens

: North West corner of Temple Mains Farmhouse

Pylons visible : 123 : 126

: 124 : 127

: 125



VIEW 2

OVERLAY C

(G194)

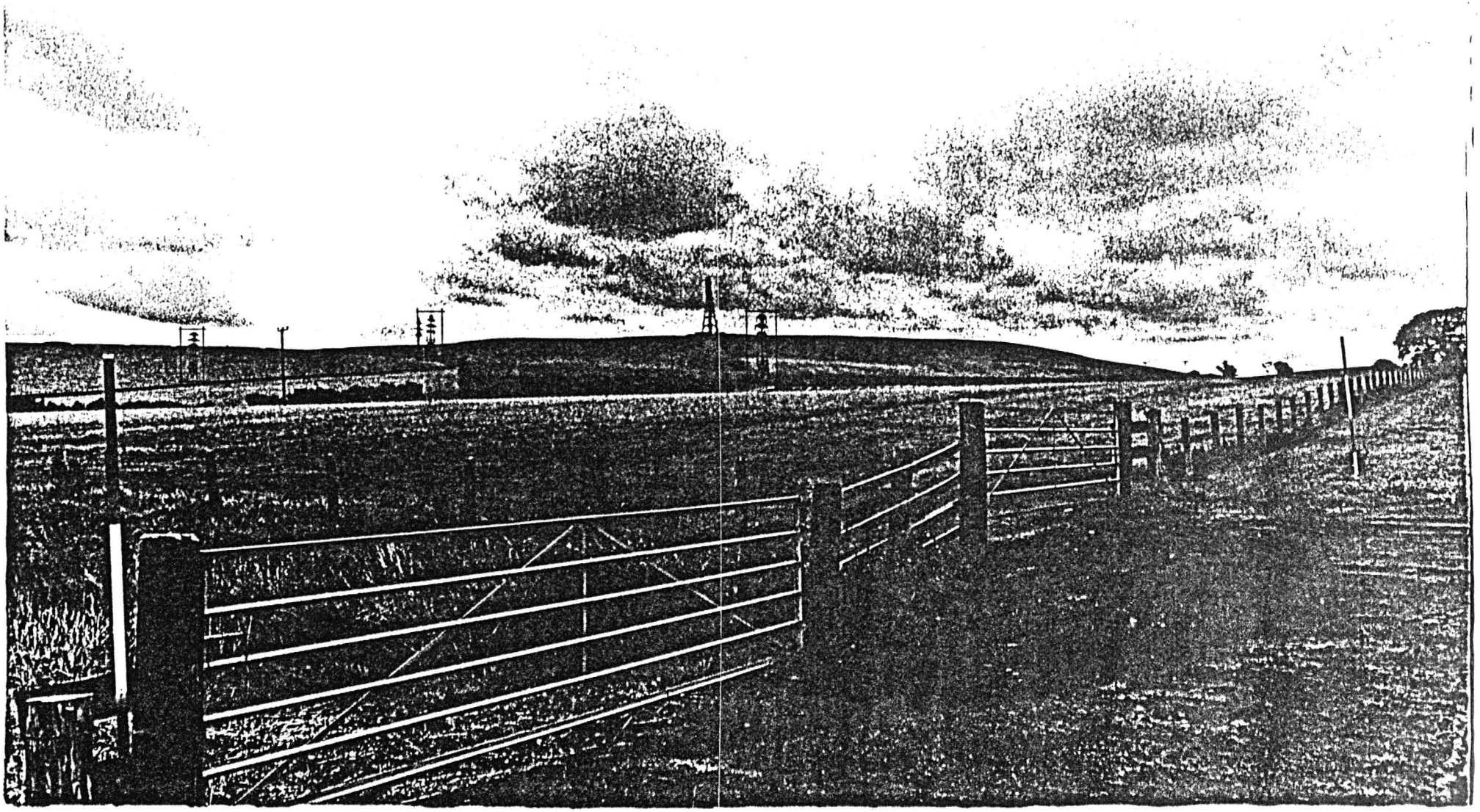
Boundaries of predicted error in pylon location

Control Points : North West corner of Temple Mains Farmhouse

: North West corner of Innerwick Church

Pylons visible : 123

124



VIEW 3

OVERLAY c

(G195)

Boundaries of predicted error in pylon location

Control Point : Blackcastle Hill Mast

Pylons visible : 123
: 124
: 125

VIEW 4

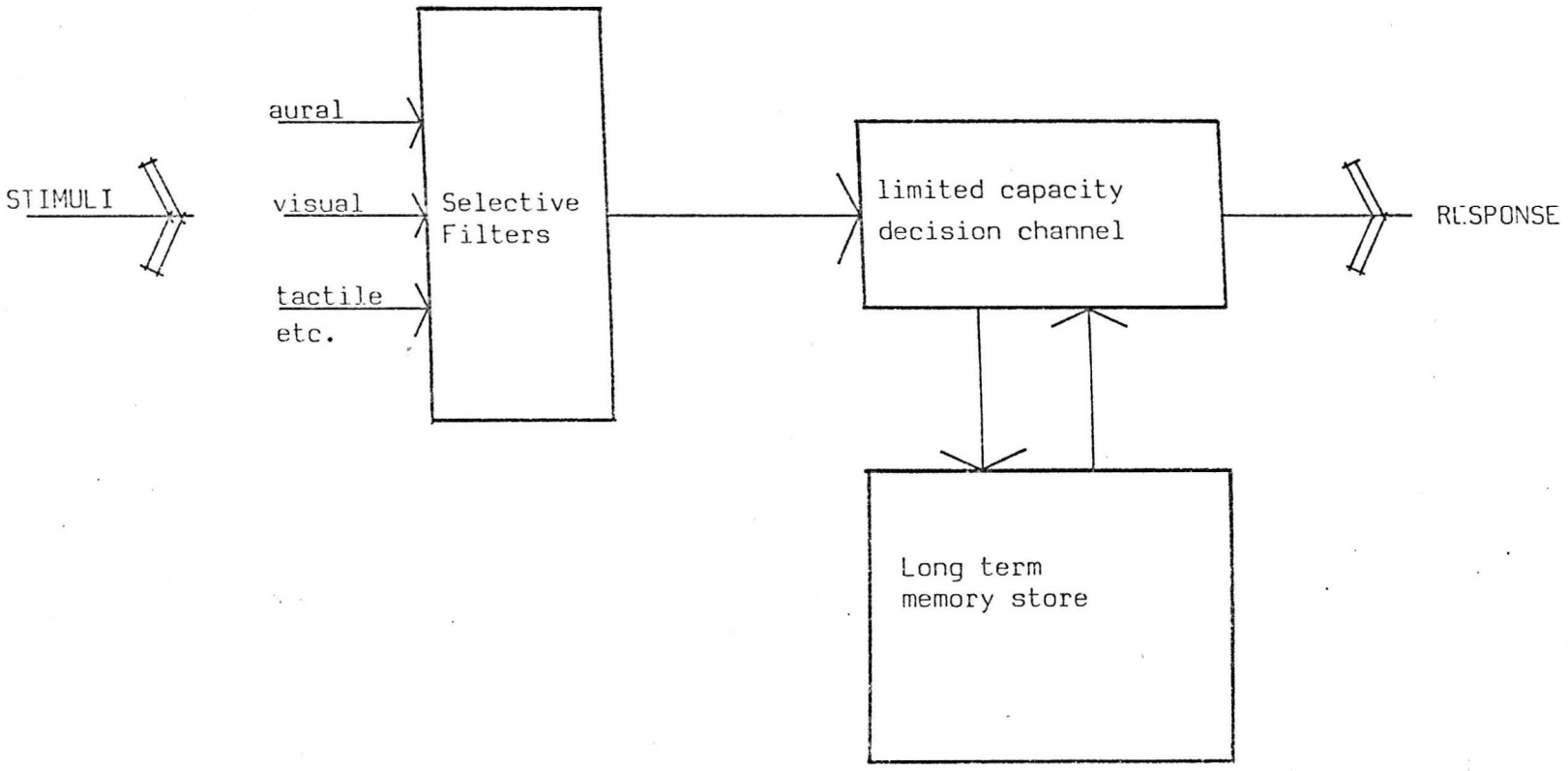
OVERLAY c

(6196)

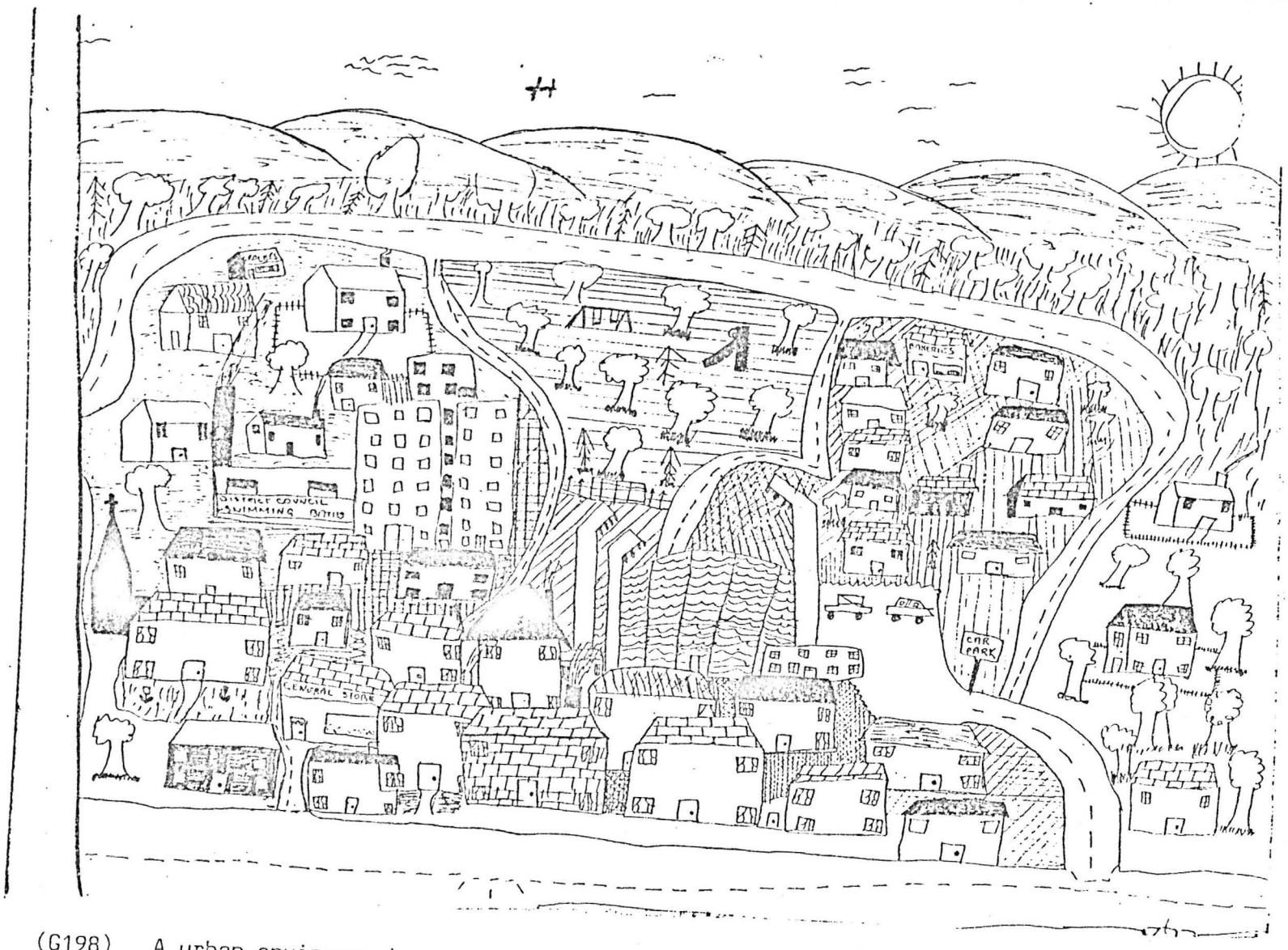
Boundaries of predicted error in pylon location

Pylons visible : 123
: 124
: 125
: 126
: 127

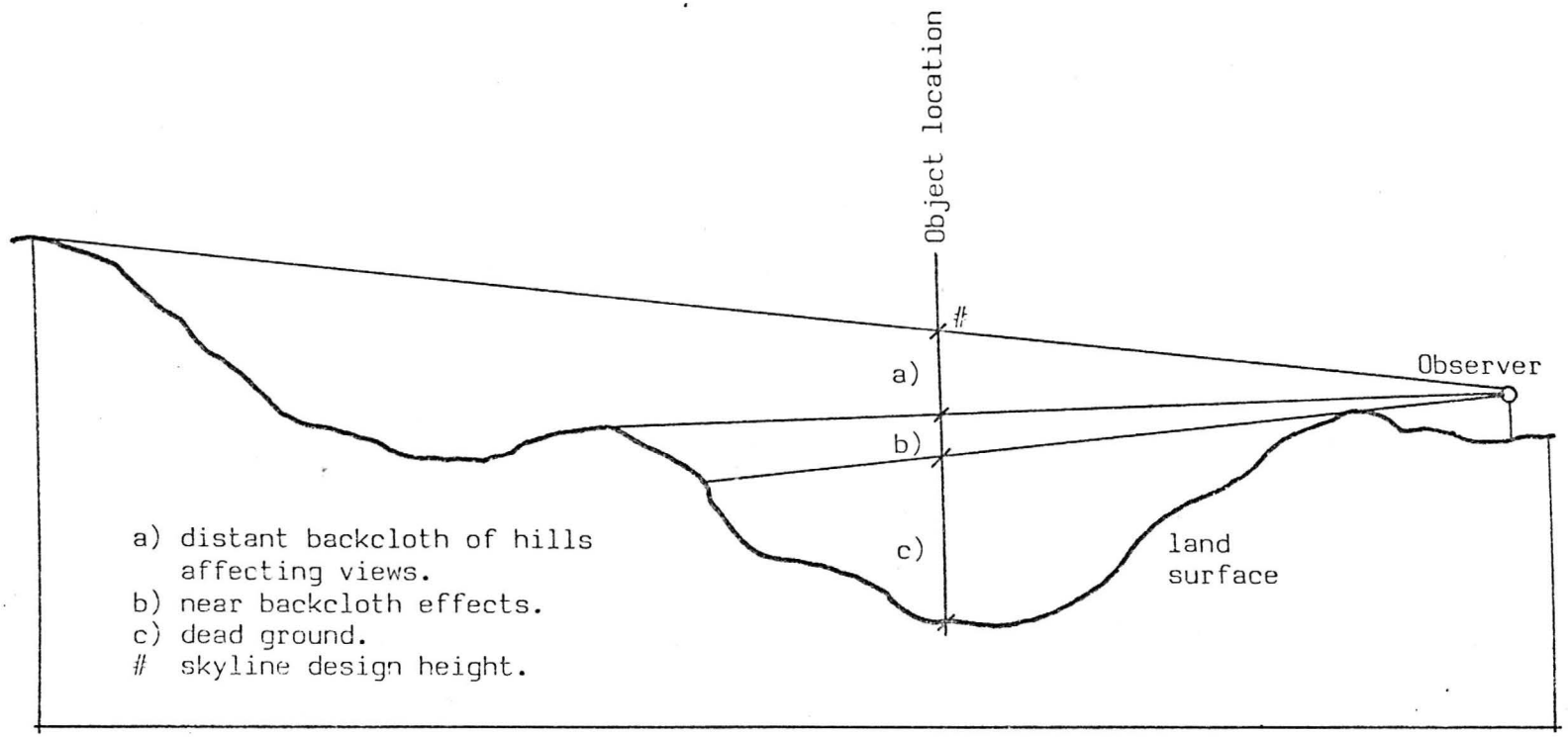
CHAPTER 5



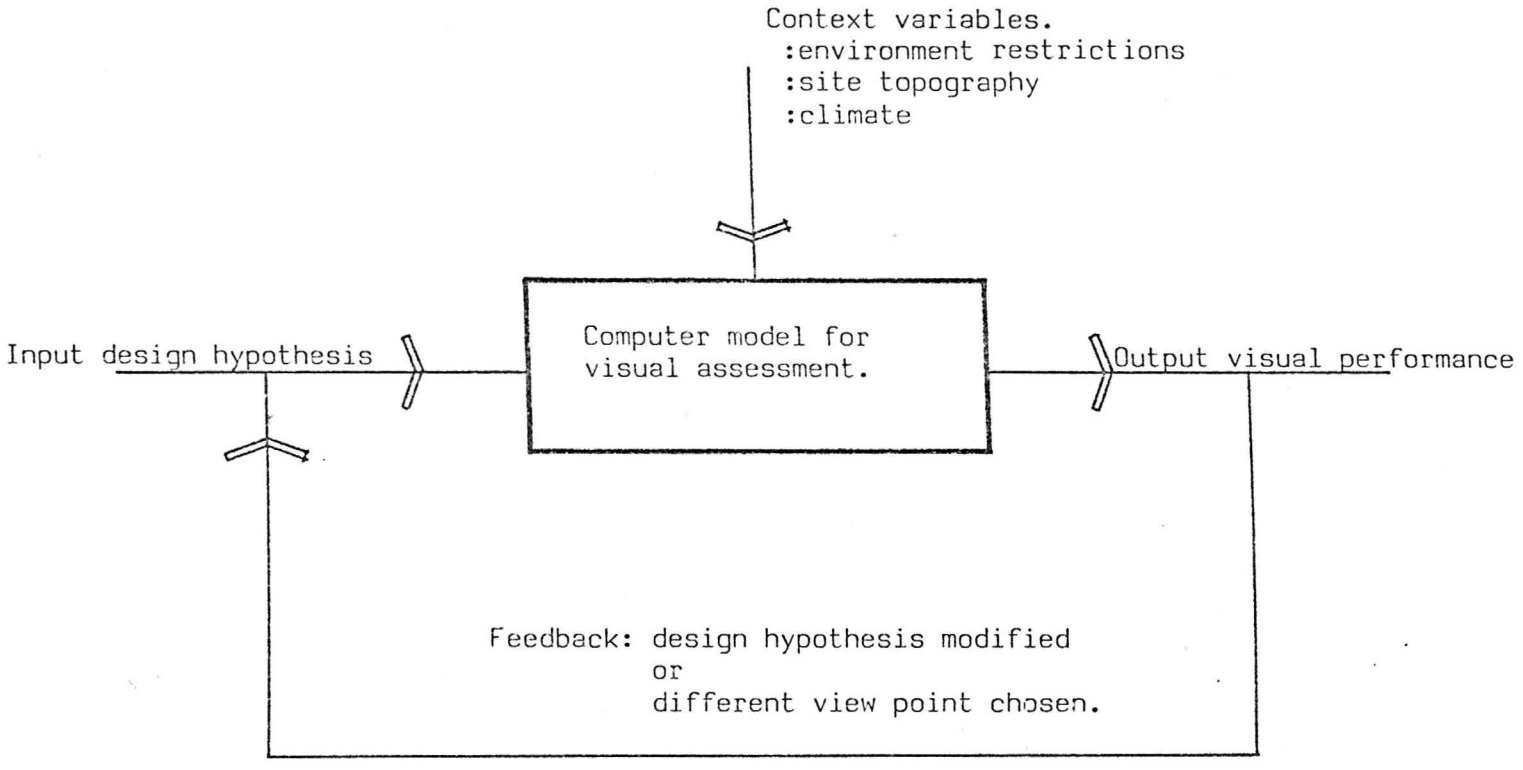
(G197) The process of perception. (HABE68)



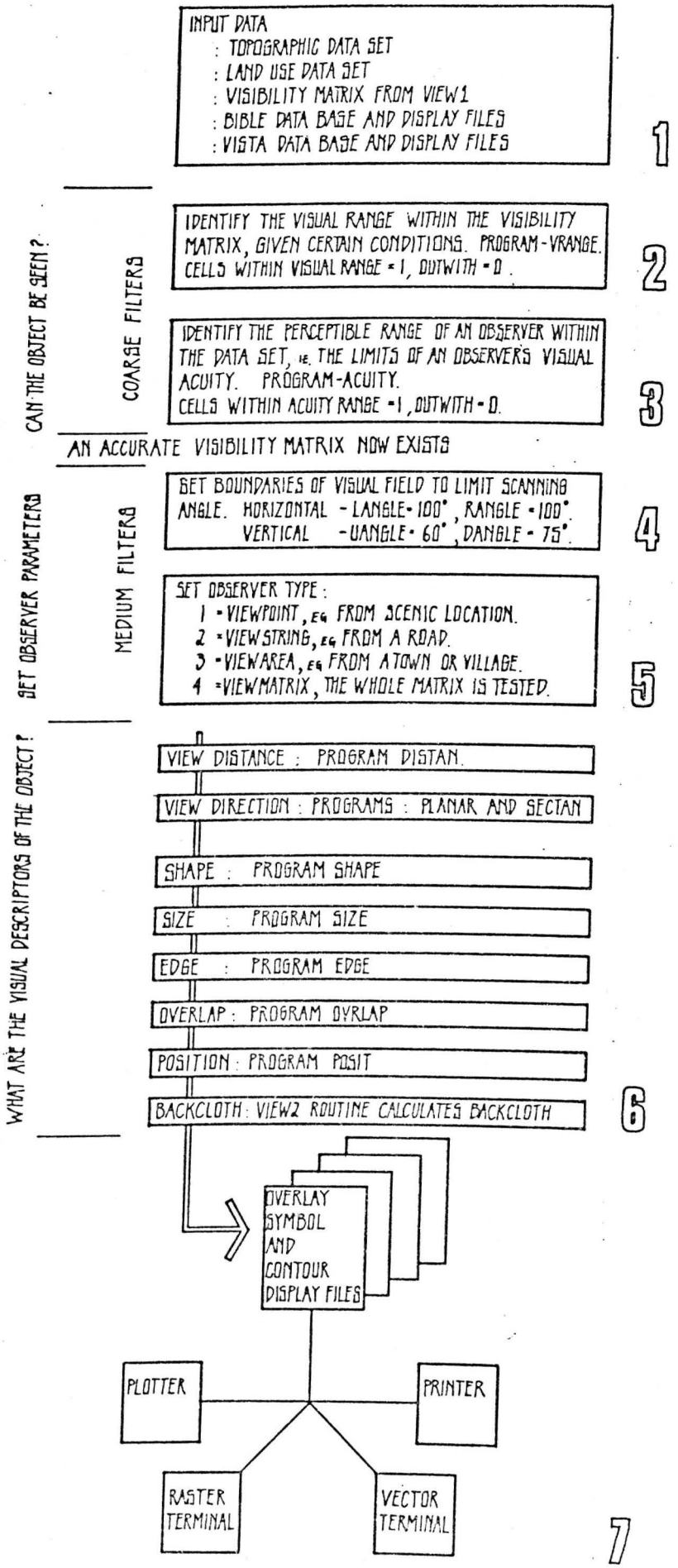
(G198) A urban environment as seen by a child. The emphasis is on edges and well defined shapes.



(G199) Skyline design space.

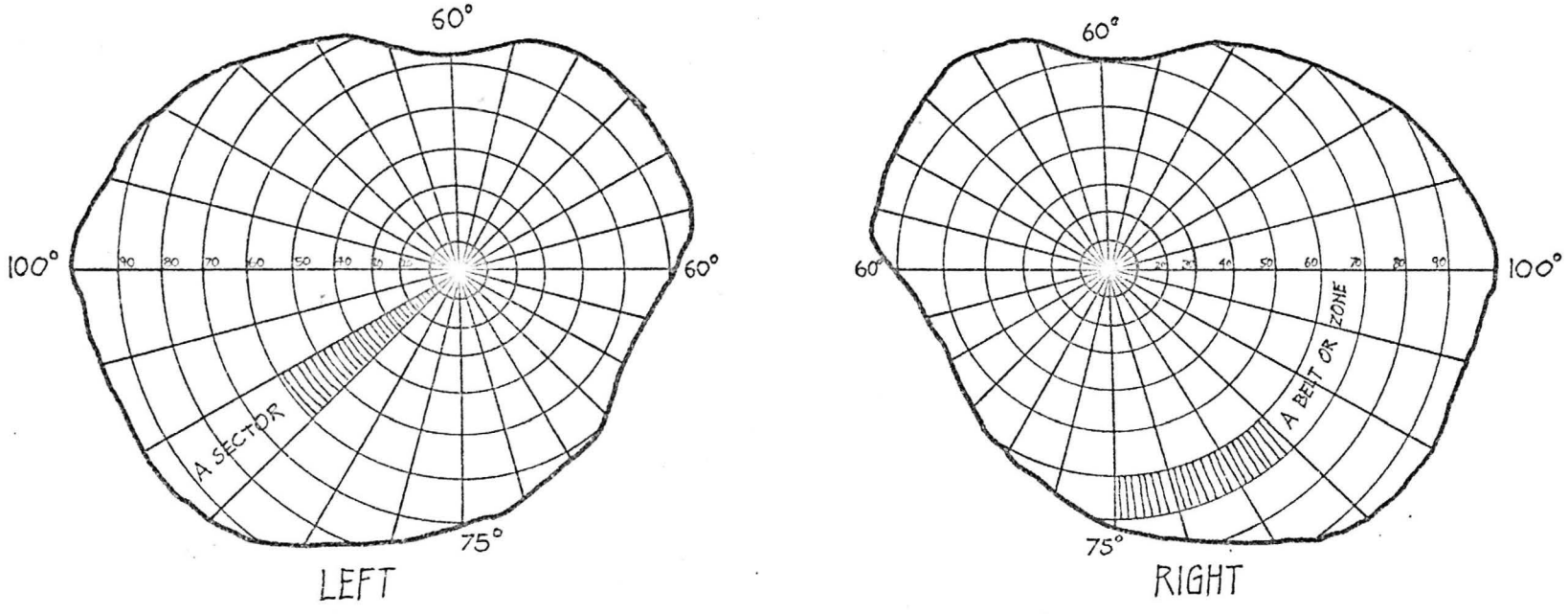


(G200) General structure of modelling procedure in visual impact assessment, relating the interest object, the context environment and desired observer locations.



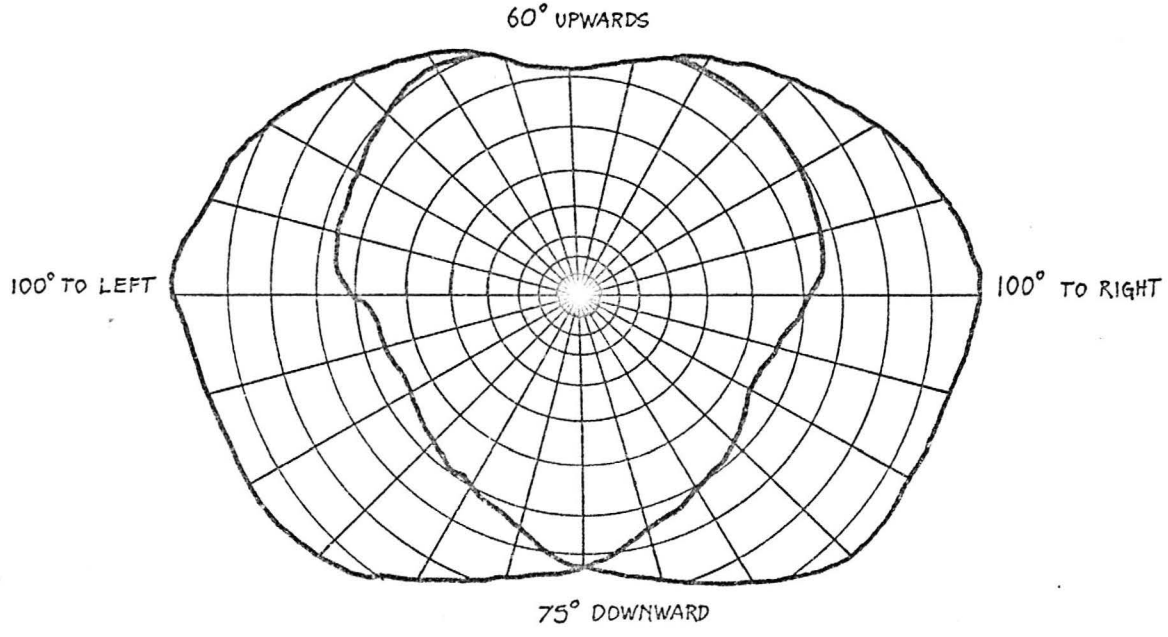
(G201) Outline structure of the program suite VIDERE.

(G202) The input data to VIDERE.



MONOCULAR HUMAN VISUAL FIELDS

(G203) The right and left monocular visual fields.



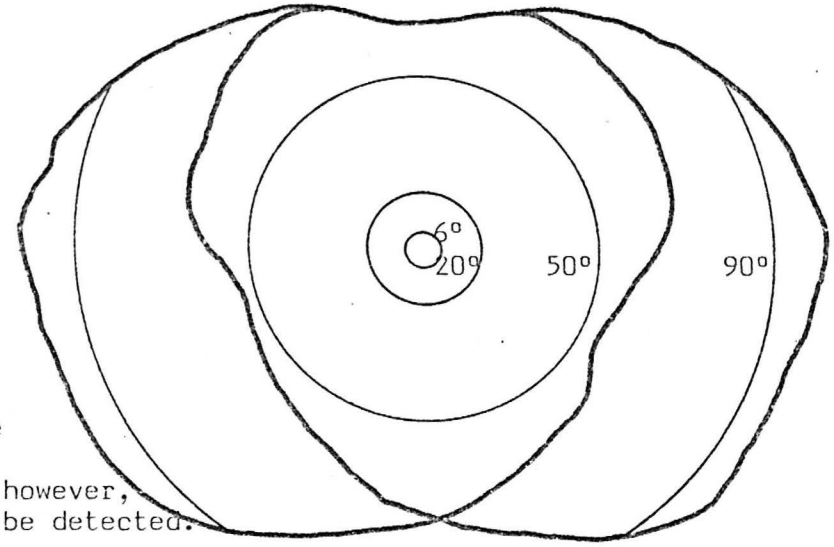
(G204) The binocular visual field.

0° - 6°
concentrated acuity.

6° - 20°
central cone of visual sensitivity.

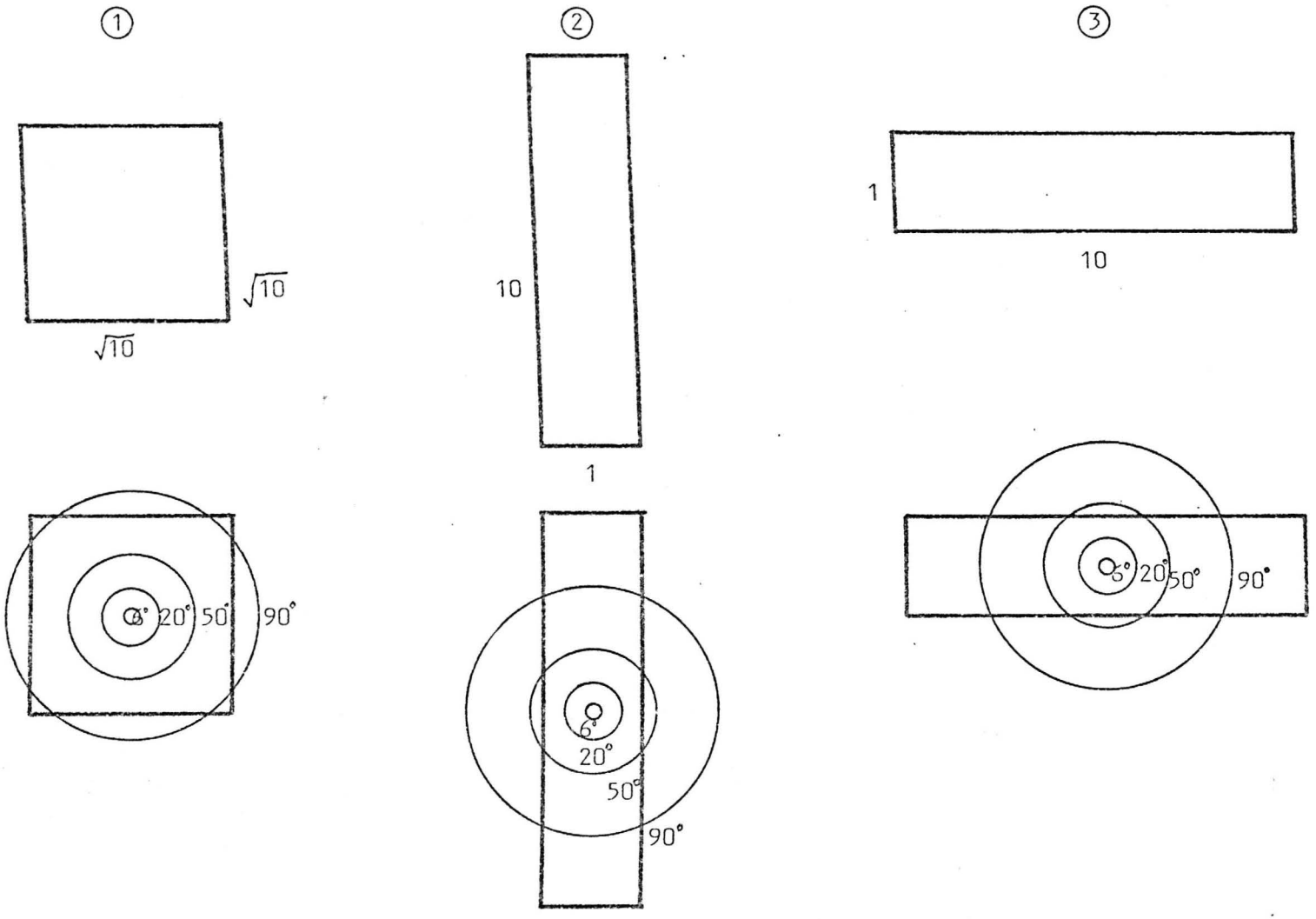
20° - 50°
objects in this cone begin to become blurred.

50° - 90° and over.
objects in this area are seen by only one eye. Discrimination is poor, however, movement and change can be detected.

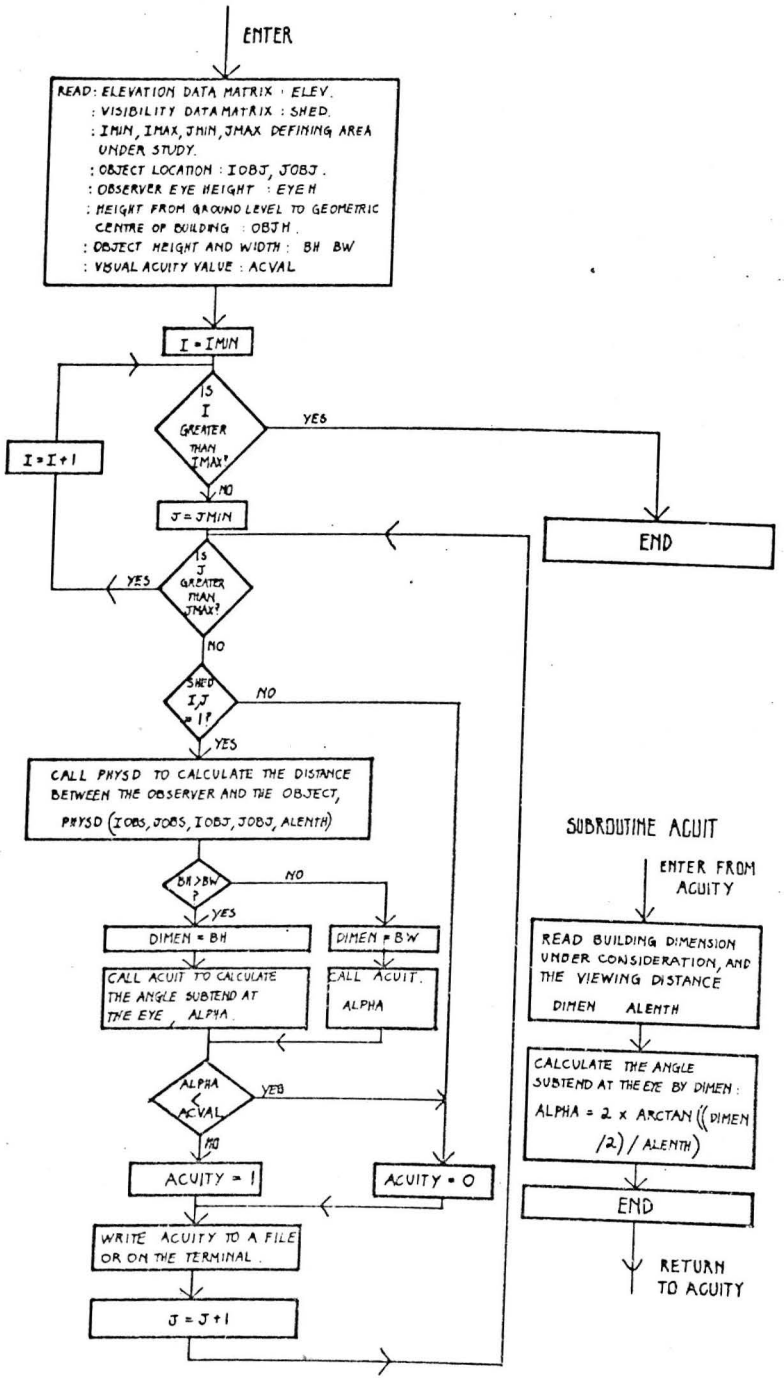


The sensitivity of the visual field is not uniform throughout. Gibson describes this variation as central to peripheral gradient of clarity, in which the lowest thresholds of perception are obtained in the periphery of the retina. The idea of concentric circles and a position factor in the visual field are detailed in (HOPK71).

(G205) Concentric cones of visual attention in the visual field.



(G206) The importance of position factor weighting.



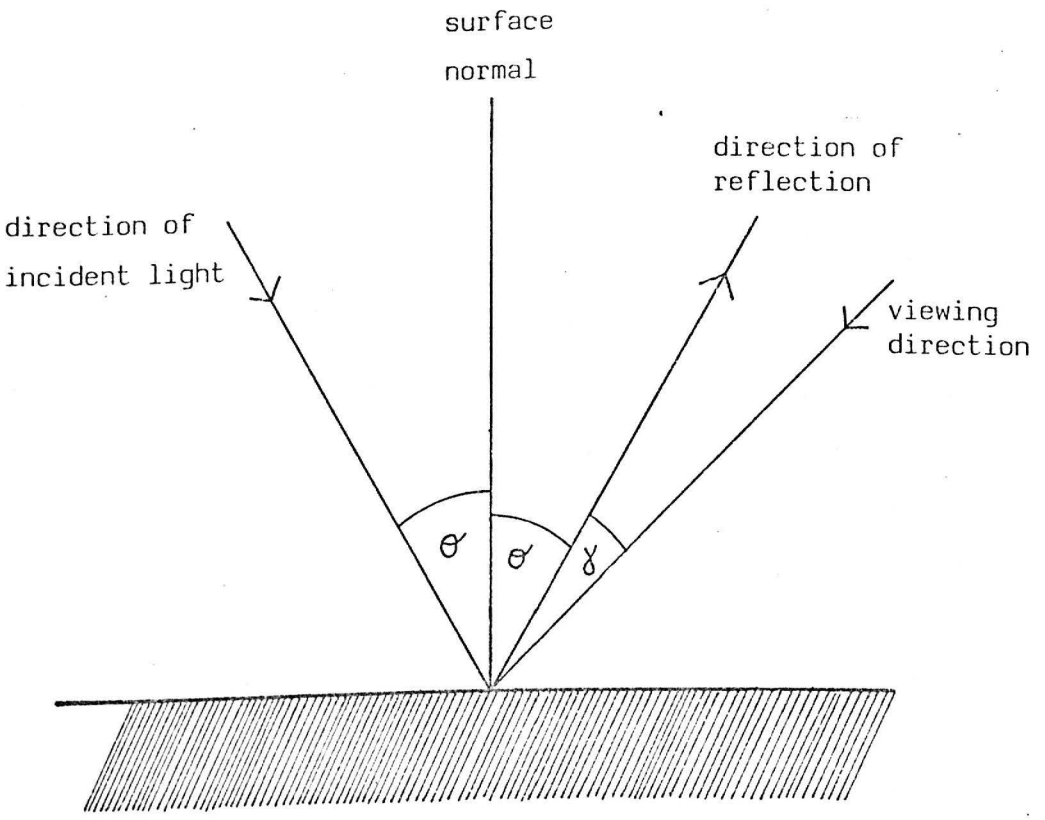
(G207) Algorithm flow shart - program ACUITY.

	BRE average sky: sun illuminance, normal to a surface. (in lumens/m^2 or lux)
January	17883
February	21834
March	25785
April	27177
May	28569
June	29962
July	28659
August	27357
September	26055
October	22013
November	17973
December	13933

(G208) Monthly sun illuminance values, normal to a surface.

	BRE average sky: sky illuminance in lumens/m^2 or lux.
January	14617
February	20053
March	25489
April	28960
May	32431
June	35902
July	32594
August	29286
September	25978
October	20379
November	14780
December	9182

(G209) Monthly sky illuminance values.



θ = angle of incidence = angle of reflectance

γ = angle between the viewing direction and the angle of reflectance.

(G210) The geometry of surface reflectivity (STEA83)

Building element	
BRICK	
Outer leaf	0.30
Inner leaf	0.30
Vermiculite Insulating	0.30
CONCRETE	
Heavy Mix	0.35
Light mix	0.35
Aerated Concrete Block	0.35
Aerated Concrete	0.35
Refactory Insulating	0.35
Vermiculite Aggregate	0.35
METAL	
Copper	0.35
Aluminium	0.80
Steel	0.80
WOOD	
Block	0.35
Hardboard (Medium)	0.30
Hardboard (Standard)	0.30
Fir (20% moist)	0.35
Flooring	0.35
Cork Board	0.40
Chipboard	0.35
Weatherboard	0.35
Oak (Radial)	0.35
STONE	
Sandstone	0.40
Granite (Red)	0.45
Marble (White)	0.55
PLASTER	
Dense	0.50
Light	0.50
Gypsum Plasterboard	0.50
Perlite Plasterboard	0.40
Gypsum Plastering	0.50
Perlite Plastering	0.50
Vermiculite Plastering	0.50

Building element	
SCREEDS & RENDERS	
Lightweight Concrete	0.20
Cast Concrete	0.35
Granolithic	0.35
White Render	0.50
TILES	
Clay	0.40
Concrete	0.35
Slate	0.15
Plastic	0.60
Rubber	0.18
Cork	0.40
Asphalt/asbestos	0.30
P.V.C./Asbestos	0.40
ASPHALT + BITUMEN	
Asphalt	0.10
Bitumen Felt	0.10
Roofing Felt	0.10
Asphalt Mastic Roofing	0.10
ASBESTOS	
Cement	0.40
Cement sheet	0.40
INSULATING MATERIAL	
Fibreboard	0.50
Woodwool	0.50
Glasswool	0.70
Urea Formaldehyde Foam	0.50
Thermalite	0.30
Polyurethane Foam Board	0.50
Siporex	0.60
P.V.C.	0.40
Polystyrene	0.70
Hard Rubber	0.80
Cratherm Board	0.50
Silcon	0.40

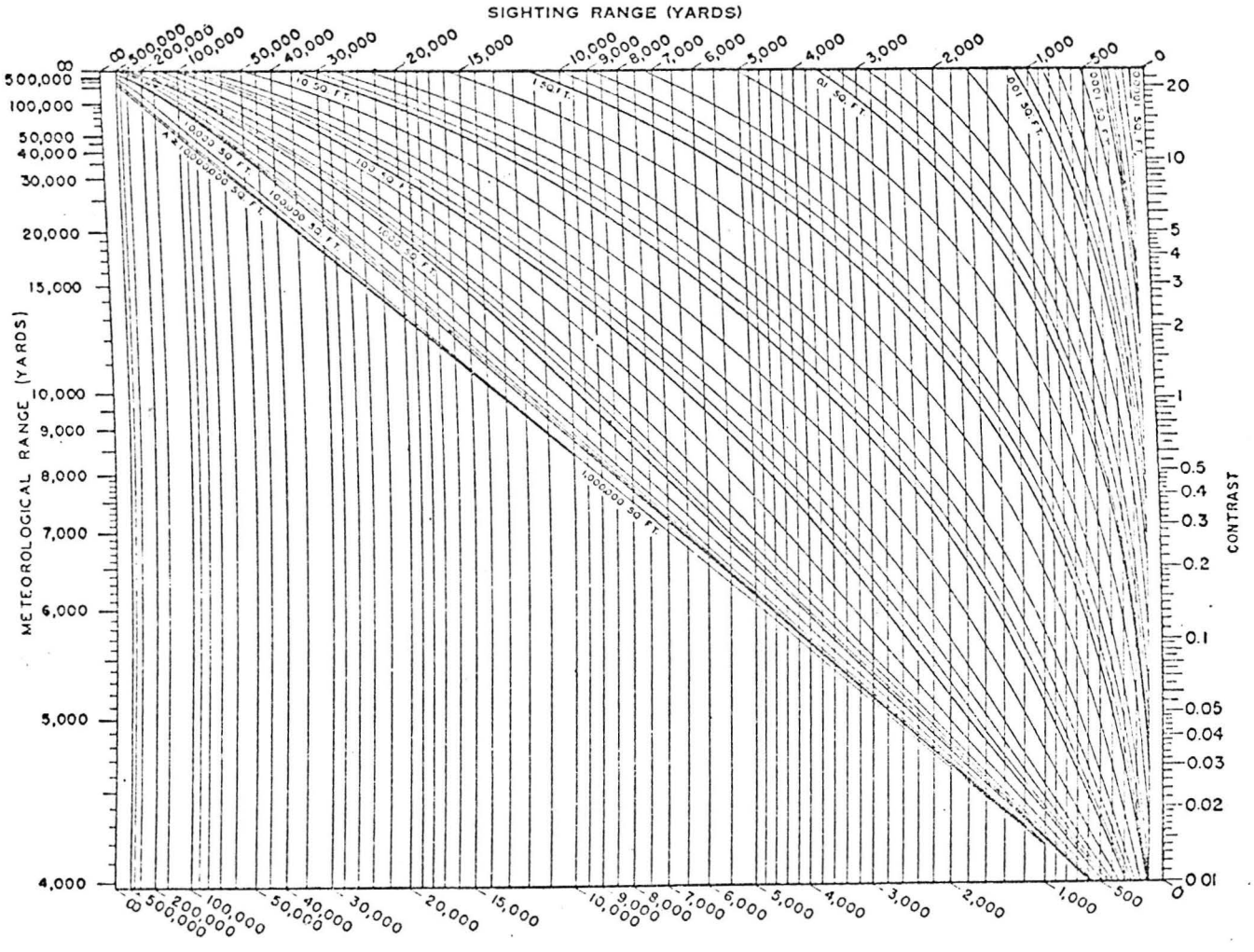
Landscape Element	
grass/earth	0.20
distant landscape hillside	0.25
extensive wood on hillside	0.04
desert	0.40

(G211) Surface reflectance values for building materials and landscape surfaces. (CLAR83).

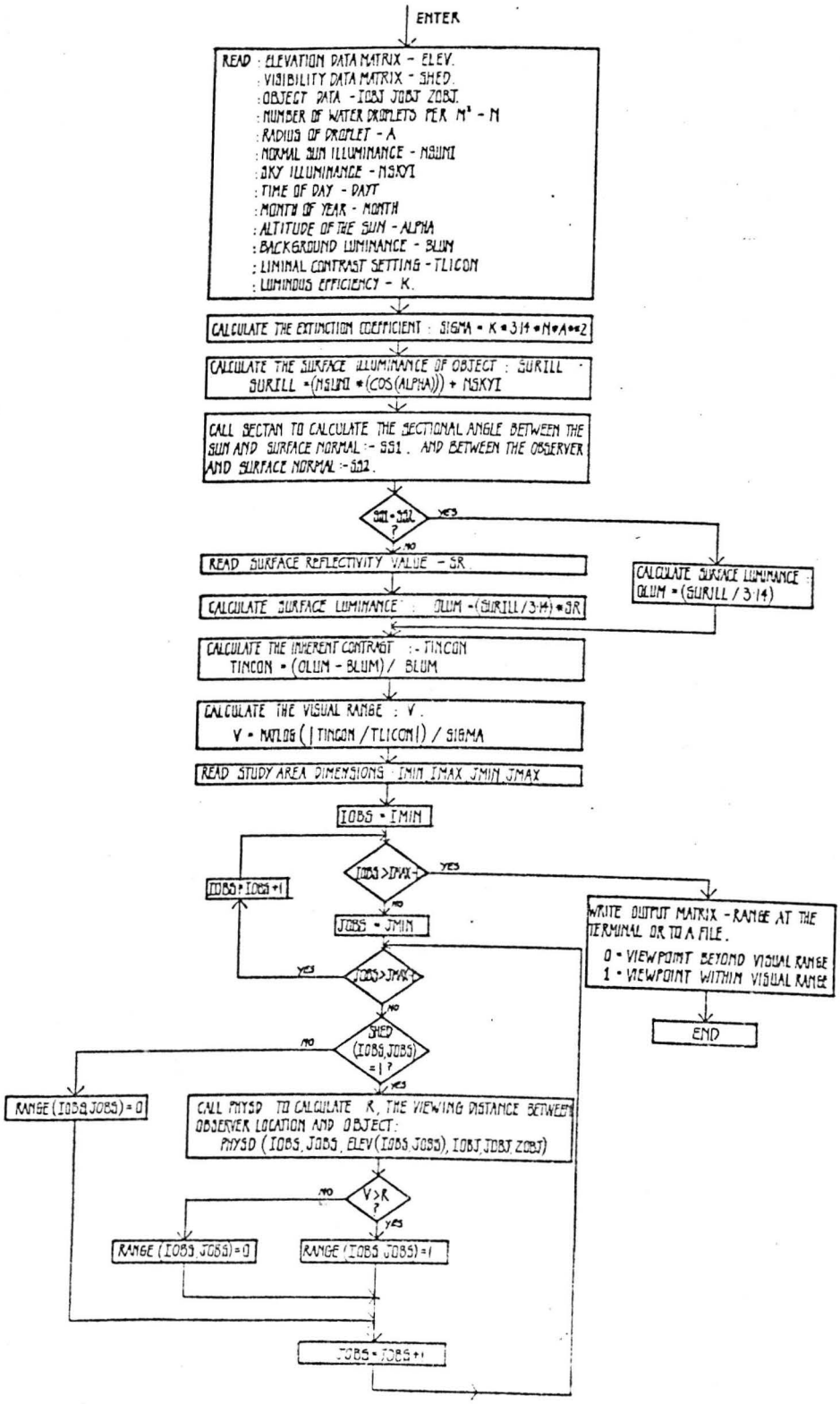
	BRE average sky: luminance of sky in candelas/m^2 or apostilbs
January	2131
February	3045
March	3959
April	4622
May	5286
June	5949
July	5345
August	4682
September	4048
October	3104
November	2161
December	1218

Sky Element (near the horizon)	Luminance measured in apostilbs.
Clear day	10000
Overcast day	1000
Heavily overcast day	100
Sunset on overcast day	10
Quarter hour after sunset; clear	1
Half hour after sunset, clear	0.1
Fairly bright moonlight	0.01
Moonless, clear night sky	0.001
Moonless, overcast night sky	0.0001

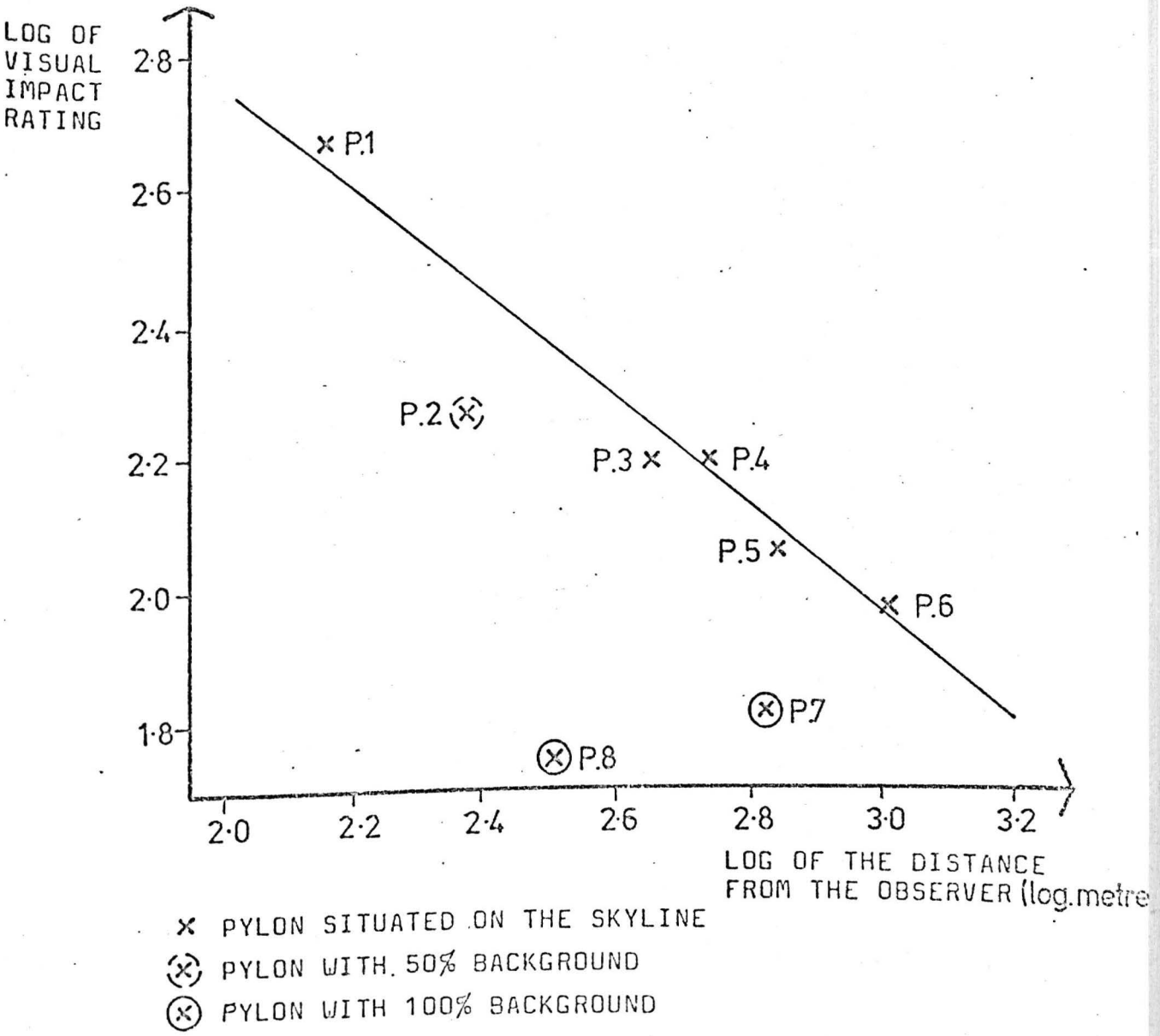
(G212) Sky luminance values.
top: monthly values using an average sky.
bottom: weather and lighting variations.



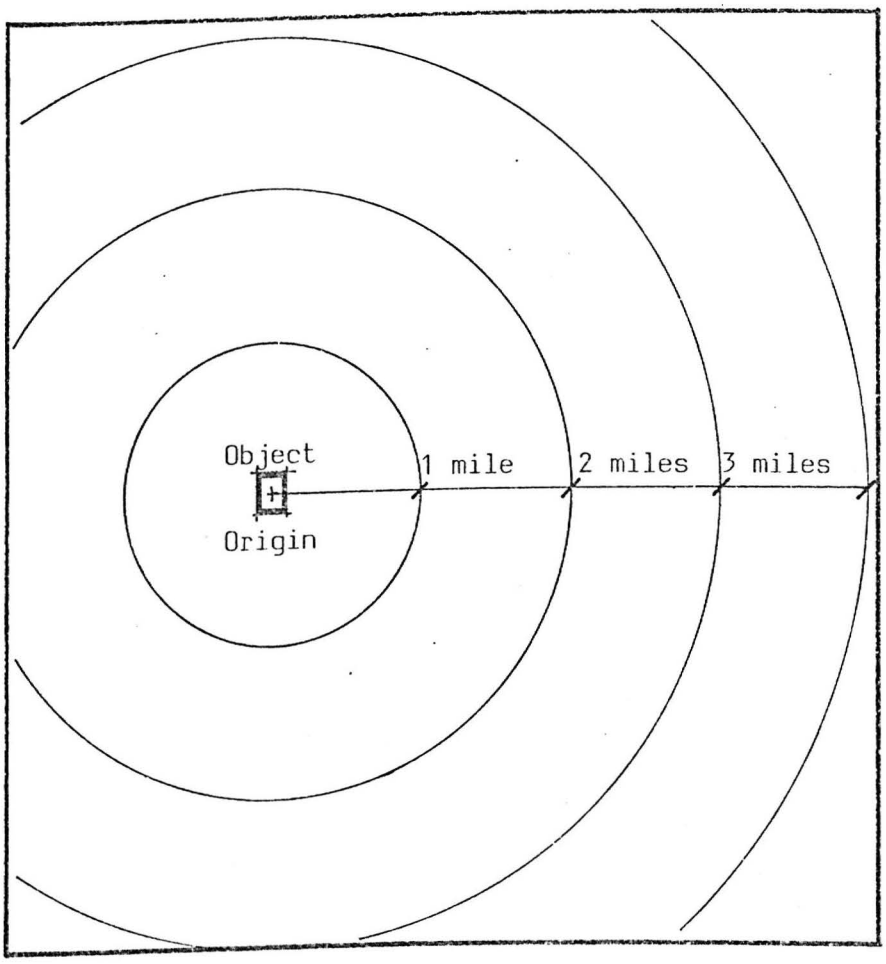
(G213) Visual range nomogram for full daylight conditions. (DUNT48).



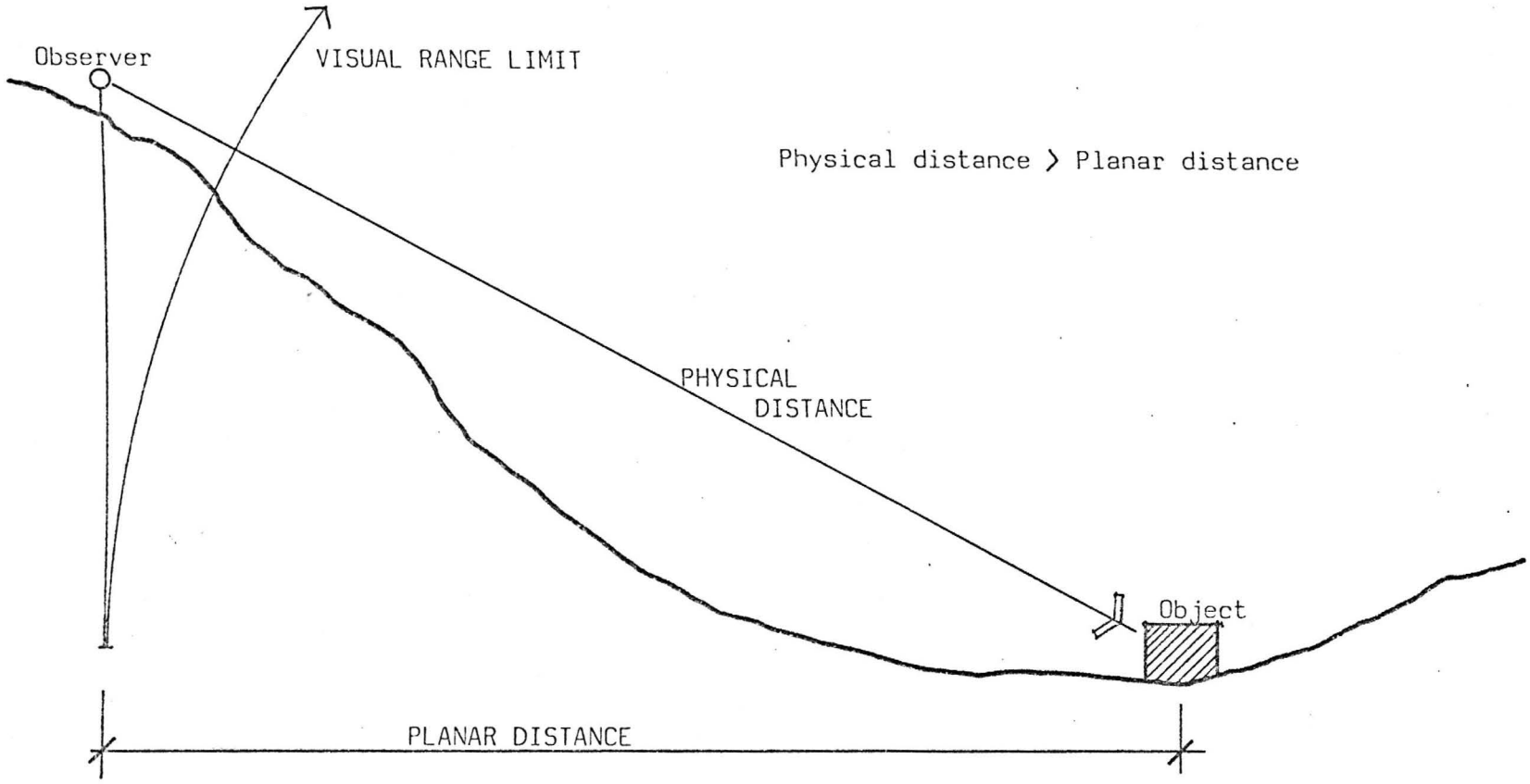
(G214) Algorithm flow chart - program VRANGE.



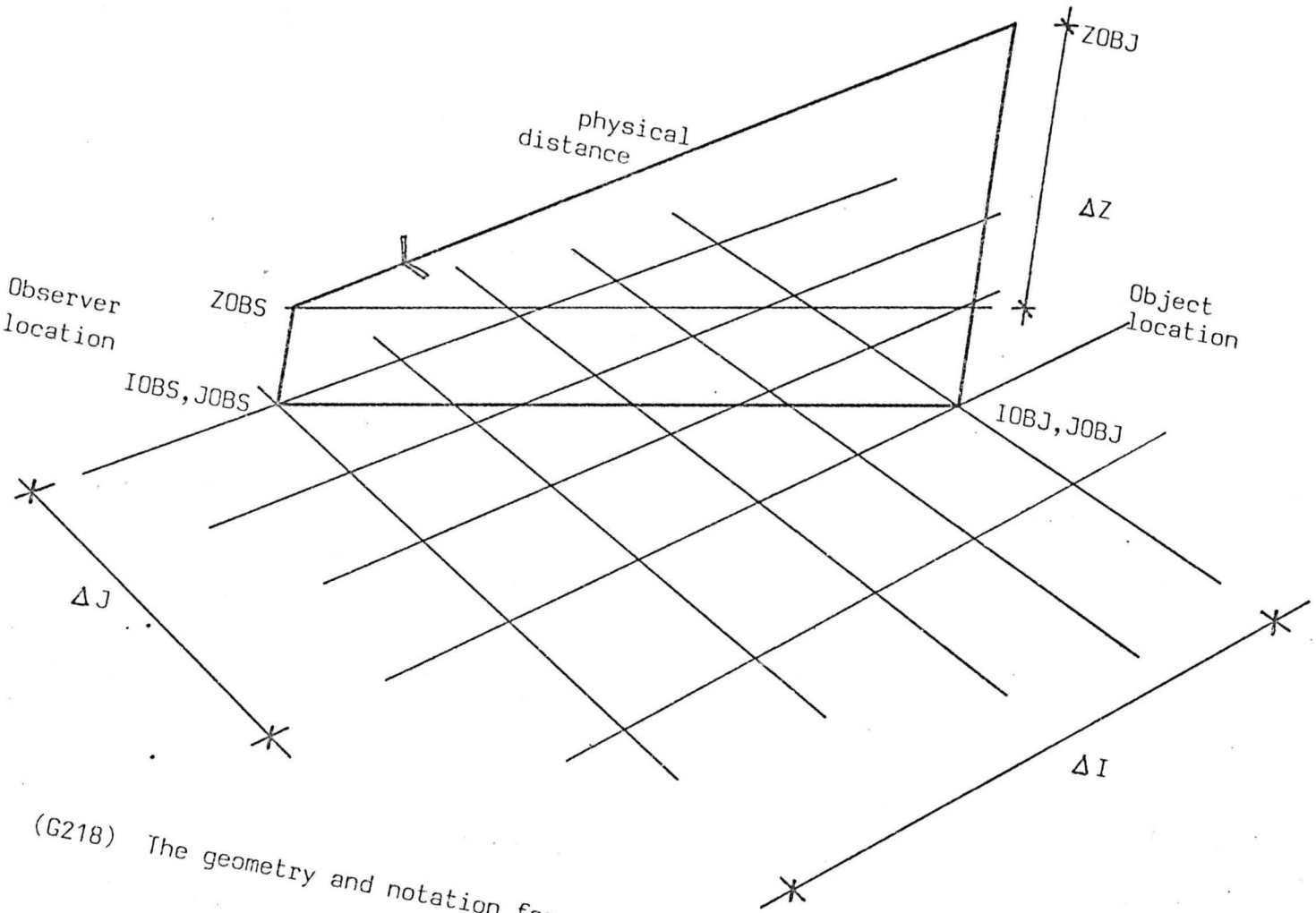
(G215) Graph depicting the relationship between the visual impact rating of a pylon and the distance of the pylon from the observer. (JOHN83) p 12.



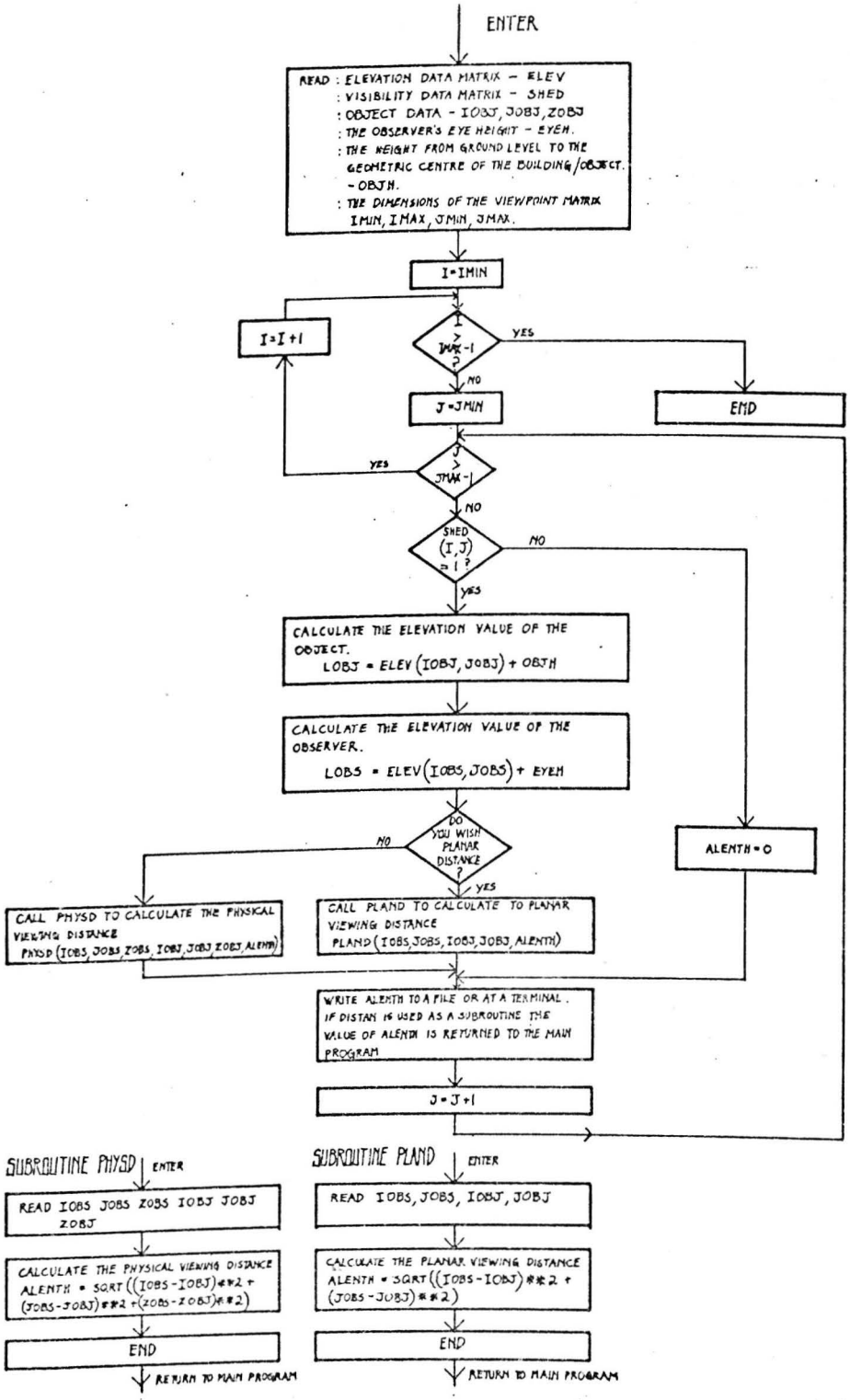
(G216) Viewing distance - traditionally measured in plan from the object site and represented as concentric circles.



(G217) Visual range and the measurement of viewing distance by the planar or physical method.

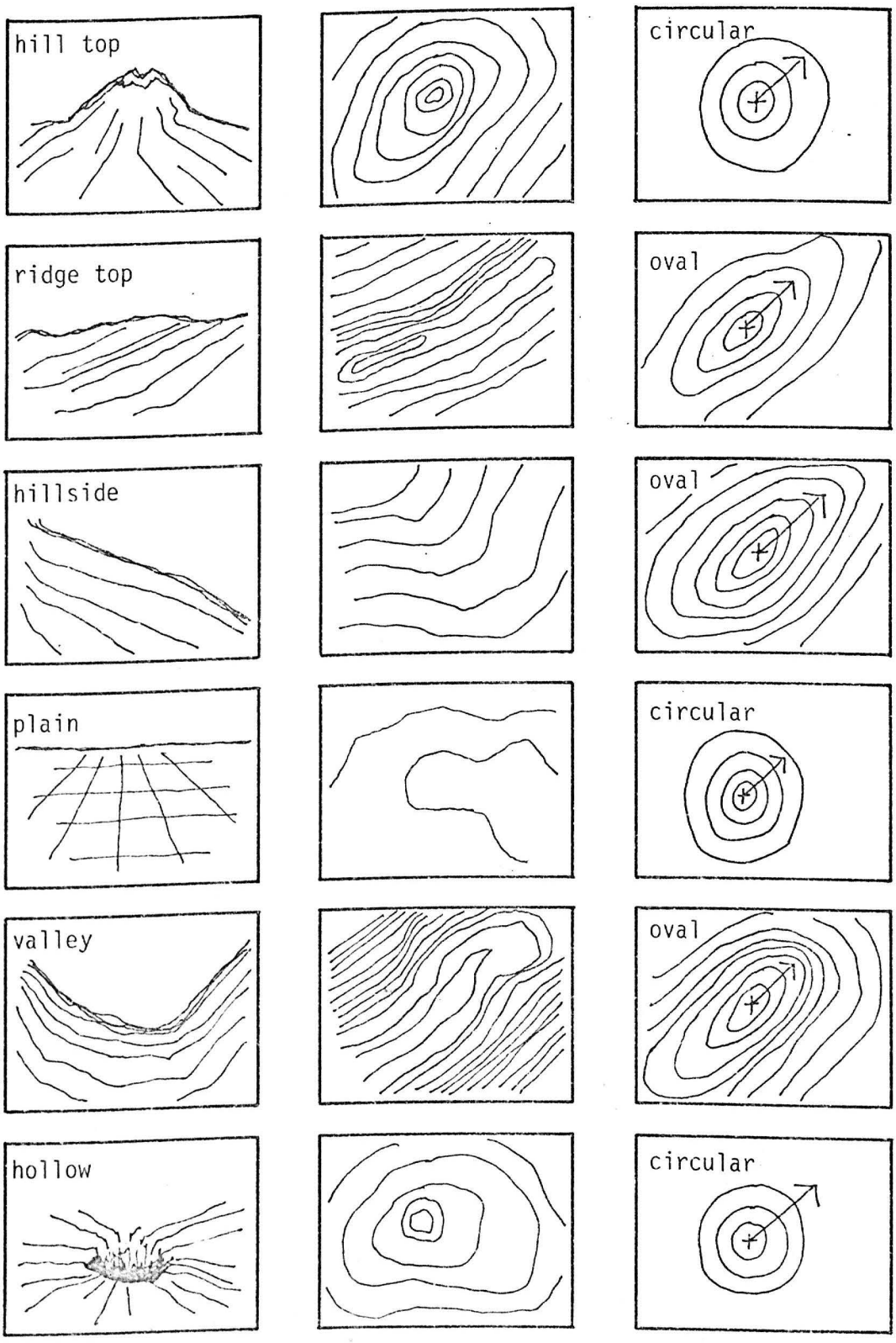


(G218) The geometry and notation for measuring physical distance.

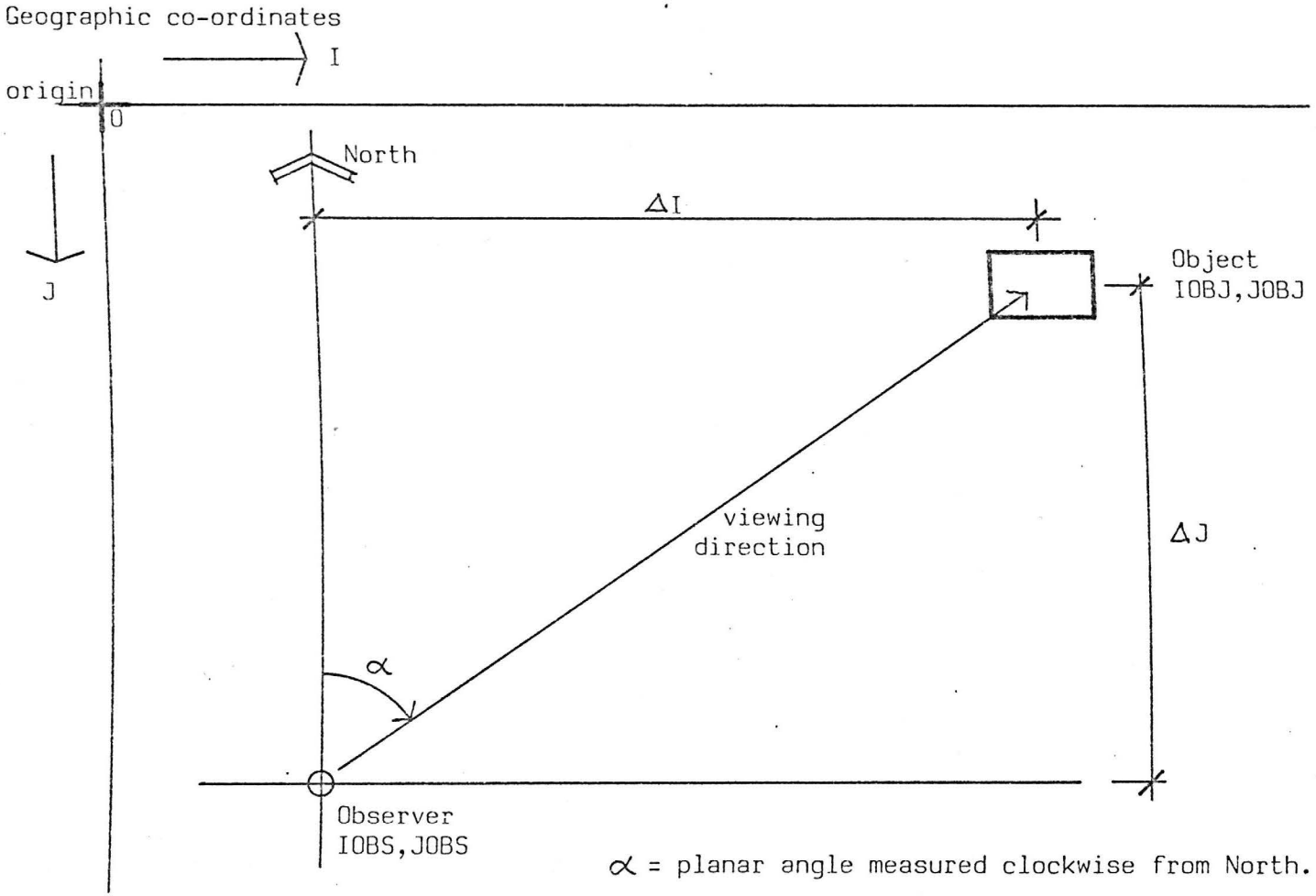


(G219) Algorithm flow chart - program DISTAN. with subroutines PLAND and PHYSD.

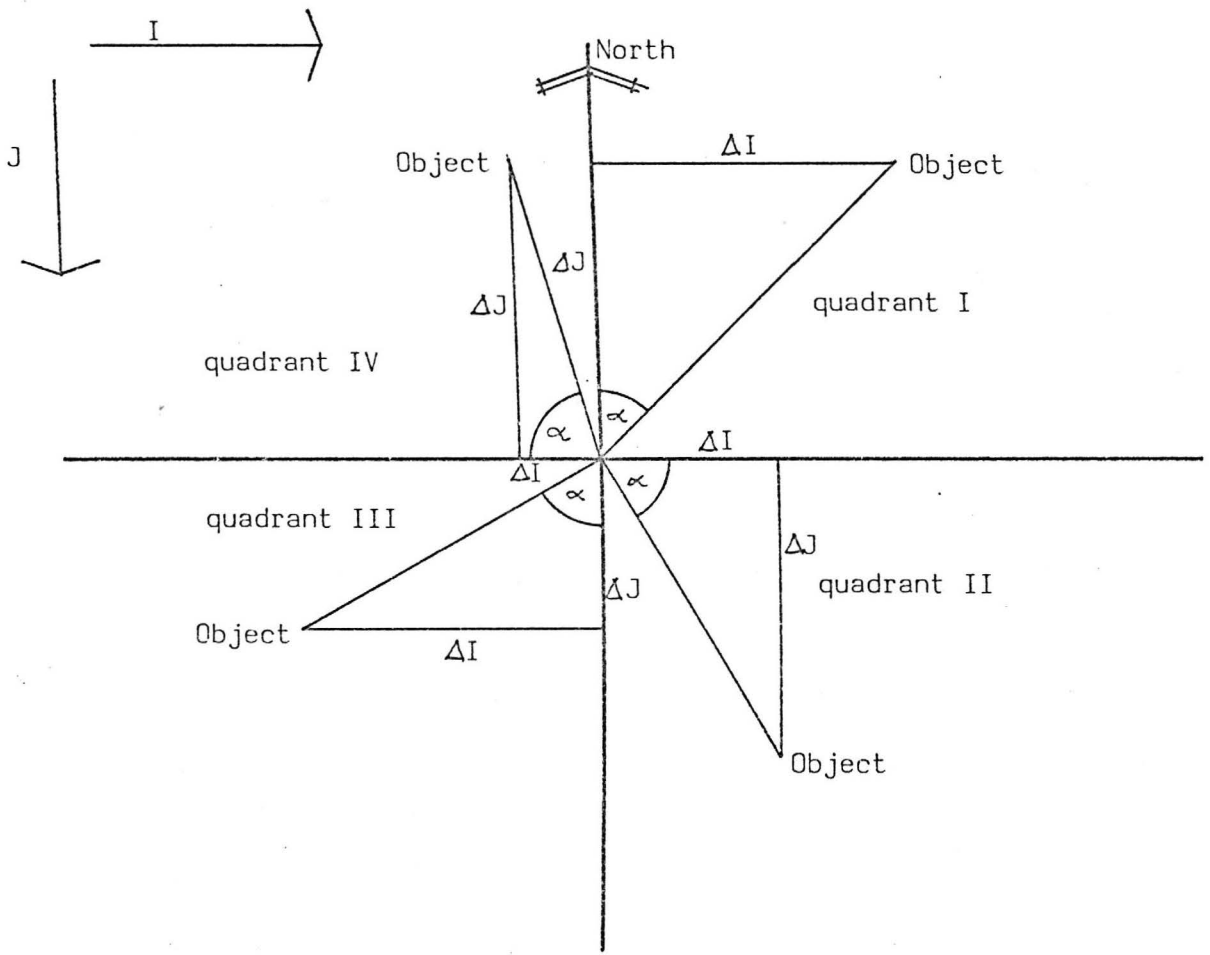
LANDFORM CLASSIFICATION	ELEVATION CONTOUR MAP	HYPOTHESISED PHYSICAL DISTANCE CONTOUR MAP
hill top		circular
ridge top		oval
hillside		oval
plain		circular
valley		oval
hollow		circular



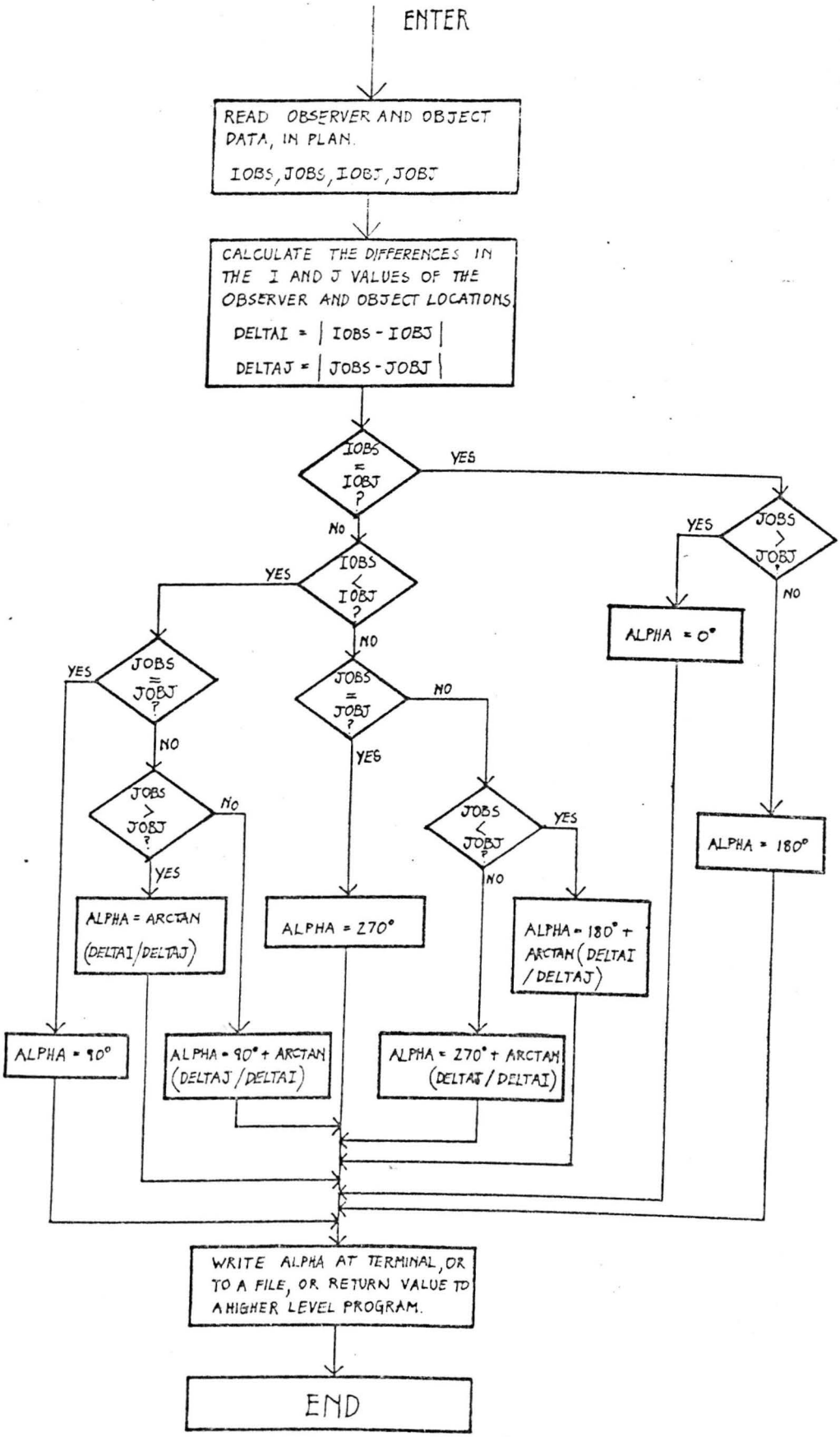
(C220) Hypothesised maps of physical distance for various terrain types.



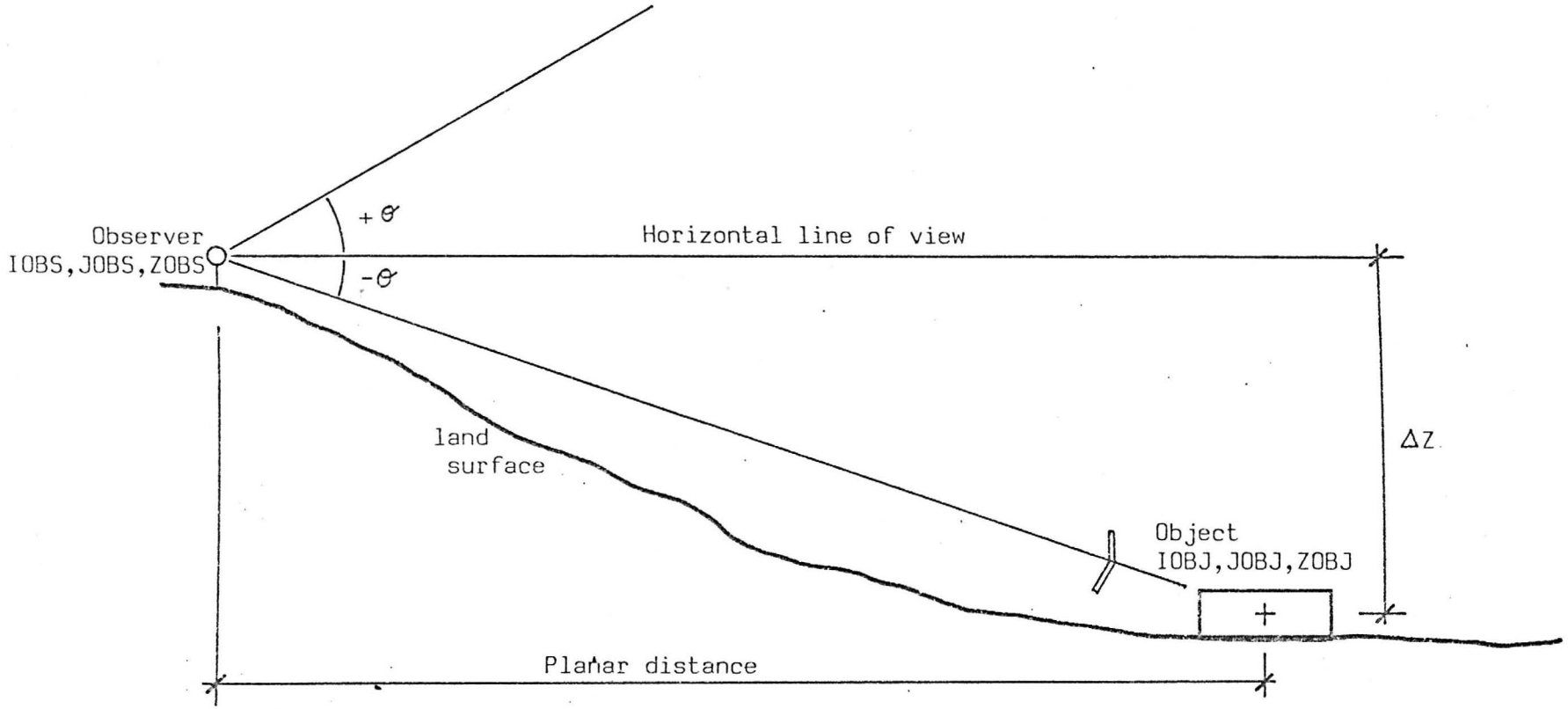
(G221) Planar angle : geometry and notation.



(G222) The value of ∝ in each graph quadrant, with the observer imagined at the origin.

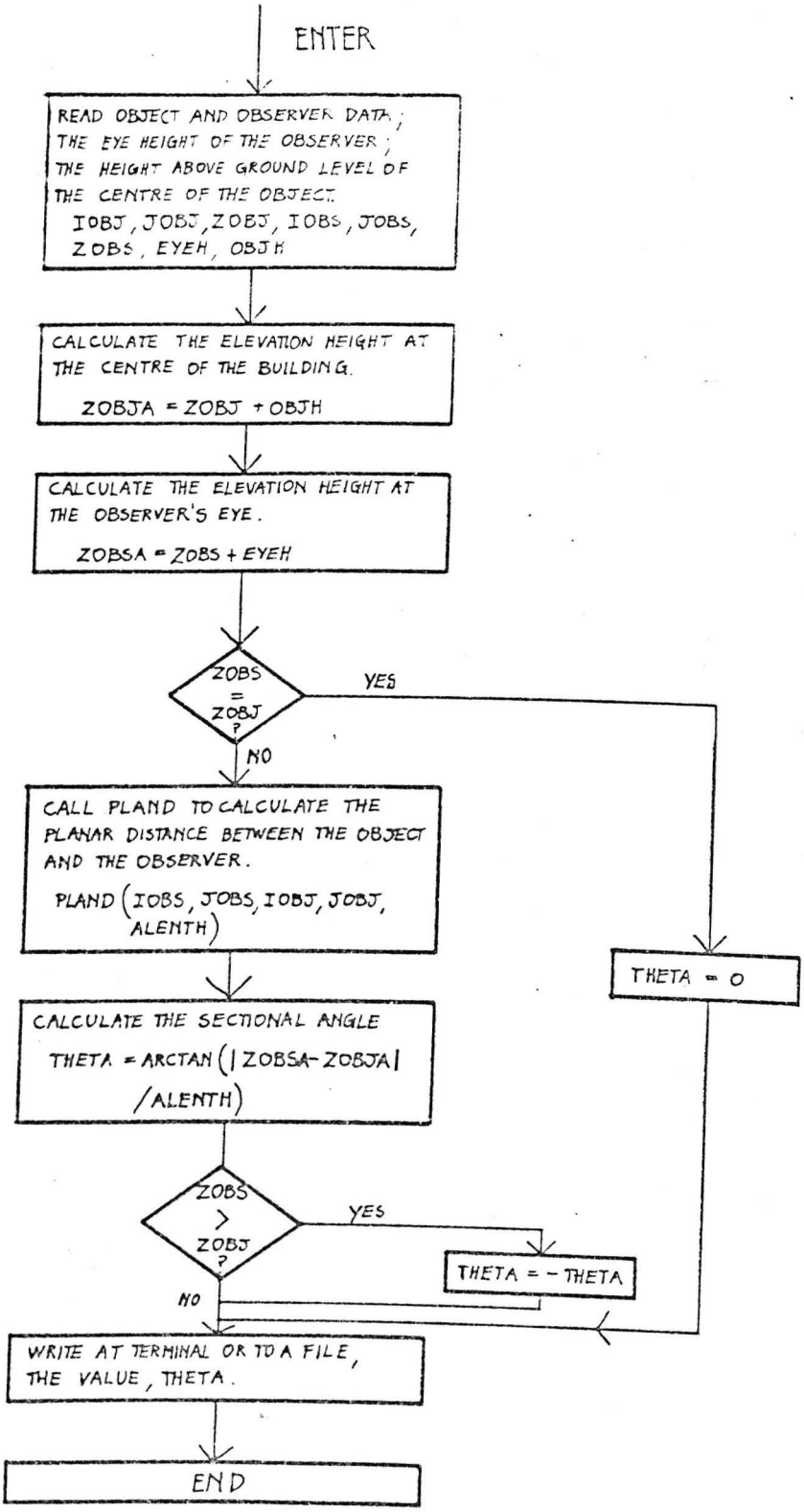


(G223) Algorithm flow chart - program PLANAR.

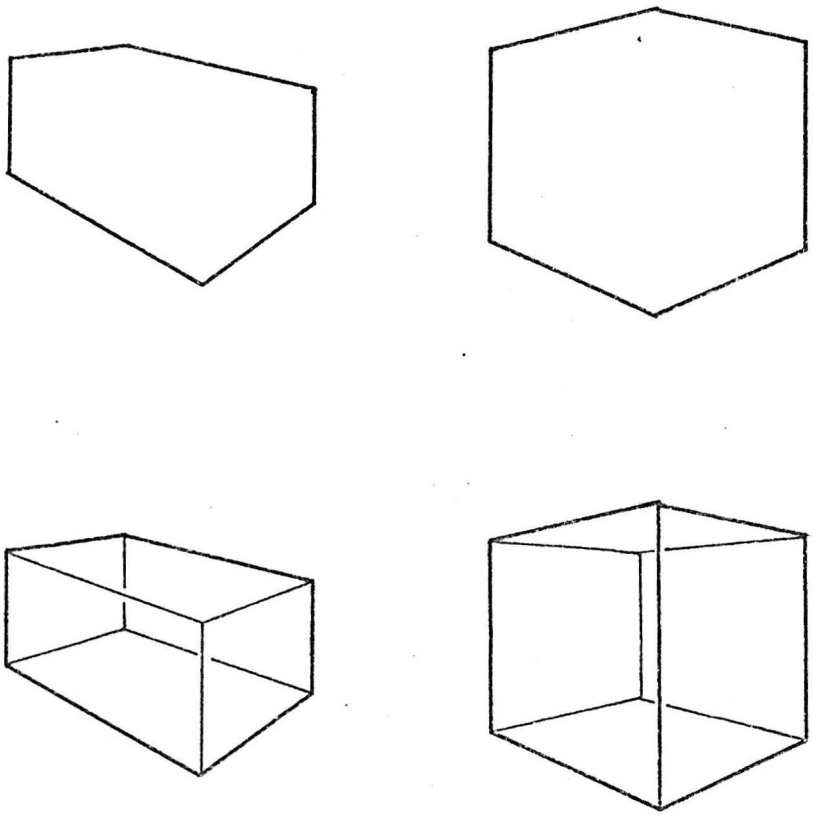


θ measured from a line defining horizontal viewing.

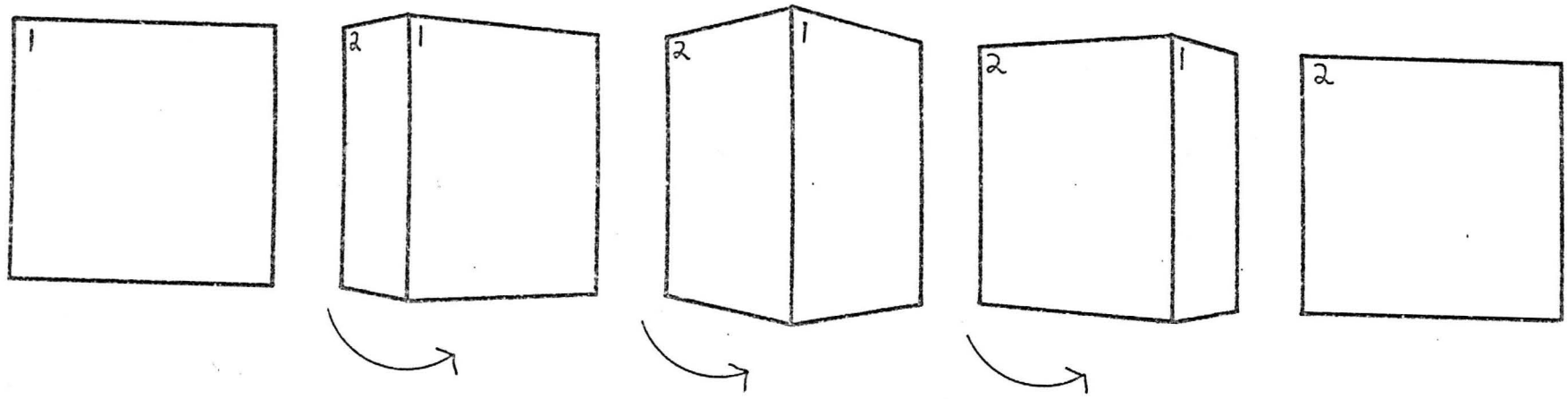
(G224) Sectional angle : geometry and notation.



(G225) Algorithm flow chart - program SECTAN.



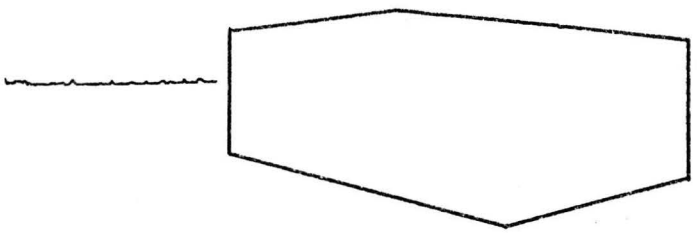
(G226) Shape : delimited by the exterior edges or bounding contour of a form.



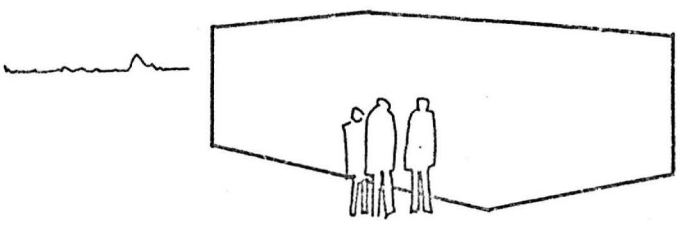
Depth shape of surfaces 1 and 2 : always a square.

Projected shape of surfaces 1 and 2 : varies from a square to a trapesium.

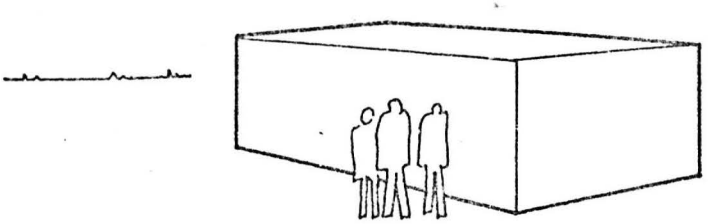
(G227) Depth shape constancy. Under object manipulation the form or depth shape remains constant, while the projected shape varies.



First order descriptor:
SHAPE.
:defines areas of contrast.
outlines/profiles appear.

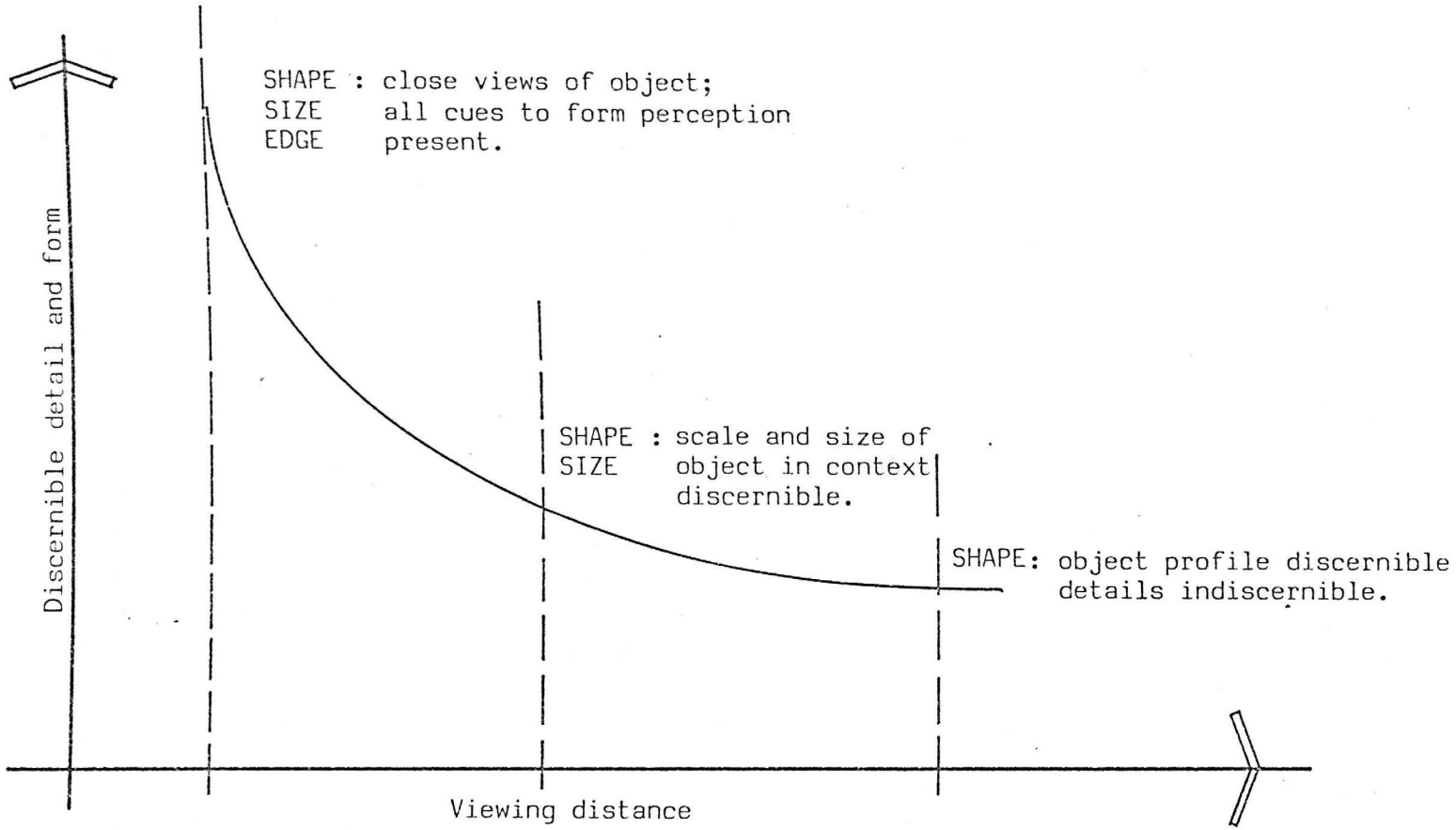


Second order descriptor:
SIZE.
:scale of the object in context given.

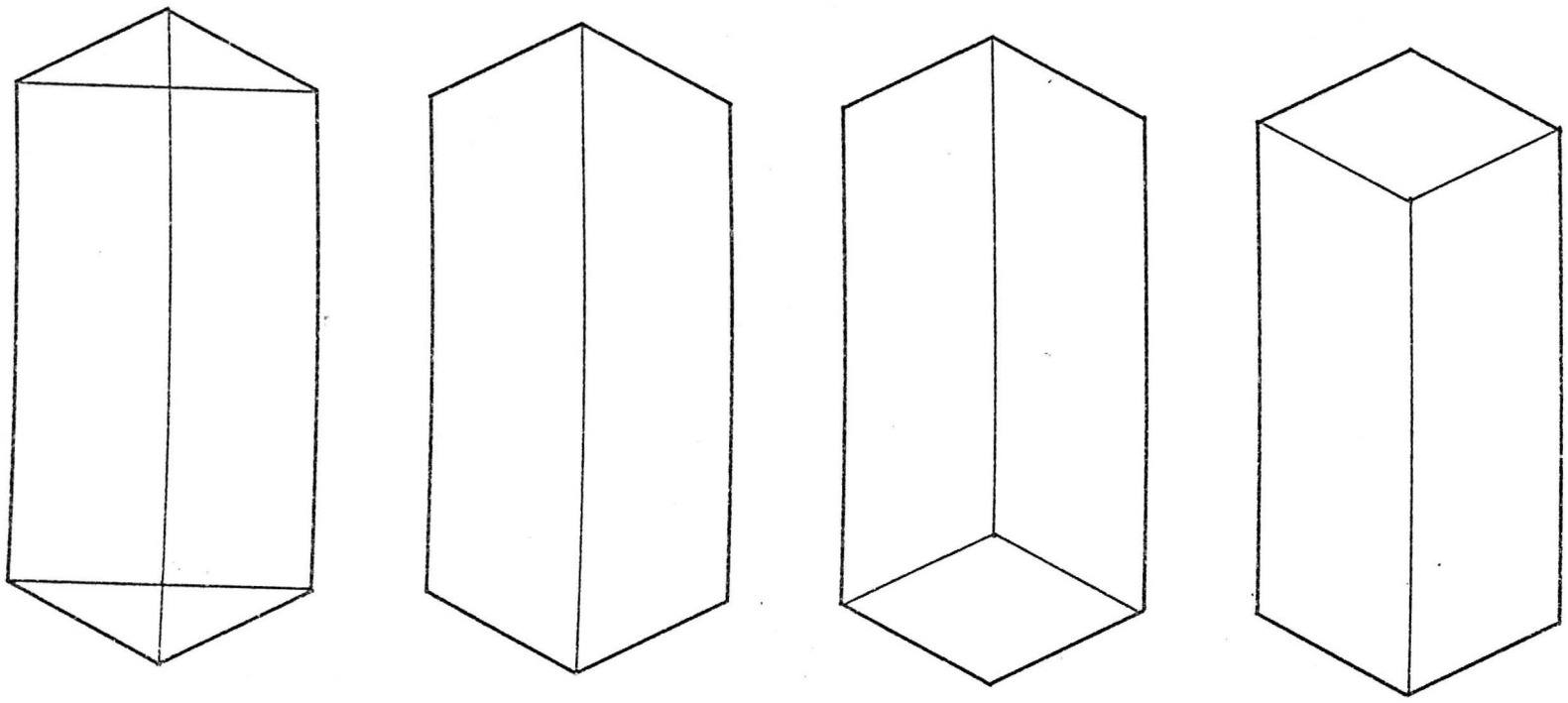


Third order descriptor:
EDGE.
:external edges sharpen perception of the projected shape.
:internal edges describe depth shape.

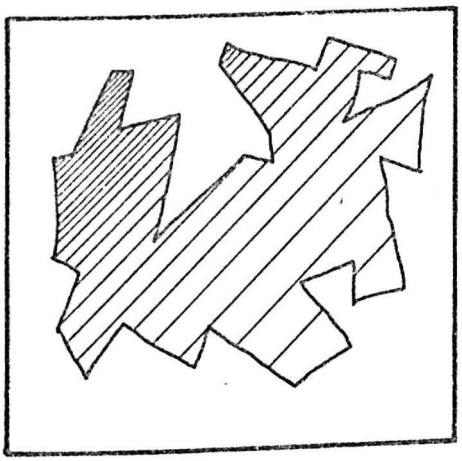
(G228) Cumulative factors in form discrimination.



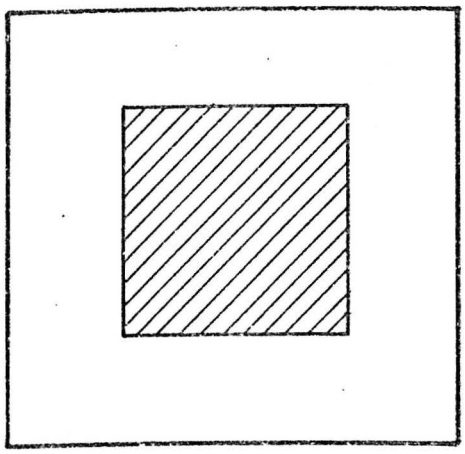
(G229) Graph of discernible building detail and form against the viewing distance.



(G230) The ambiguity of projected shape in reading a form.

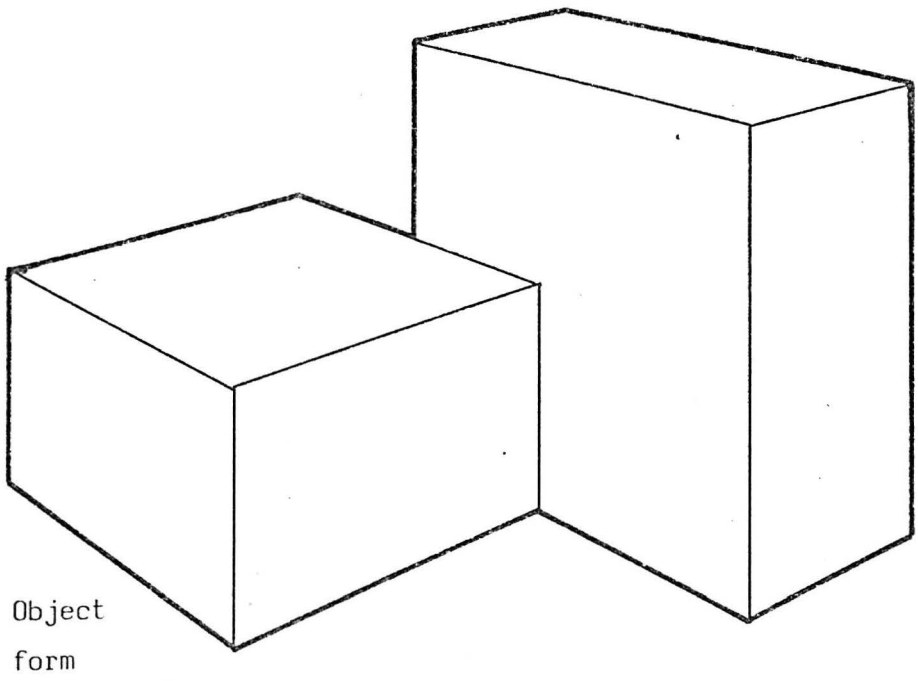


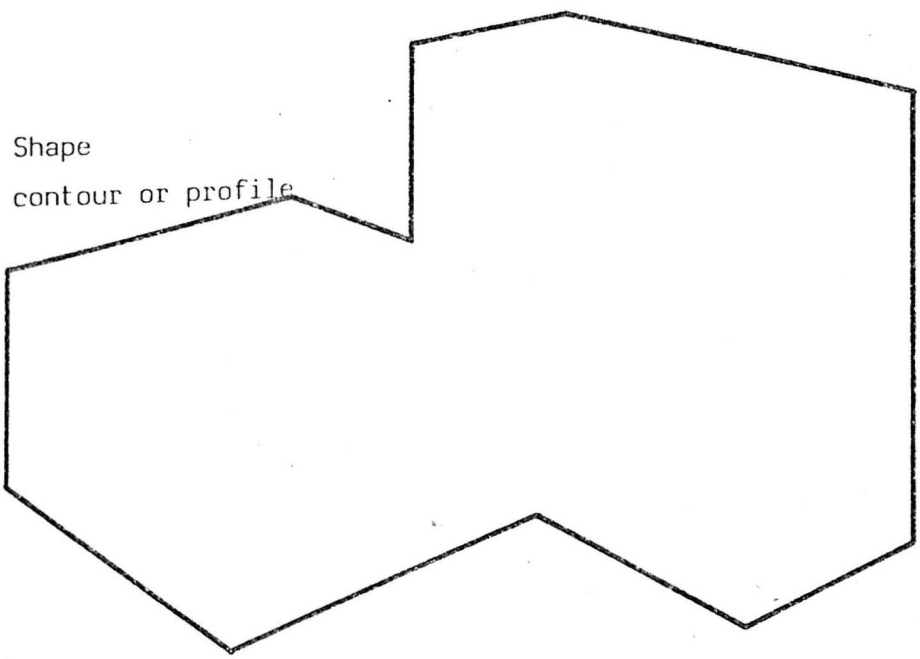
Very little visual redundancy.



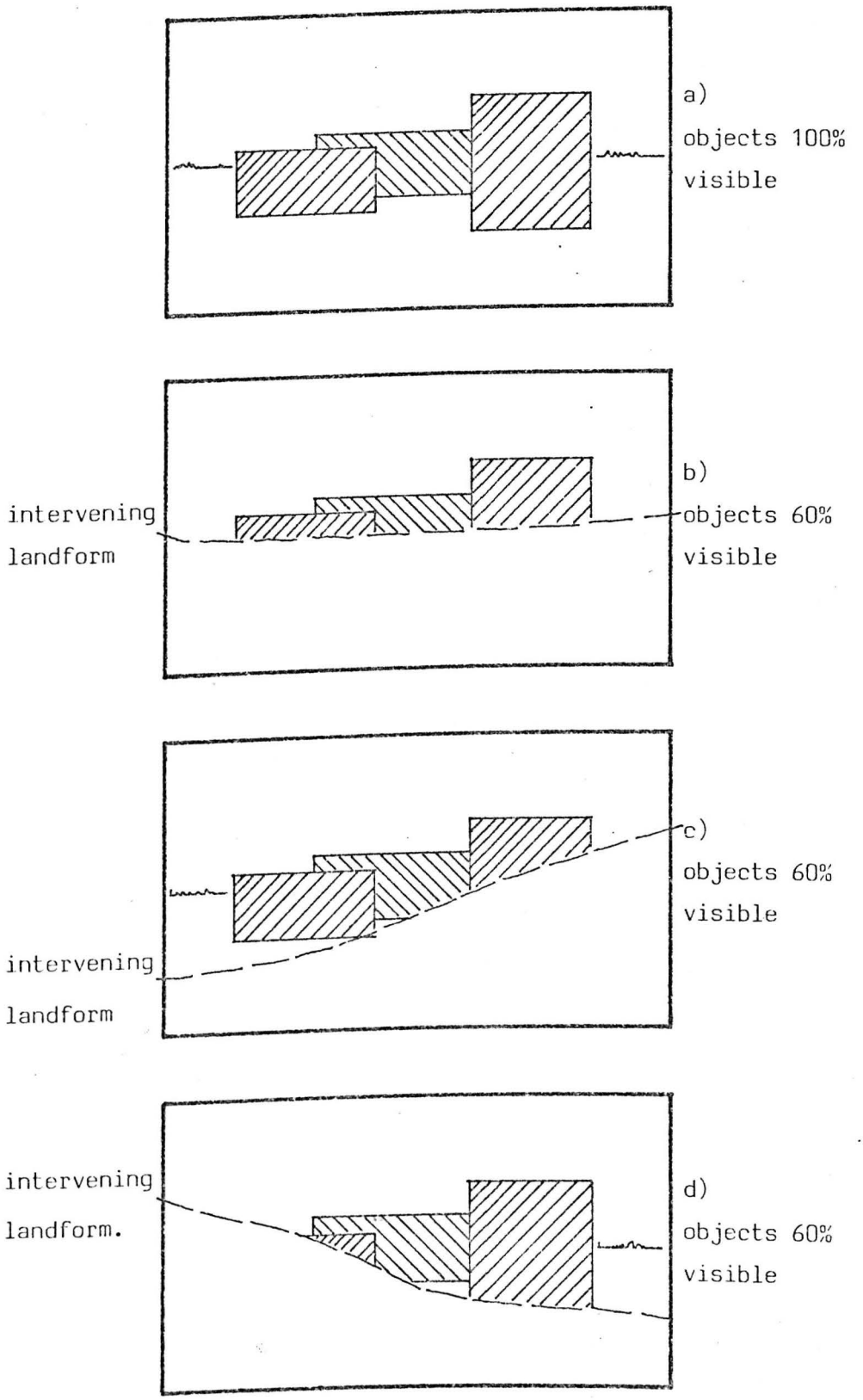
High visual redundancy.

(G231) Visual redundancy.

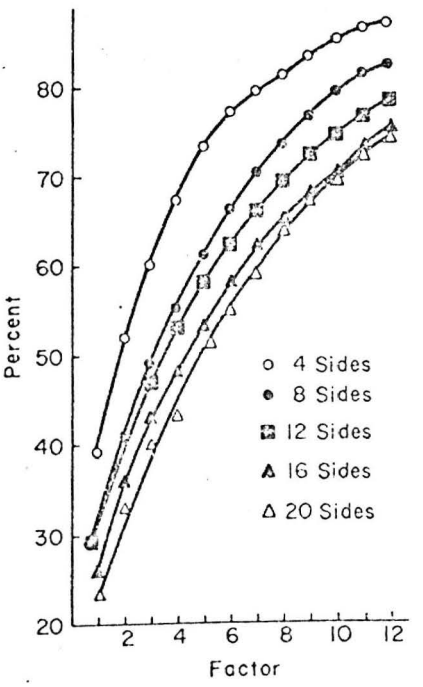




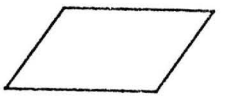
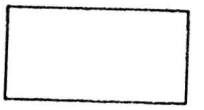
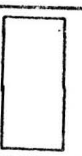
(G232) Projected shape in complex groupings of buildings.

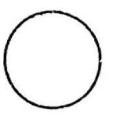
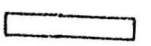


(G233) Projected shape as modified by screening topography or land use.

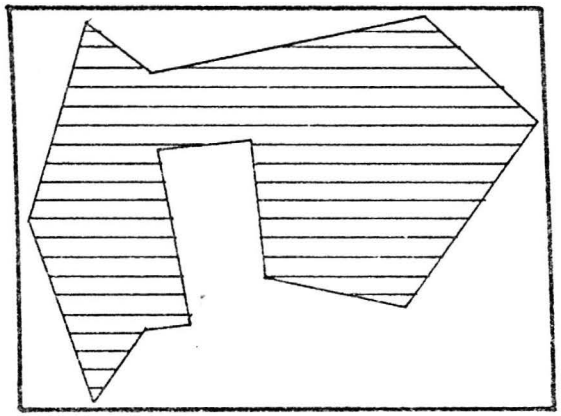


(G234) The percentage of communality accounted for by 12 factors for shapes with 4, 8, 12, 16 and 20 sides. (ZUSN70) p225.

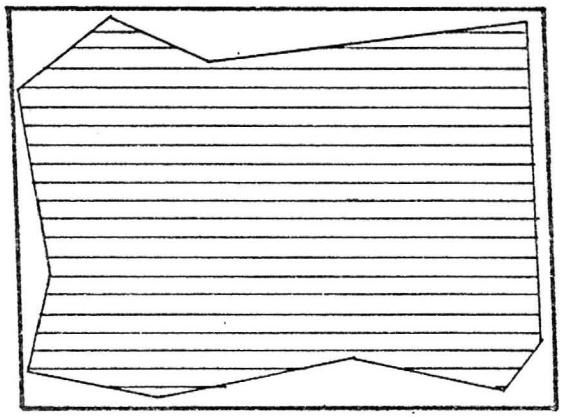
EDGE Number	SHAPE
4	
4	
4	
4	

EDGE Distance	SHAPE
10	
10	
10	
10	

(G235) The number of edges and the distance around the perimeter edge of a shape are inappropriate measures of shape for the reasons indicated above.

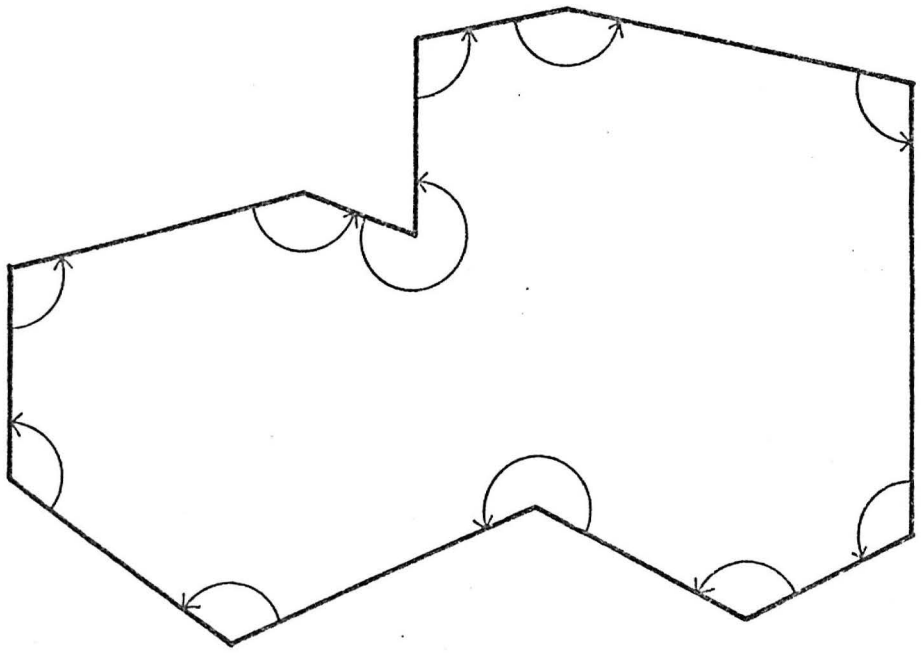


High irregularity/complexity.
60% of bounding box covered by shape.

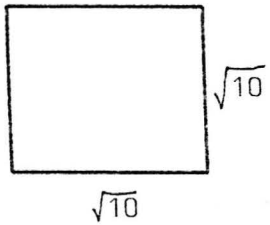
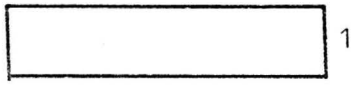
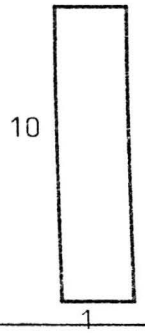


Irregular, but low complexity.
85% of bounding box covered by shape.

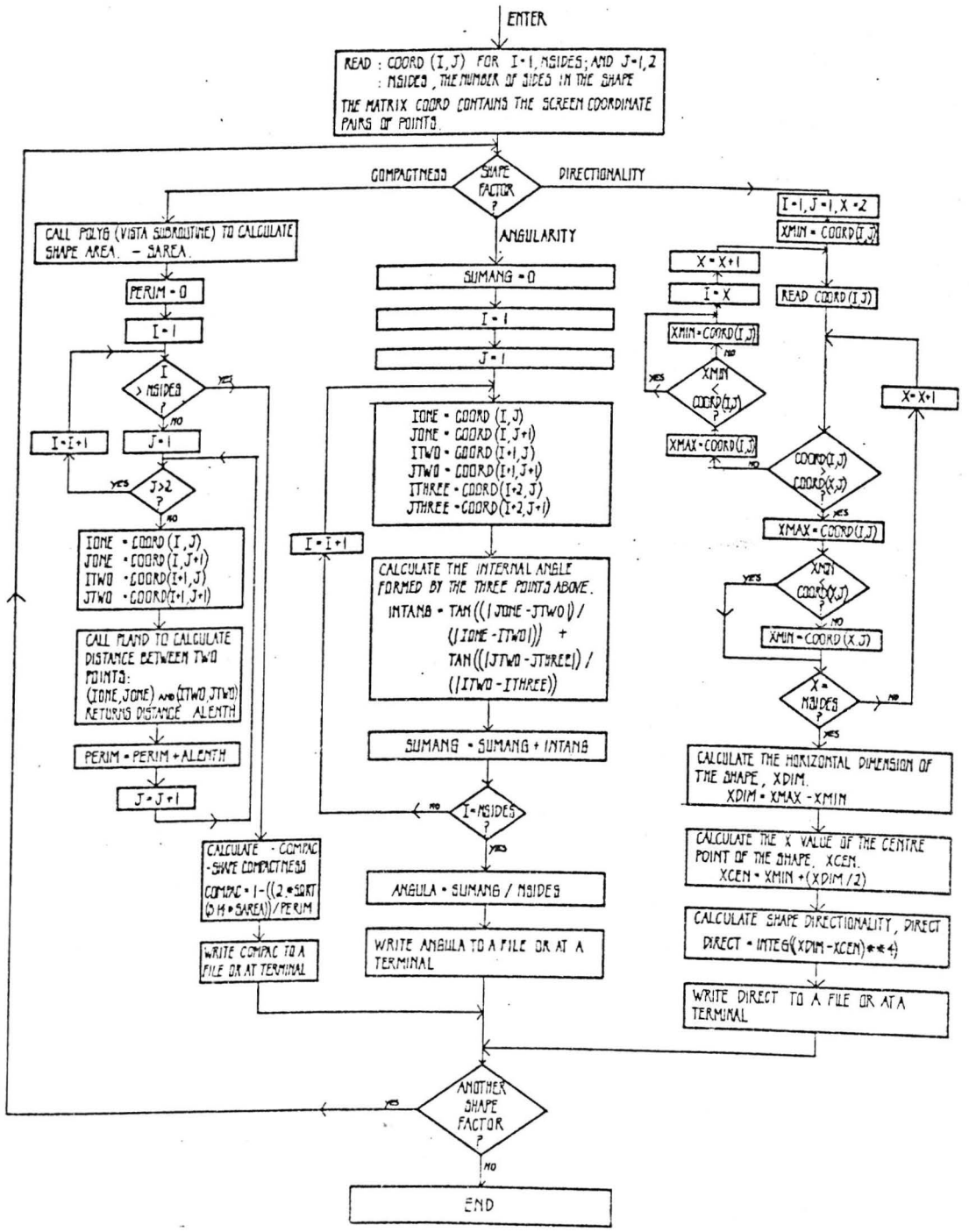
(G236) Shape complexity : % area of the minimum bounding box occupied by the shape.



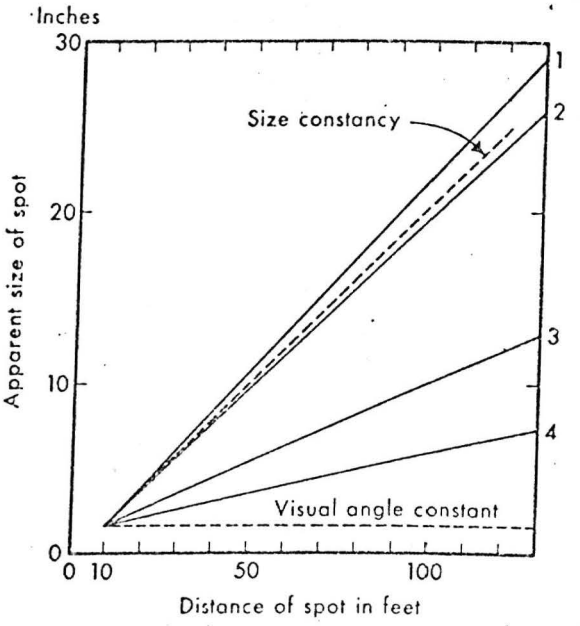
(G237) Shape angularity : the sum of the internal angles of a projected shape.

SHAPE			
Fourth Moment of area.	$\left[\frac{(x-\bar{x})^5}{5} + \frac{(\bar{x})^5}{5}\right] \cdot y$	$\left[\frac{(x-\bar{x})^5}{5} + \frac{(\bar{x})^5}{5}\right] \cdot y$	$\left[\frac{(x-\bar{x})^5}{5} + \frac{(\bar{x})^5}{5}\right] \cdot y$
	= 12.5	= 1250	= 0.125

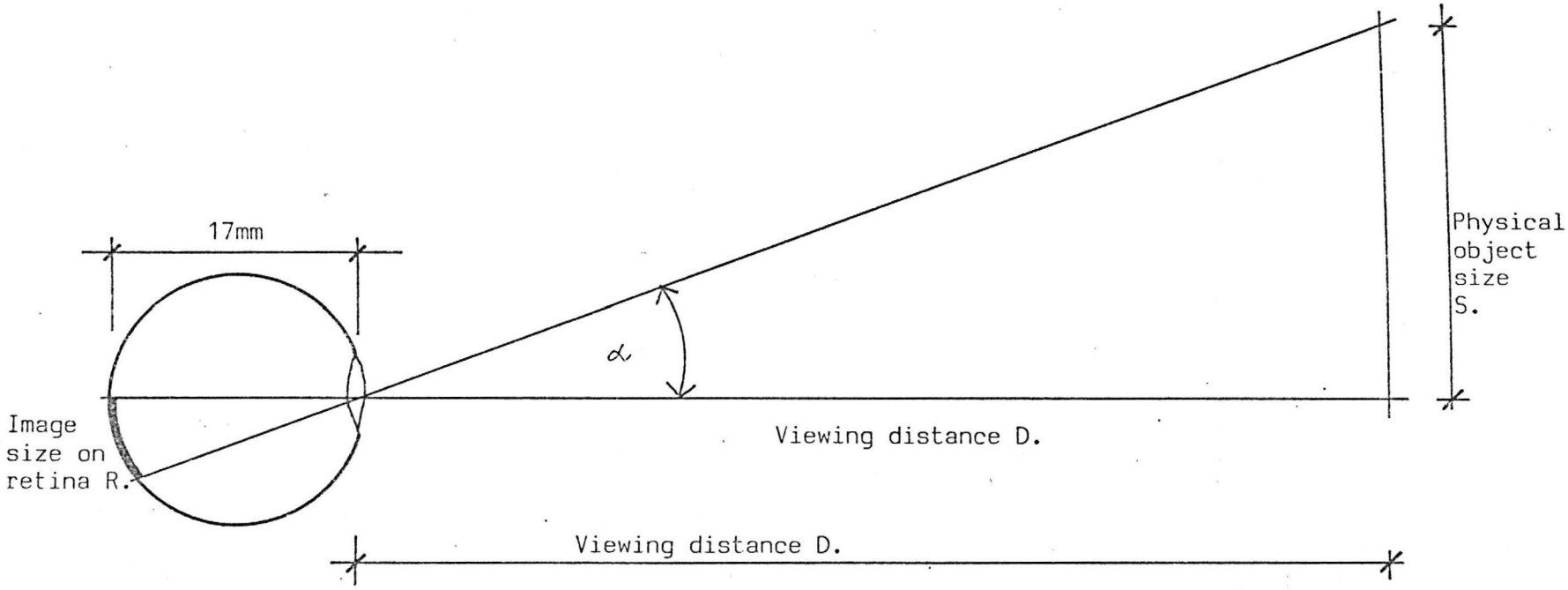
(G238) Shape directionality calculated for three different shapes.



(G239) Algorithm flow chart - program SHAPE.

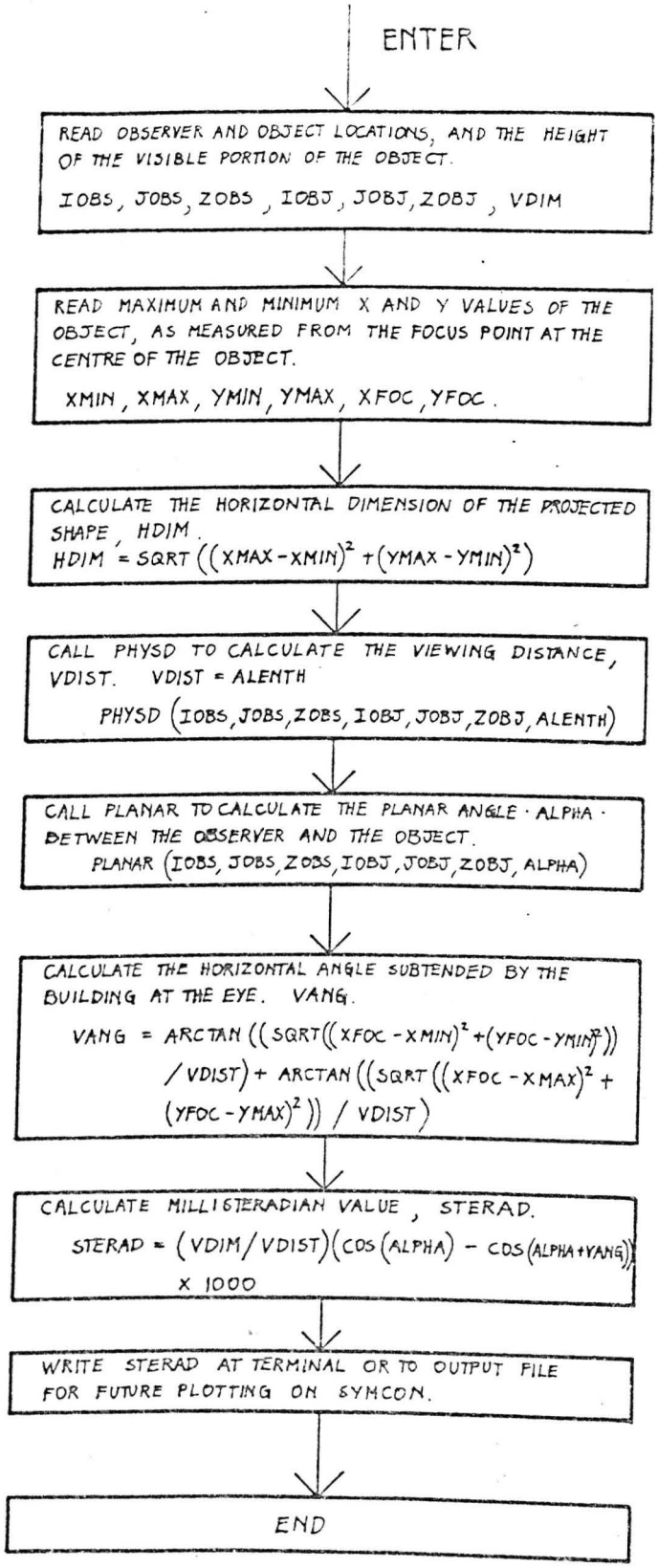


(G240) Graph of apparent size against distance. Cues to distance are progressively eliminated from line 1 to 4, resulting in the object size appearing smaller. (HOLW41).

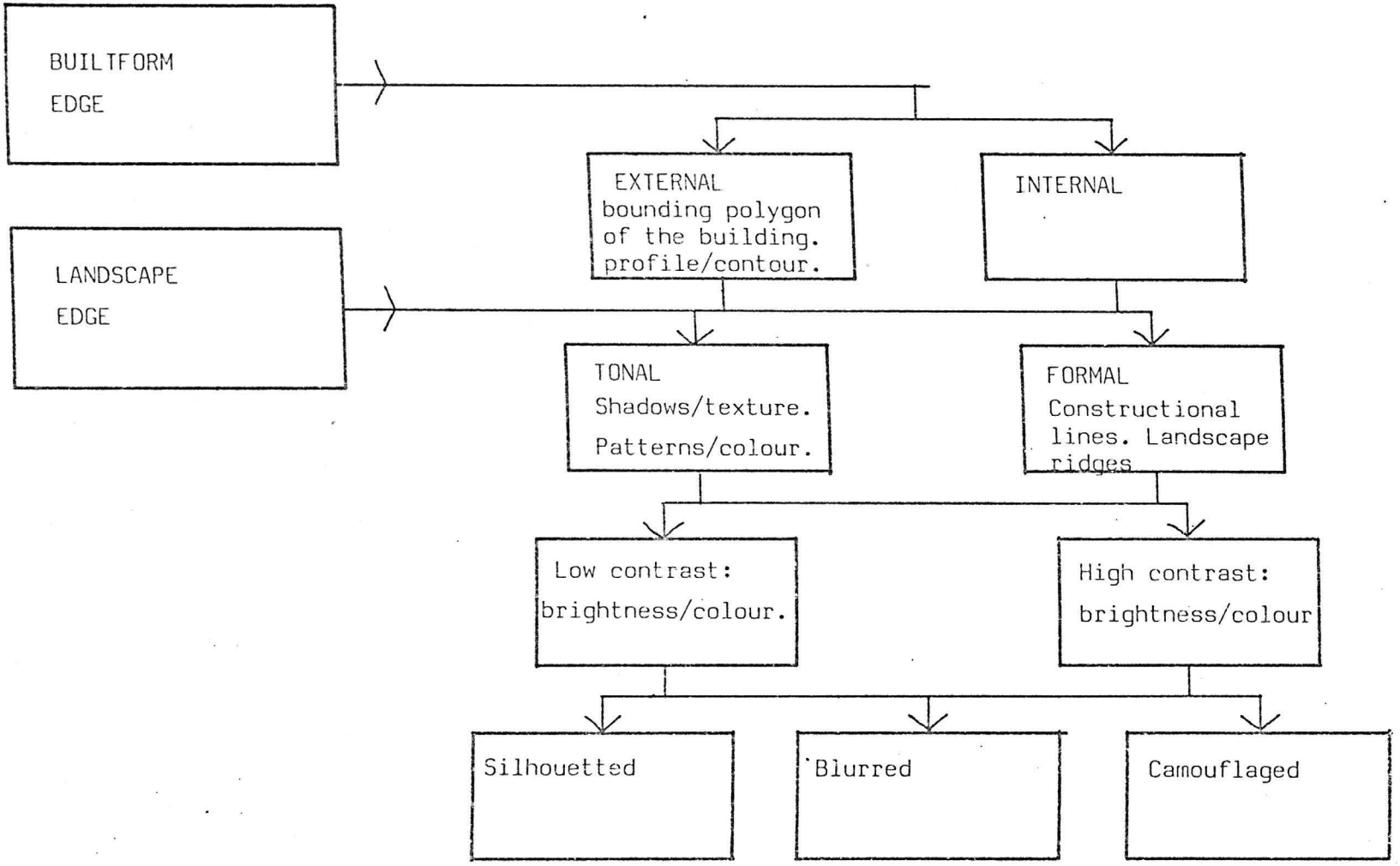


For any object size, S, the following simple geometrical relationship holds $\frac{S}{D} = \frac{R}{17}$ and $\tan \alpha = \frac{S}{D}$

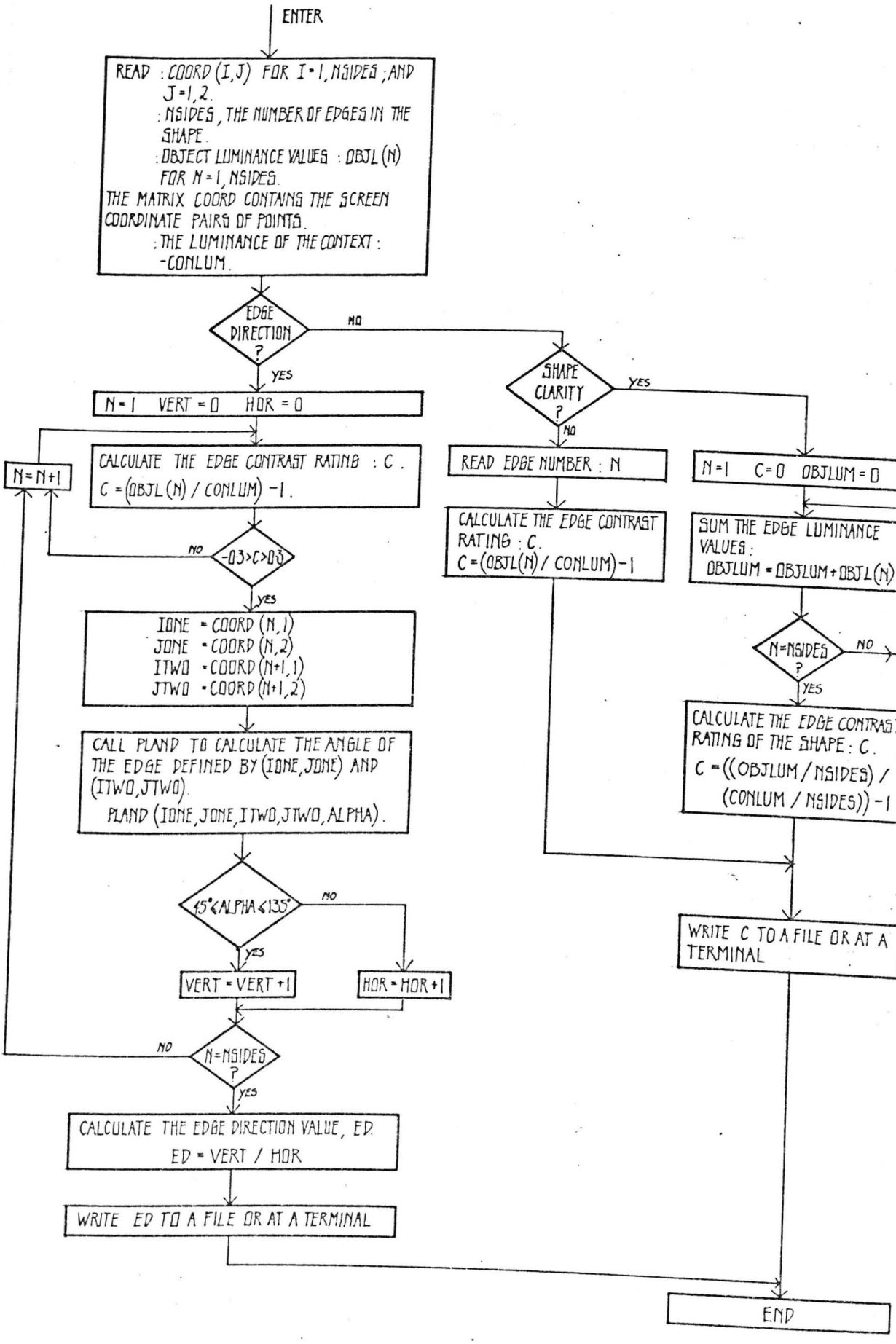
(G241) The geometry and notation of vision.



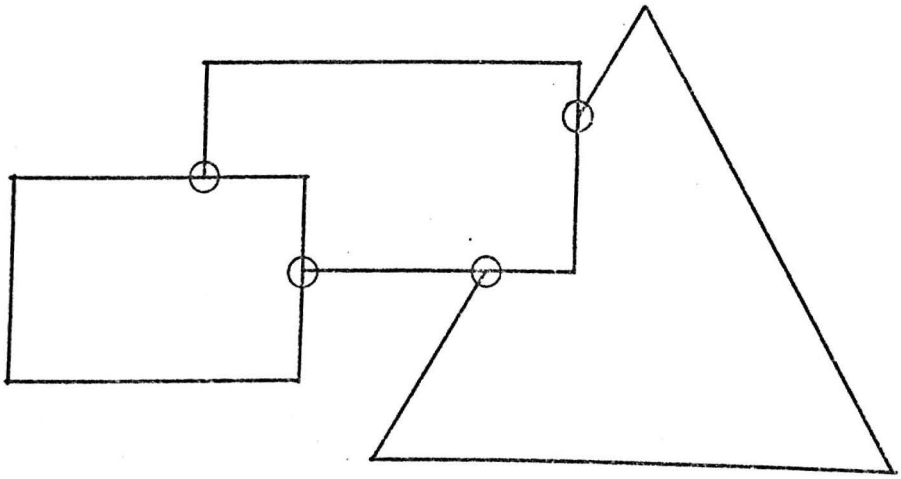
(G242) Algorithm flow chart - program SIZE.



(G243) A taxonomy of edges for builtform and landscape studies.



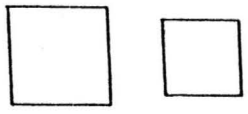
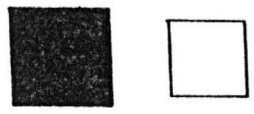
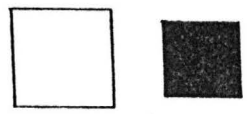
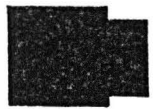
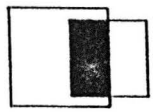
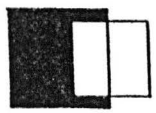
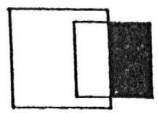
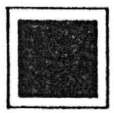
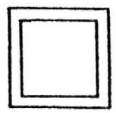
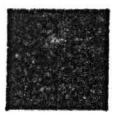
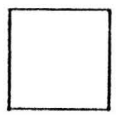
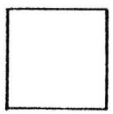
(G244) Algorithm flow shart - program EDGE.



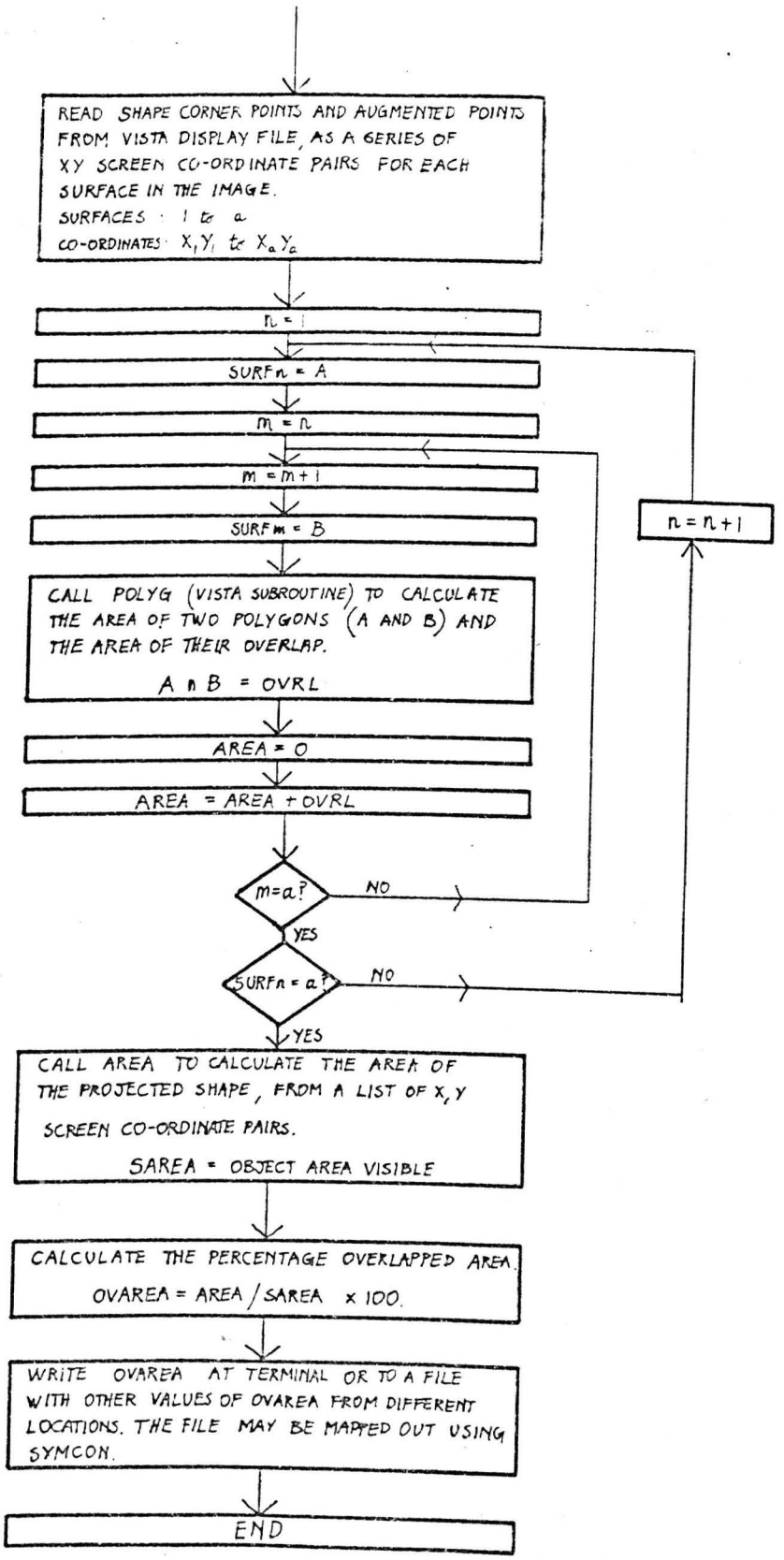
○ Augmented or junction points in overlapping shapes.

(G245) Overlap : junction points or augmented points common to two overlapping shapes.

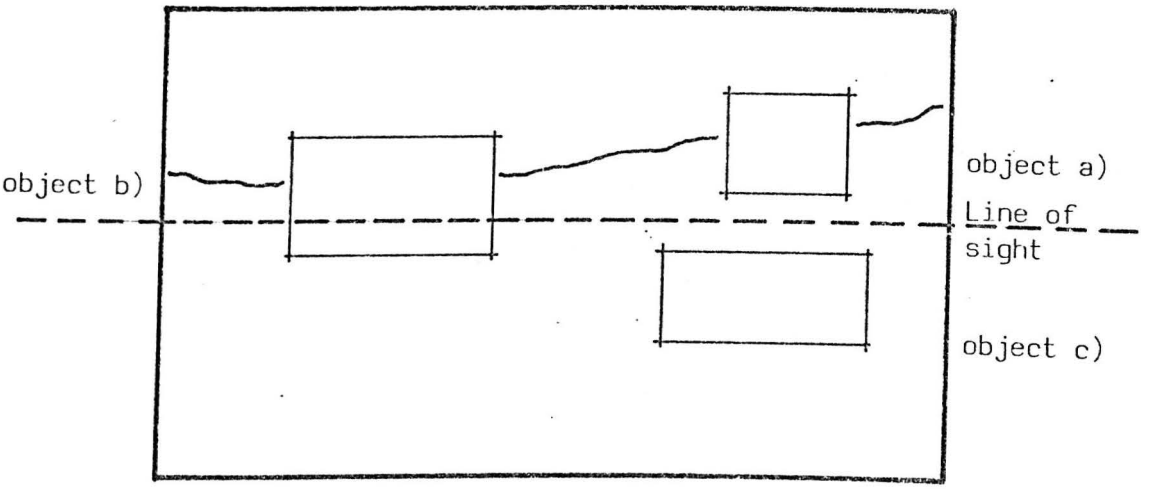
* only the shaded areas are considered for processing in the program OVRLAP

POLYGON SET OPERATION / OVERLAP	UNION A u B	INTERSECTION A n B	DIFFERENCE A-B A - B	DIFFERENCE B-A B - A
DISJOINT				
CONJOINT				
SUBJOINT				
CO-INCIDENT				

(G246) Overlap/Polygon Set Operation Matrix

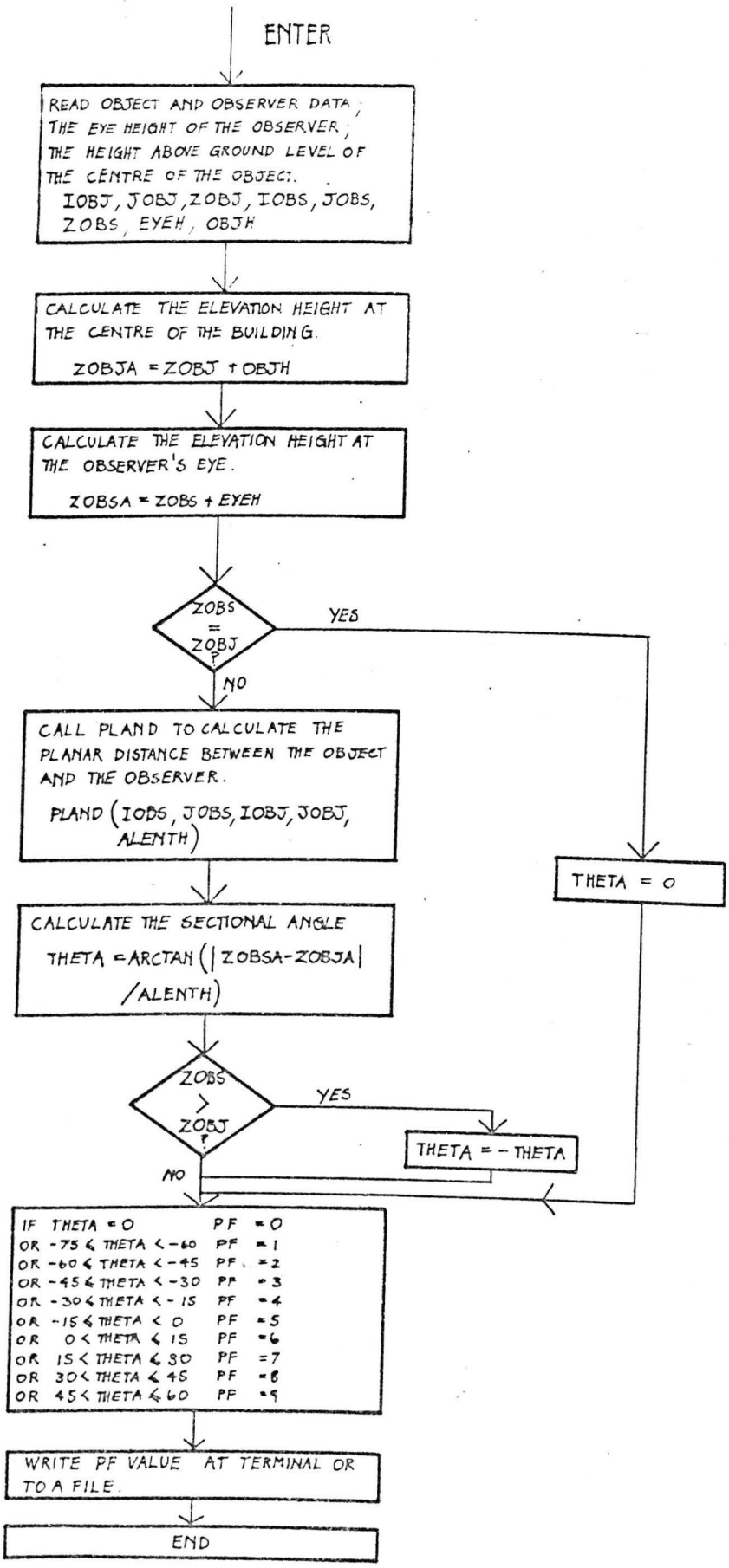


(G247) Algorithm flow shart - program OVRLAP.

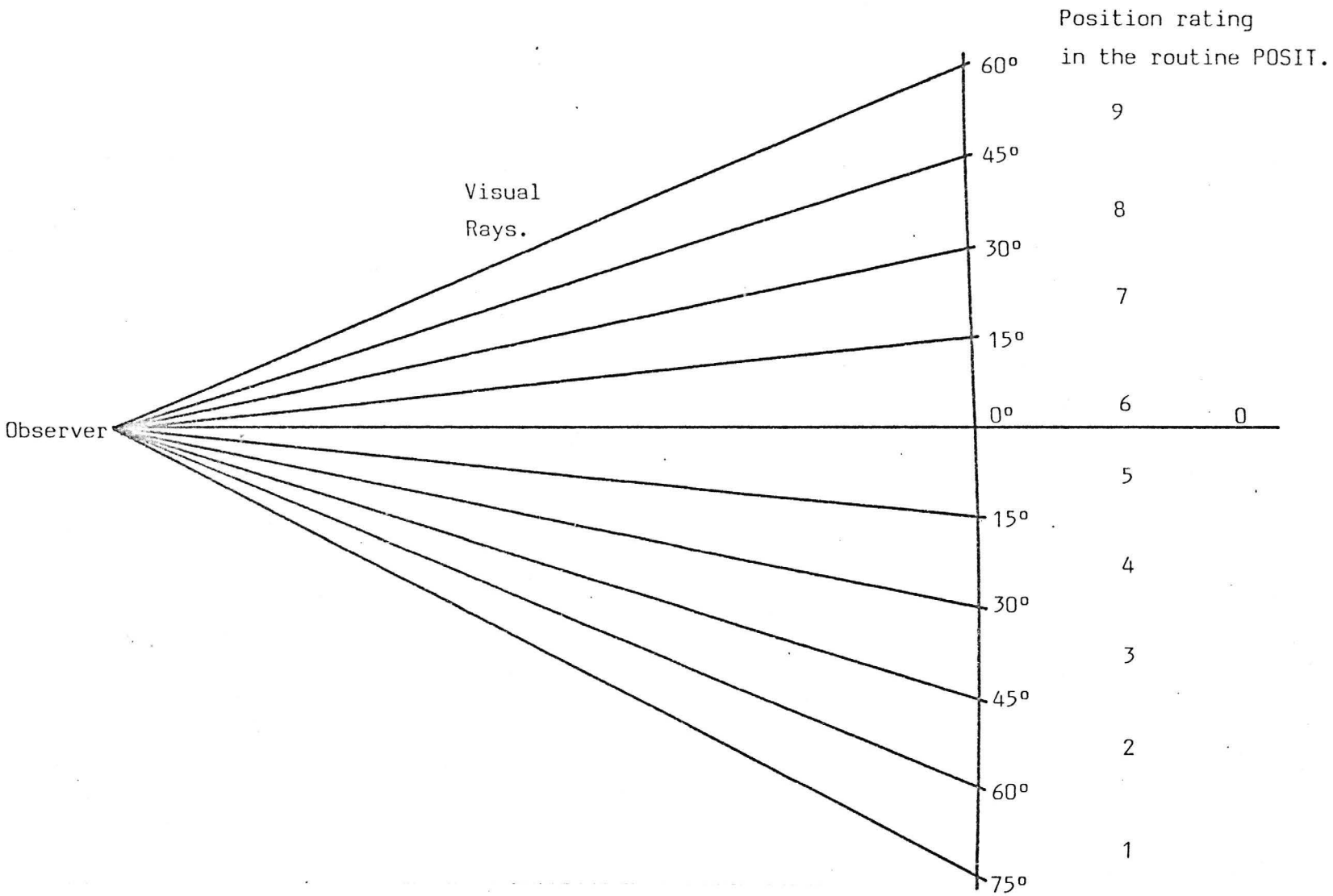


Object a) appears above the observer's eye level, and may be considered further distant in the scene than objects b) and c). Object c) is perceived as nearest since it is below the horizontal line of sight.

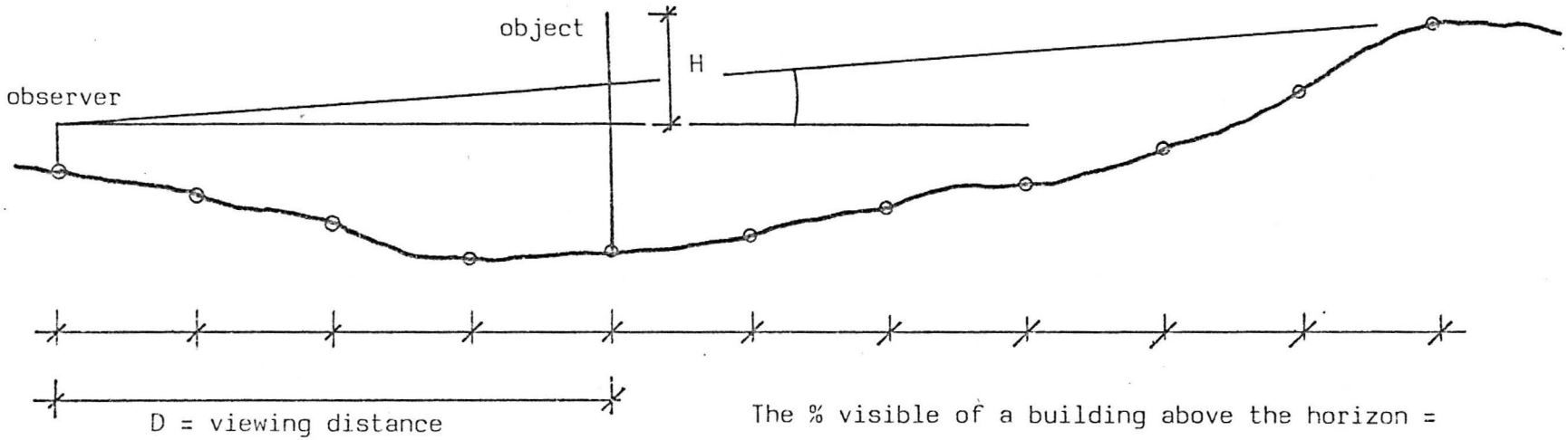
(G248) Position : in general objects whose bases are below the horizontal line of sight are seen as nearer and further objects commonly have a base line higher up the field of view, perhaps above the line of sight.



(G249) Algorithm flow chart - program POSTIN.



(G250) Position Factor values for the program POSTIN output.



The % visible of a building above the horizon =
= H - (tan b)D , where the angle b is the greatest angle between the observer and any grid cell in the viewing direction.

(G251) Backcloth : geometry and notation.

CHAPTER 6

INTEGRATED SYSTEM FOR COMPUTER AIDED VISUAL IMPACT ANALYSIS

PRE PROCESSING

ENTER

PHOTOGRAMMETRIC DATA CAPTURE

LANDFORM DATA GENERATION

- MANUAL INTERPOLATION FROM O.S. MAPS. ALPHANUMERIC INPUT. PRONE TO ERROR.
- TOPOGRAPHIC CONTOUR DIGITISING. RESEARCH AT PLYMOUTH POLYTECHNIC.
- LASERSCAN PHOTOMAP. AUTOMATIC DIGITISING.
- LANDFORM GENERATOR
- TOPOGRAPHIC CONTOURS INTERPOLATED FROM AERIAL PHOTOS.

LAND USE DATA GENERATION

- MANUAL OS MAP INTERPOLATION. ALPHANUMERIC INPUT. PRONE TO ERROR.
- CONTOURS OF LAND USE AREAS. PLYMOUTH POLYTECHNIC RESEARCH.
- CONTOURS OF LAND USE AREAS DERIVED FROM AERIAL PHOTOS.
- BUILDINGS AND OTHER MAN MADE FEATURES DERIVED FROM AERIAL PHOTOS.

GALILEO STEREOSIMPLEX STEREO PLOTTER

3-d DIGITISING SYSTEM

EXISTING DATA FILES
GEOMETRY DATA FILES MAY ALREADY EXIST FOR USE IN OTHER PROGRAMS, OR STORED IN A GEOMETRY LIBRARY.

MANUAL KEYBOARD INPUT
ALPHANUMERIC INPUT. PRONE TO ERROR. EXCEPTIONALLY SLOW PROCESS FOR UNSKILLED TYPISTS.

DIGITISING TABLET
GRAPHICAL INPUT BEST SUITED TO ARCHITECTURAL WORK

FORM GENERATORS
BIBMAK FOR DATA PROCESSING ON:
- BUILDING ELEMENTS.
- ENGINEERING ELEMENTS.
- LANDSCAPE ELEMENTS.

VISIMP
VISTA INPUT MANAGEMENT MODULE.
CREATE AND EDIT
- : GEOMETRY DATABASE - BIBMAK
- : COLOUR DATABASE - VISCOL
- : TILE DATABASE - VISTIL
- : CONTROL FILE FOR VISTA VIEWING.

DATA EDITING AND CHECKING
TOPOGRAPHIC AND LAND USE DATABASES SCANNED FOR GROSS ERRORS

TOPOGRAPHY — PROPOSED DATABASE / EXISTING DATABASE

LAND USE — EXISTING DATABASE

VIEW / BIBLE translator
INTERCHANGE OF TOPOGRAPHIC AND BUILDING DATA.

BIBLE
GEOMETRY DATABASE

LOW QUALITY PRINTER FOR DATA CHECKING

BIBVIS
CONVERSION OF BIBLE GEOMETRY DATA TO VISTA. FACILITY TO/CREATE/ APPEND/ EDIT / TO FILE.

VISTA
COLOUR / GEOMETRY / TILE DATABASES.

LOW QUALITY PRINTER FOR DATA CHECKING.

HTADD PROGRAM ADDS LAND USE TO TOPOGRAPHY.

TITLE AND PARAMETER FILES FOR VIEW PROCESSING. /RADIUS OF VISIBILITY/ /WINDOW/ INTEREST OBJECT LOCATION/ PARTITION OF DATA SET/ SCAN OF VISIBILITY/

PROCESSING

VIEW2
- % VISIBILITY
- % VISIBILITY ABOVE HORIZON
- AREAS ACTING AS BACKCLOTH
- AREAS ACTING AS DEAD GROUND

VIEW1
- MULTIPLE VIEWPOINT VISIBILITY CONTOURS
- OBJECT VISIBILITY
- VIEWSHED

VIDERE
- VRANGE & ACUITY — TO MODIFY VIEW1 VIEWSHED
- INTERACTIVE DATA FILE PREPARATION SEQUENCE
- DISTAN
- PLANAR
- SECTAN
- SHAPE
- SIZE
- EDGE
- OVRLAP
- POSIT
- BACKCLOTH

BIBLE GEOMETRY DATA BASE

VISTA GEOMETRY DATA BASE

DISPLAY FILES FROM VIDEO DISC STORAGE

BIBLE
WIRE LINE PERSPECTIVE DRAWING

- PROJECTIONS : ORTHOGRAPHIC / PERSP.
- CAMERA LENS SIZE ENLARGEMENT FACTOR
- OBSERVER LOCATION. VIEWFINDER PROGRAM BIBVIS
- VIEWING DIRECTION AND WINDOW

- MAX. 8 LIGHT SOURCES FOR SHADING.
- CAMERA VIEWCONE
- OBSERVER LOCATION BIRD'S EYE / GROUND
- VIEW TYPE : ELEVATION / PERSPECTIVE

VISTA
COLOURED AND SHADED PERSPECTIVE DRAWING

output

output

output

output

output

LANDSCAPE DESIGN PROGRAMS
:CUT AND FILL
:DRAINAGE etc.

BIBLE VIEW FILE

POST PROCESSING

SECT — LOW QUALITY DOT MATRIX PRINTER

SYMCON — HIGH QUALITY DAISYWHEEL PRINTER

SPHINX — DRUM PLOTTER

PERSPX — ACCESS TO COLOUR GRAPHICS TERMINAL AED1024 AND INK JET PLOTTER

STATISTICAL AND GRAPHICAL DATA

CONTOUR / SYMBOL OVERLAY MAPS.
PROJECTIONS OF LANDFORM AND BUILTFORM.
SECTIONAL DRAWINGS.

BIBPLT
PROGRAM TO PLOT BIBLE VIEW FILES

TEKTRONIX THERMAL COPIER

TEKTRONIX 4010 SERIES VECTOR TERMINALS.

TEKTRONIX 4663 FLAT BED PLOTTER

HIGH QUALITY CALCOMP DRUM PLOTTER

SCAN CONVERTOR

B/W OR COLOUR VIDEO CAMERA

PHOTOGRAPH OF SCENE

525 / 625 VEL TWO CHANNEL VIDEO MIXER

COLOUR VIDEO MIXING.

B/W OR COLOUR TV MONITOR

VIDEO RECORDER

BIBDIS
MANUAL SCREEN EDITING AND COLOURING OF BIBLE VIEWS.

USER DEFINED WINDOW ON THE SCENE

VISTA DISPLAY MODULE
- AEDDIS : AED 512 RASTER TERMINAL
- DISPLY : TEKTRONIX 4027 RASTER TERMINAL
- TEKDIS : TEKTRONIX 4010 SERIES TERMINALS

PAINT
MANUAL EDITING AND MANIPULATION OF VISTA DISPLAY FILE.

INK JET PLOTTER

AED 512 RASTER COLOUR TERMINAL

TEKTRONIX 4027 RASTER COLOUR TERMINAL

TEKTRONIX 4010 SERIES VECTOR TERMINALS

PHILIPS LASERVISION VIDEO DISC STORAGE WITH CUSTOM PRESSED DISCS.

PHOTOGRAPHIC COPYING FACILITY. IMAGE RESOURCE VIDEO PRINT.Ser

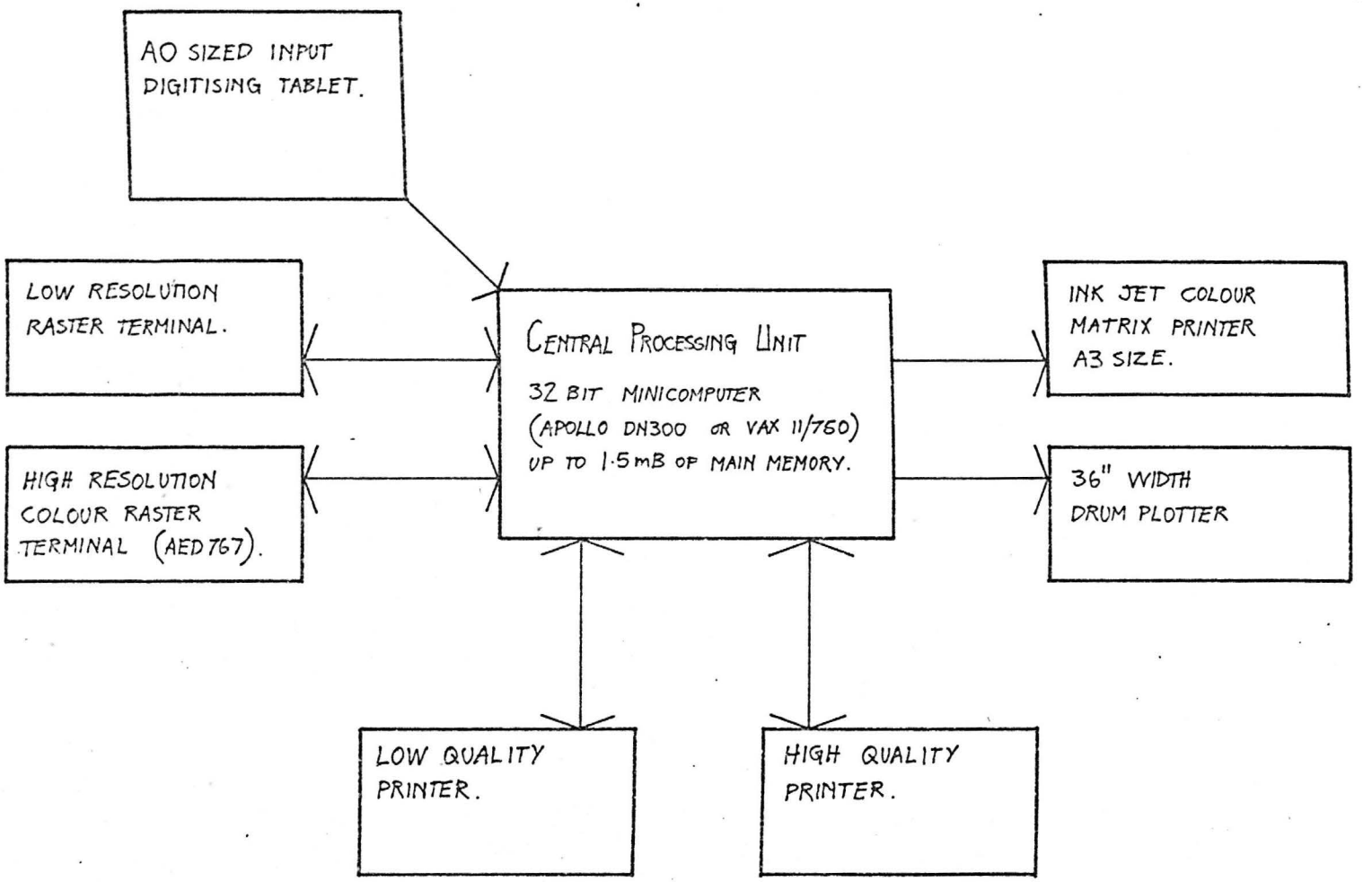
FRAME GRABBER / DIGITAL CAMERA / IMAGE HANDLING SYSTEM.

ORIGINAL SCENE OF SITE

EDIT OUT FOREGROUND OF SCENE

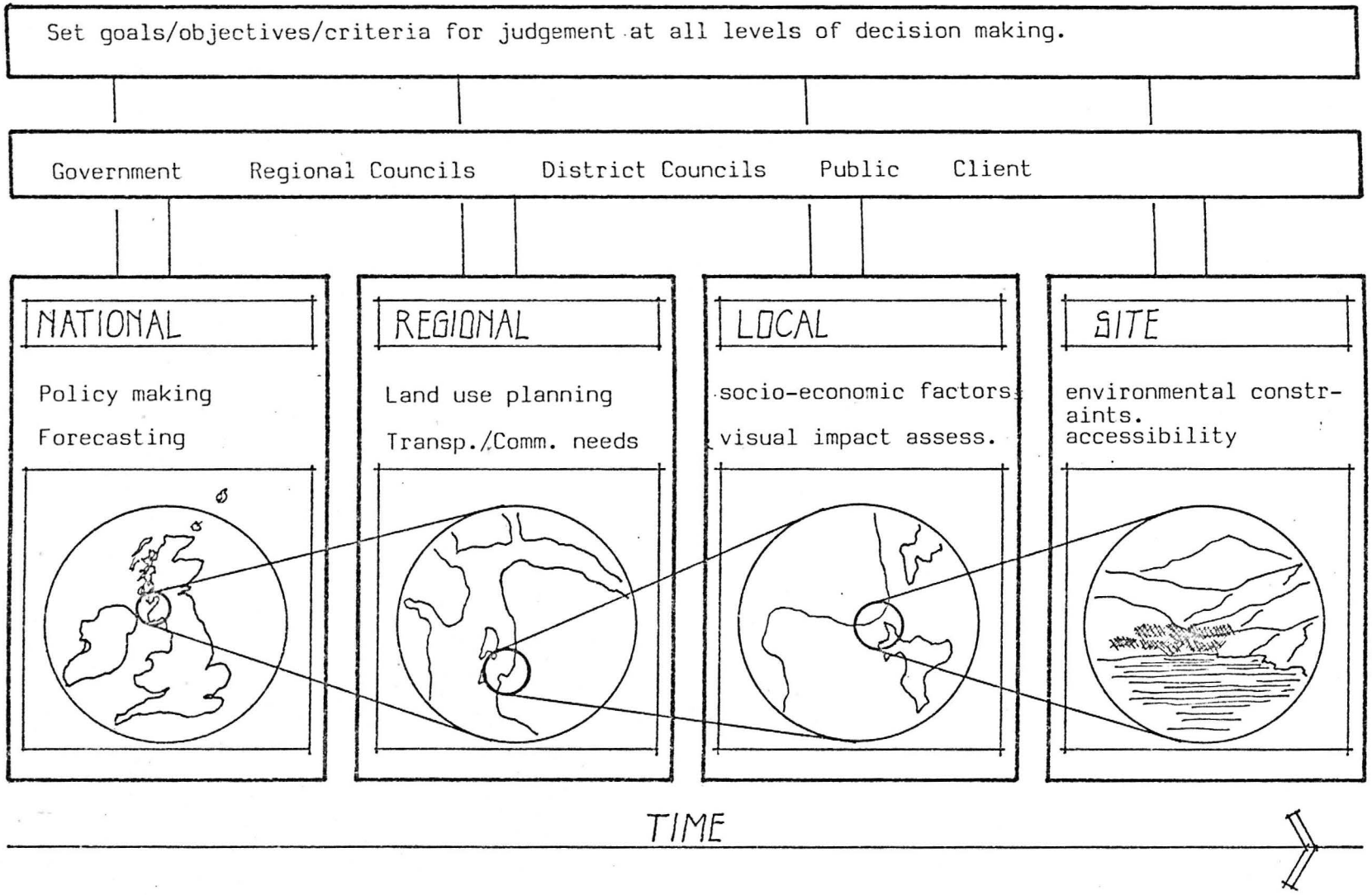
OVERLAY BUILDING ON SCENE

REINSTATE FOREGROUND



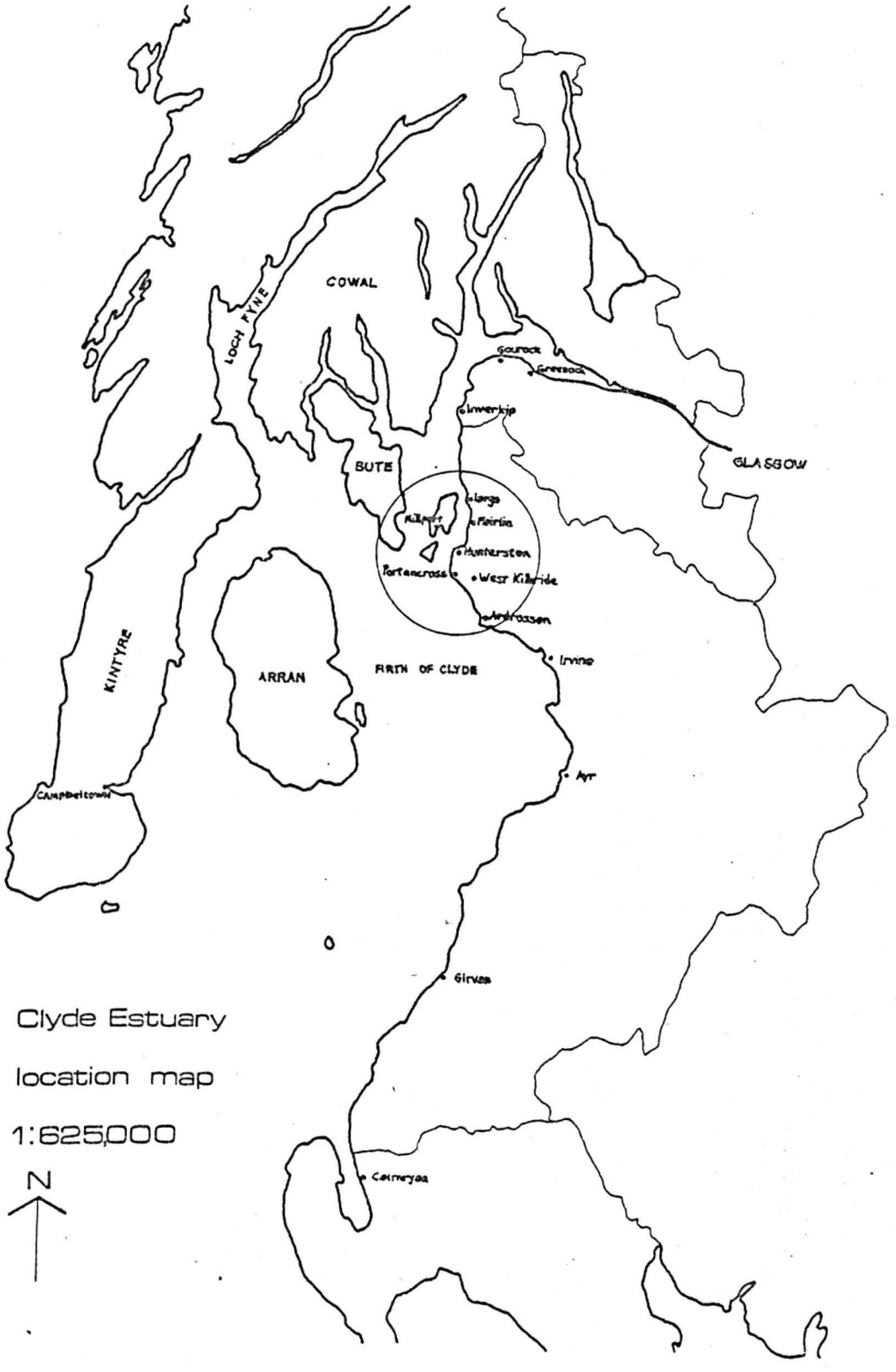
(G253) Computer based system for architectural practices involved in visual impact analysis.

CHAPTER 7

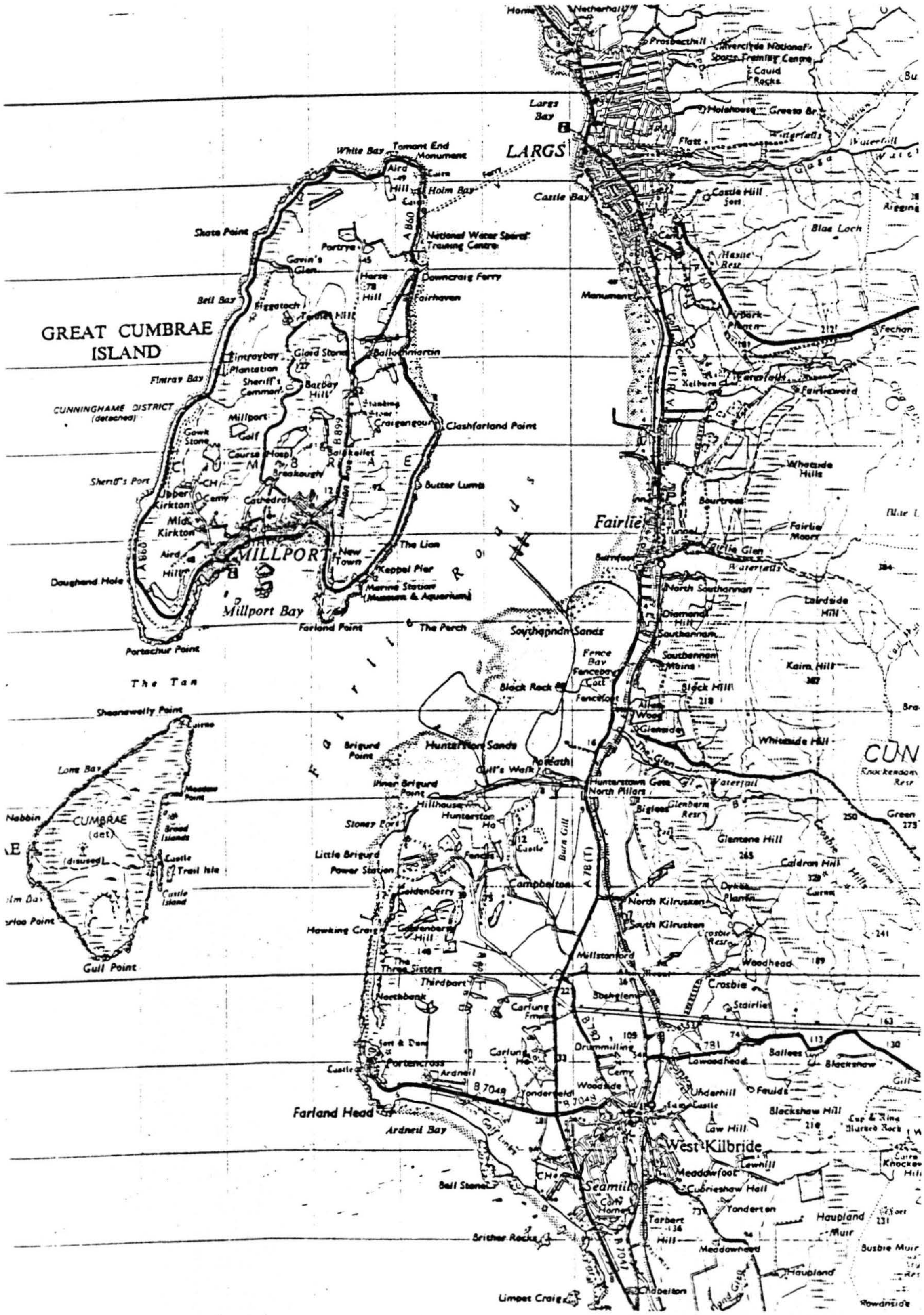


(G254) Outline methodology for impact assessment.

APPENDIX 1



(G255) Hunterston location map : Clyde estuary.



(G256) The Hunterston promontory on the Ayrshire coast. Industrial activity concentrated on the mainland shore of Fairlie Roads

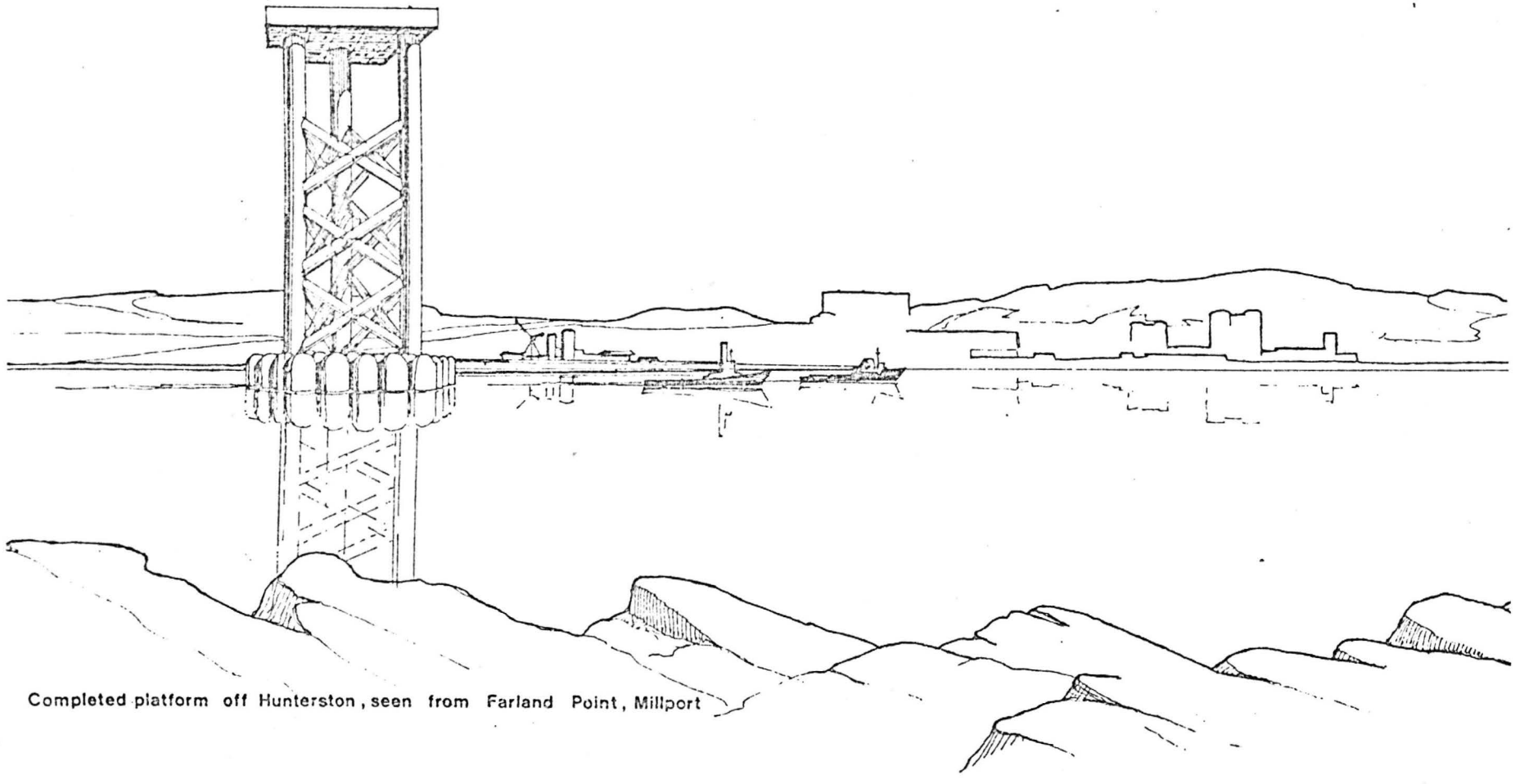
a)

b)

(G257) Industrial activity at Hunterston.

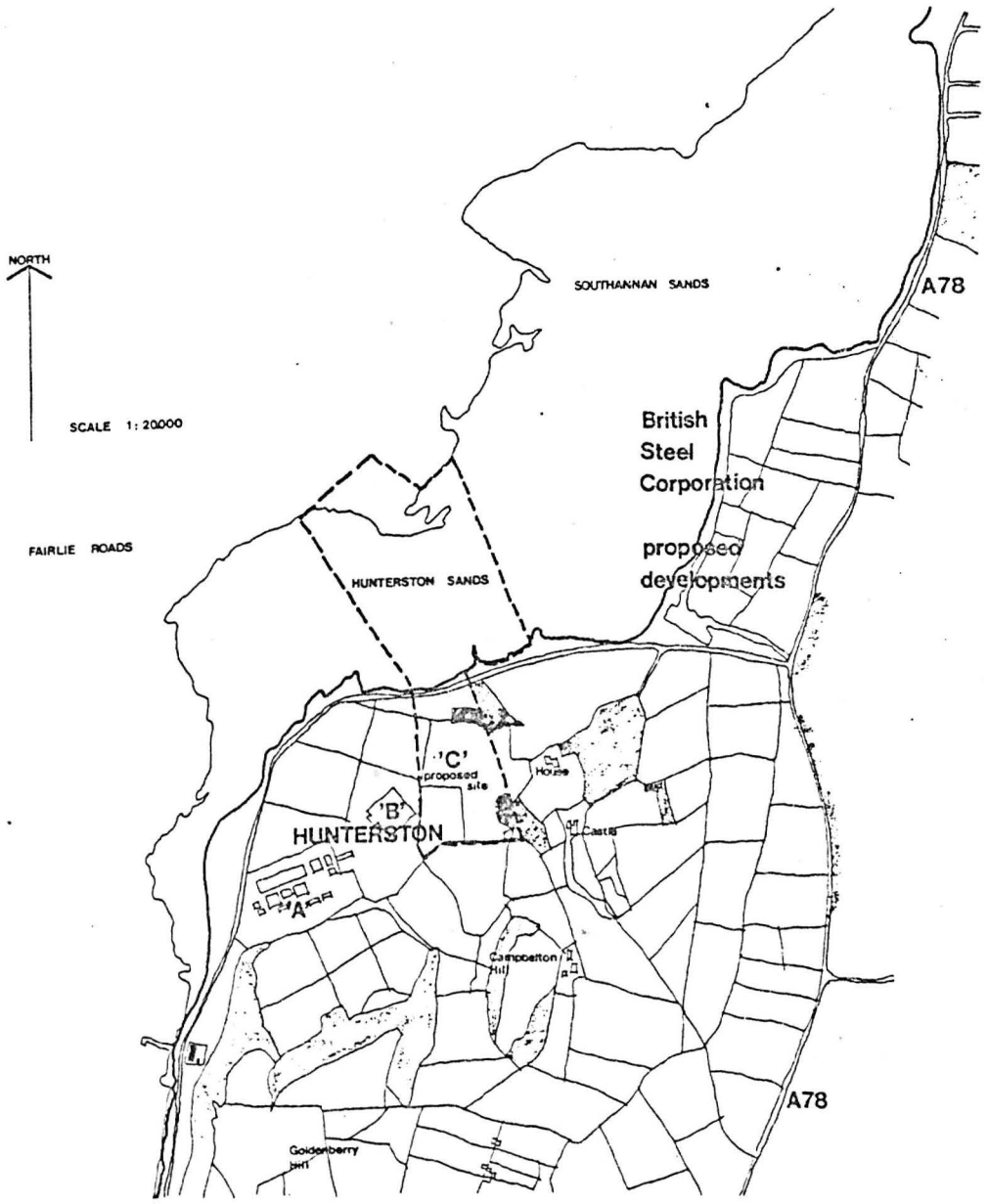
a) View from the mainland looking west.

b) View from Great Cumbrae Island looking south east.



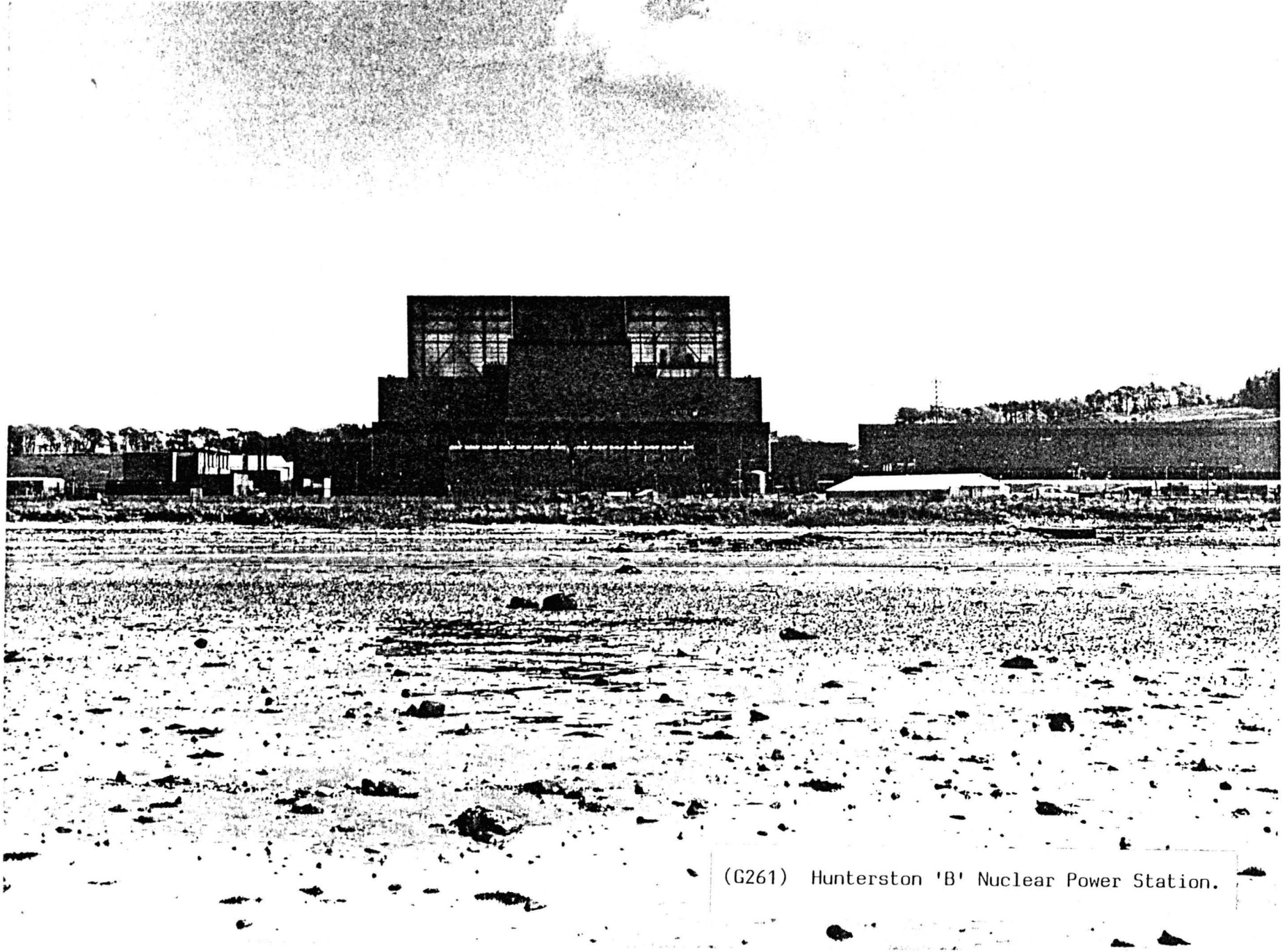
(G258) Oil rig construction yard at Hunterston (HOLM74).

Proposed siting of a third
nuclear power station at Hunterston

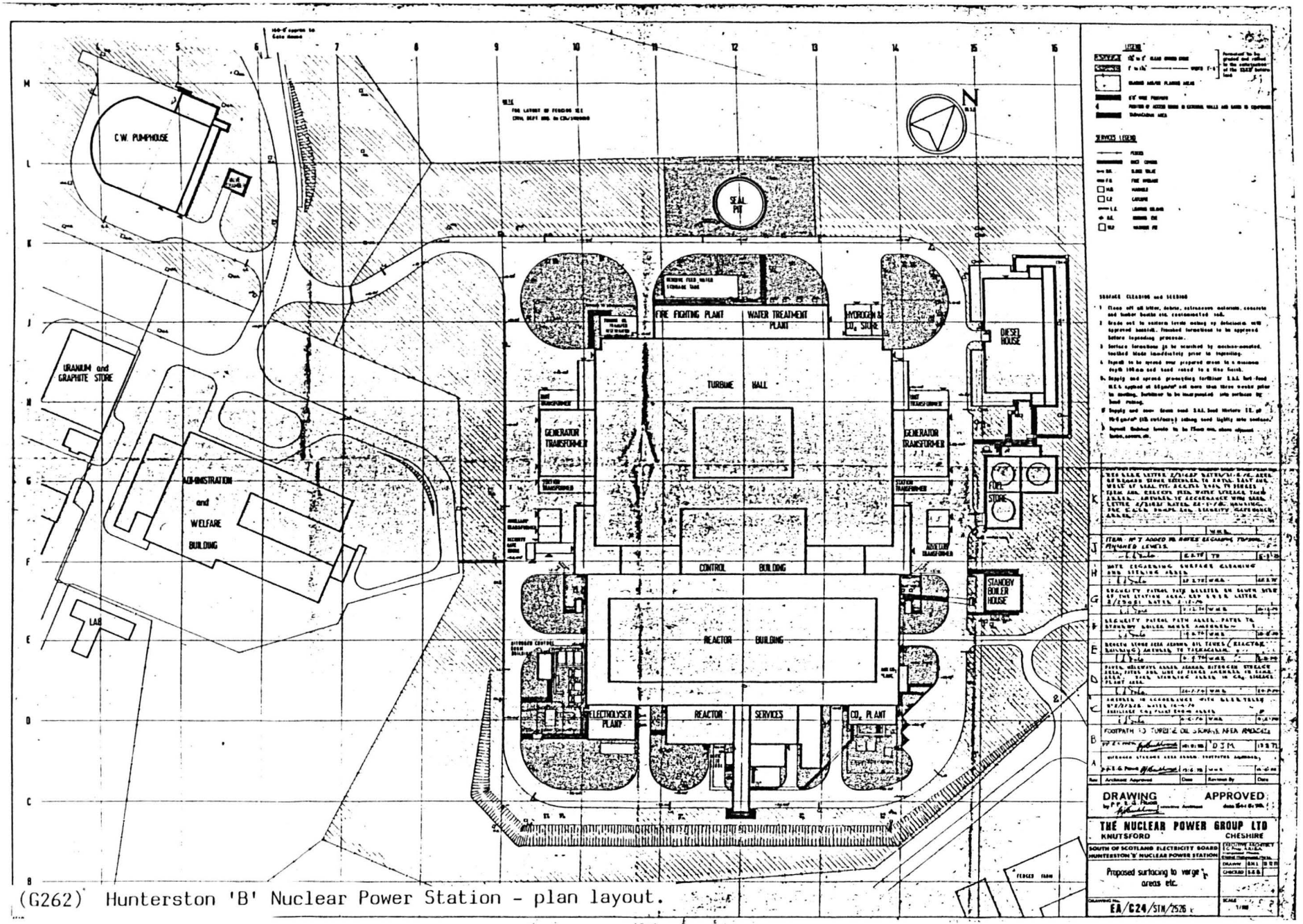


(G259) Proposed siting of a third nuclear power station at Hunterston.

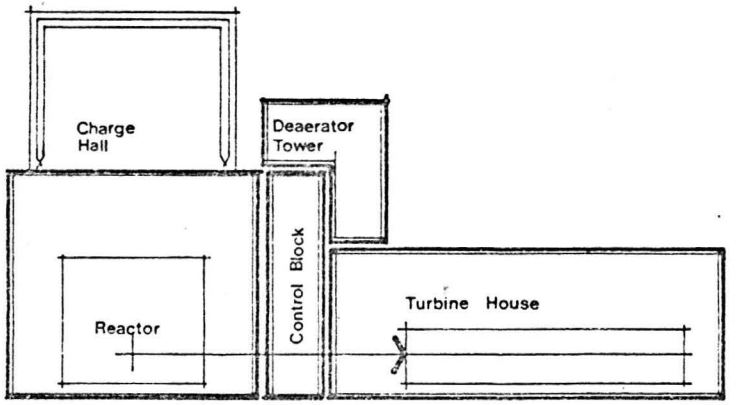
(G260) Hunterston 'A' Nuclear Power Station.



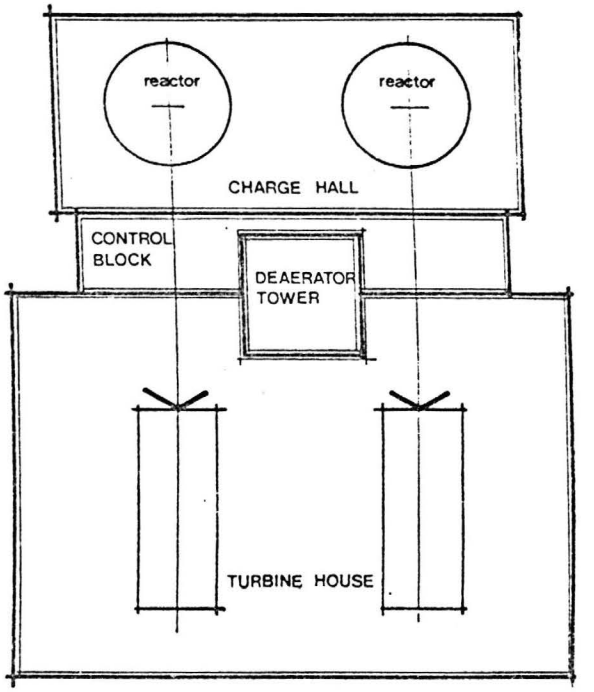
(G261) Hunterston 'B' Nuclear Power Station.



(G262) Hunterston 'B' Nuclear Power Station - plan layout.

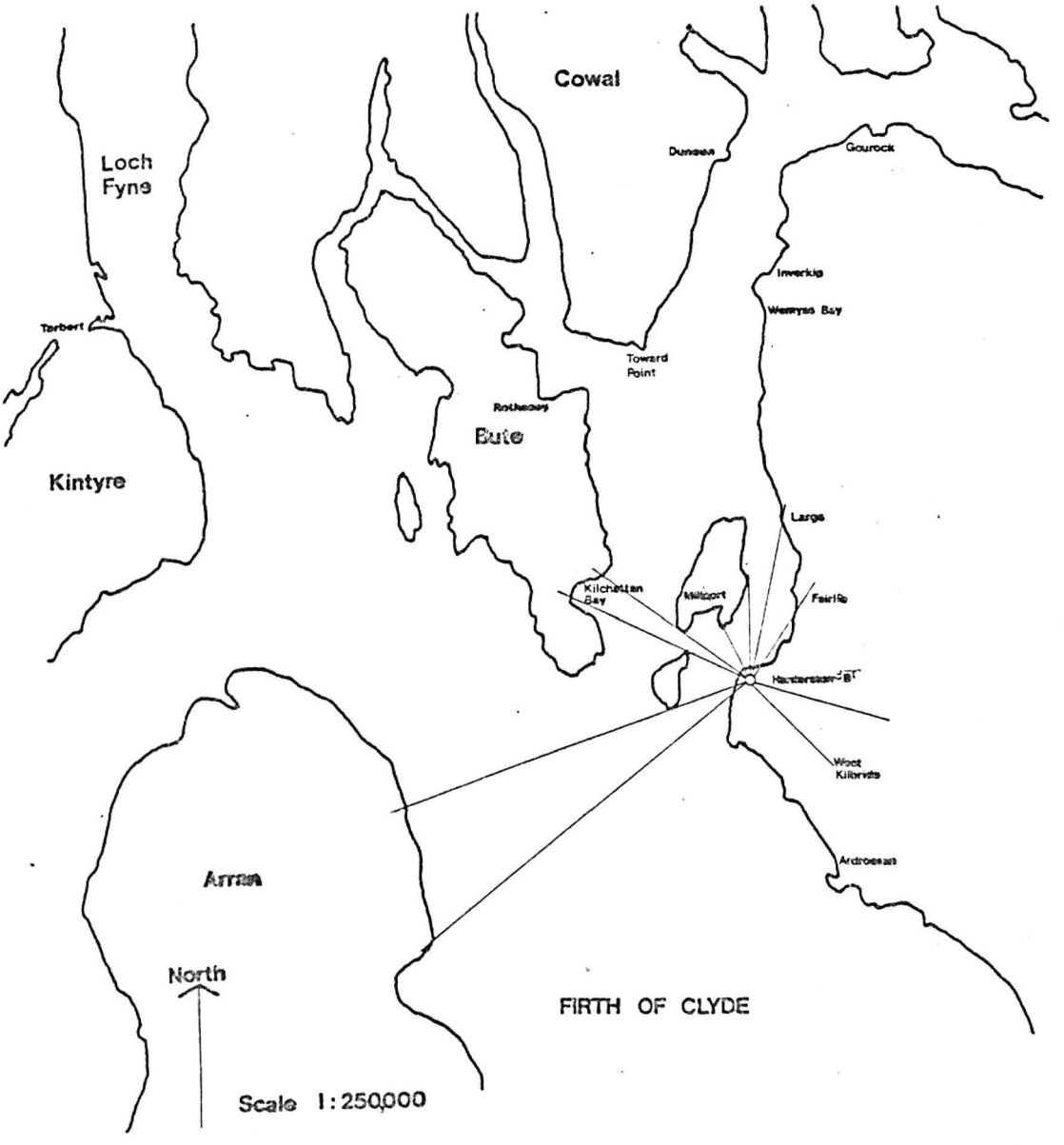


Section

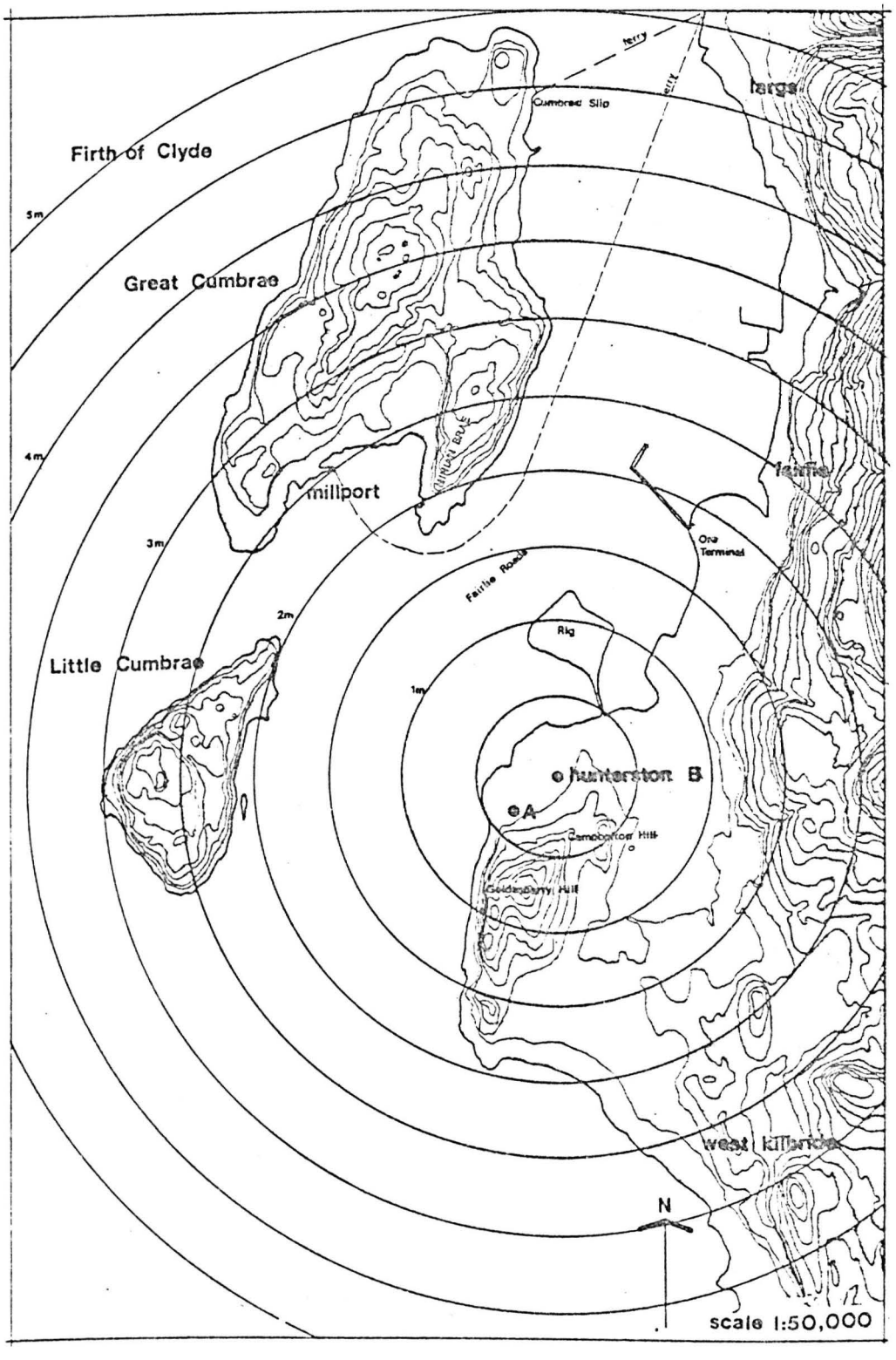


Plan

(G263) Hunterston 'B' Nuclear Power Station - sketch plan and section.

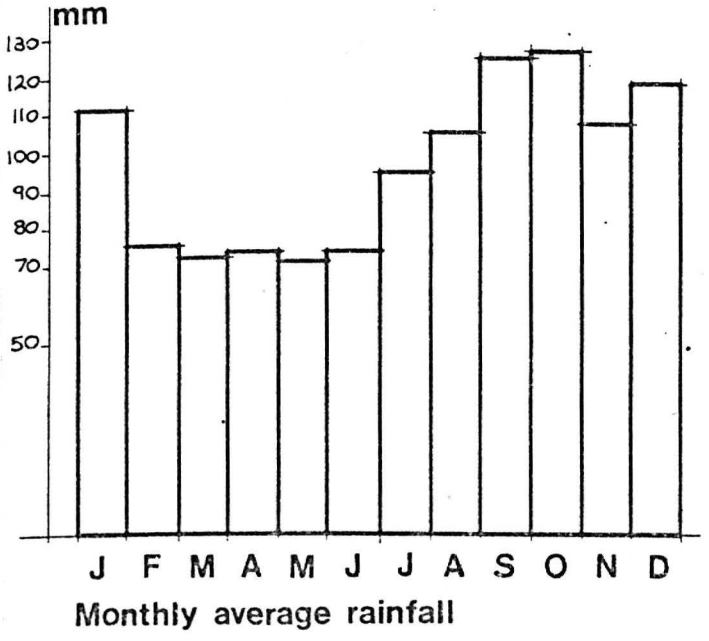


(G264) Visual impact on the Clyde estuary.

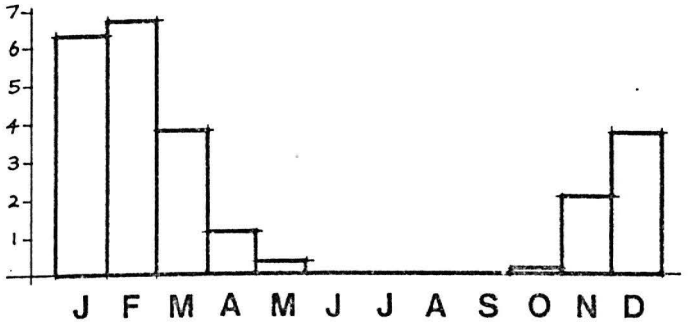


(G265) The local visual impact from Hunterston 'B'.

APPENDIX 2

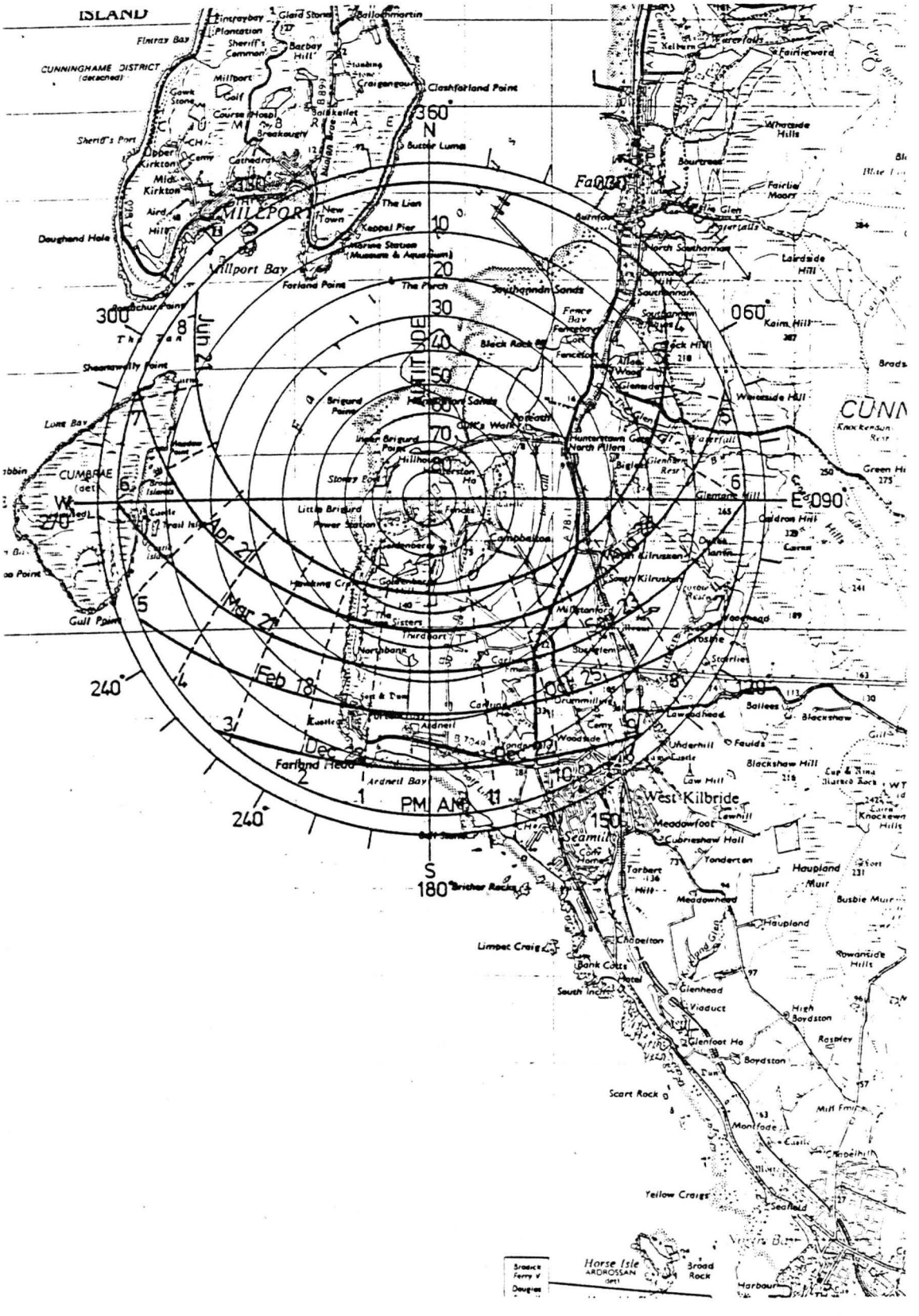


(G266) Climatological data, Hunterston. : monthly average rainfall.

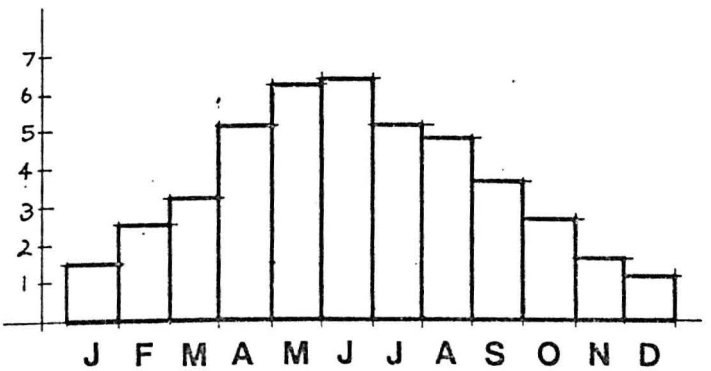


No. of days per month with snow or sleet falling

(G267) Climatological data, Hunterston : no. of days per month with snow or sleet falling.

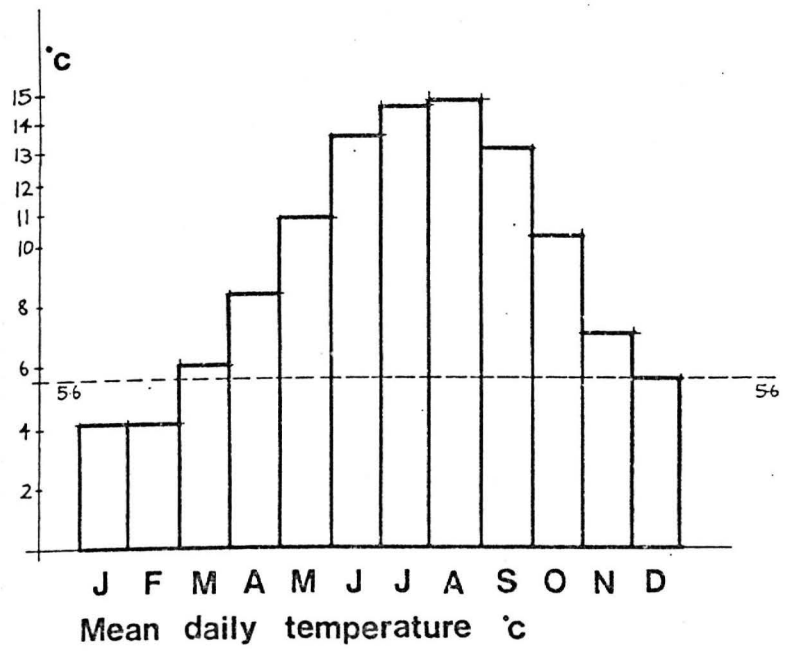


(G268) Solar azimuth and altitude chart for 56° north.

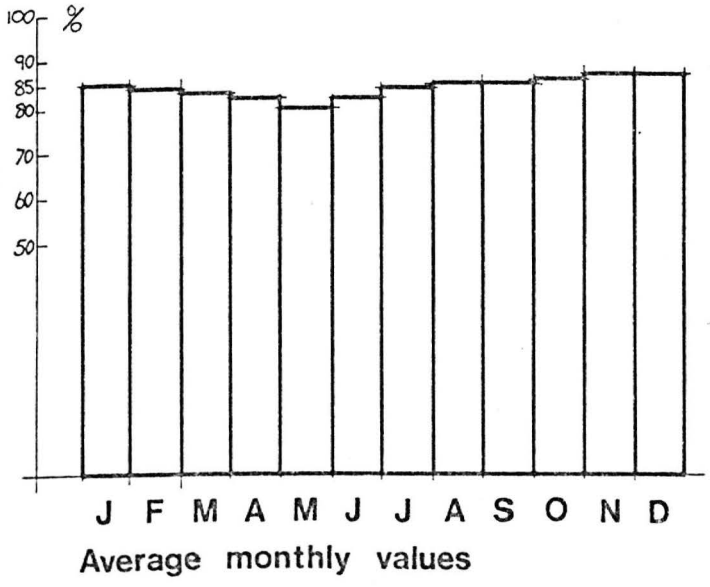


Average Daily Duration of Bright Sunshine (hours)

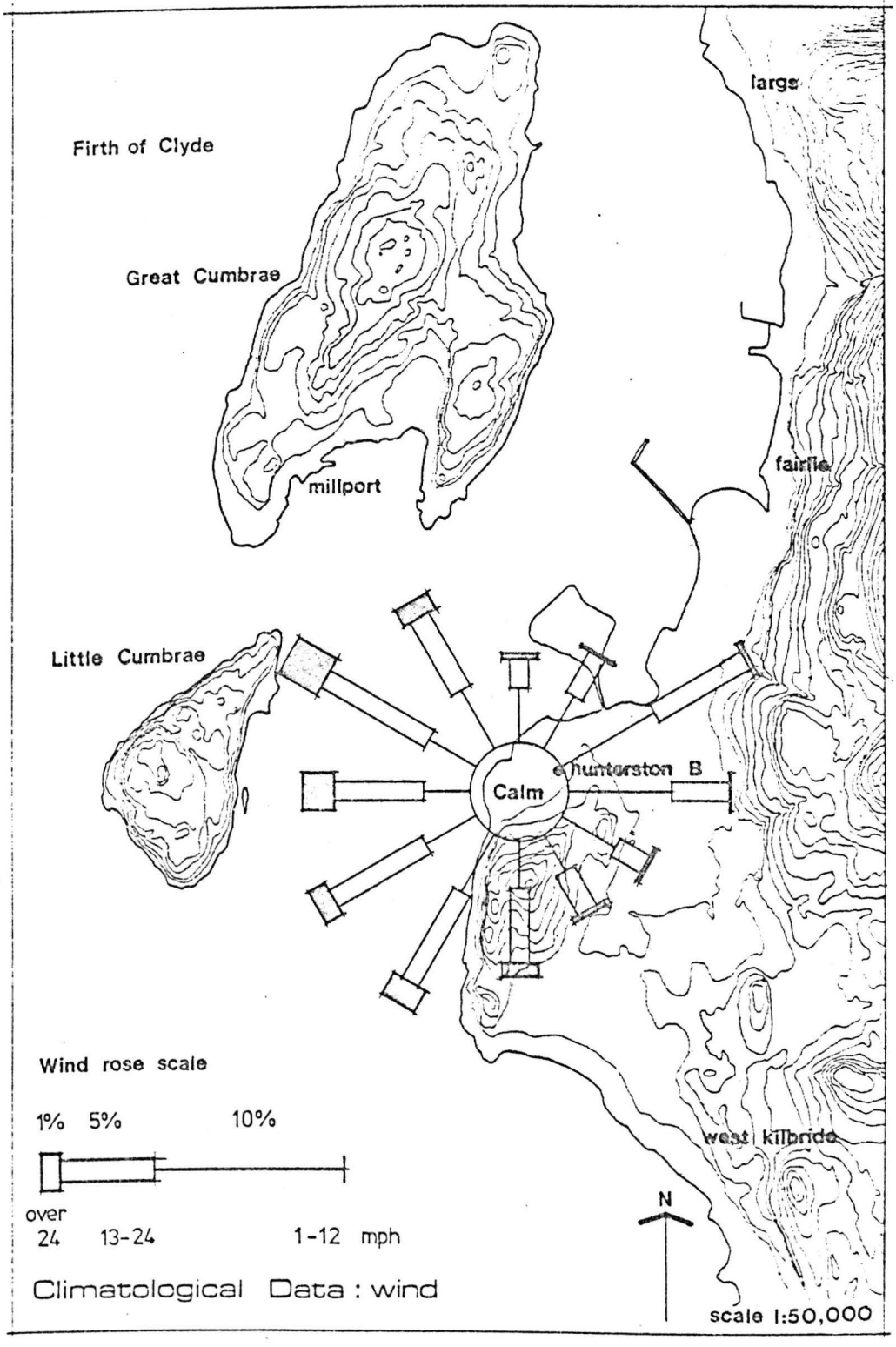
(G269) Climatological data, Hunterston : average daily duration of bright sunshine (hours).



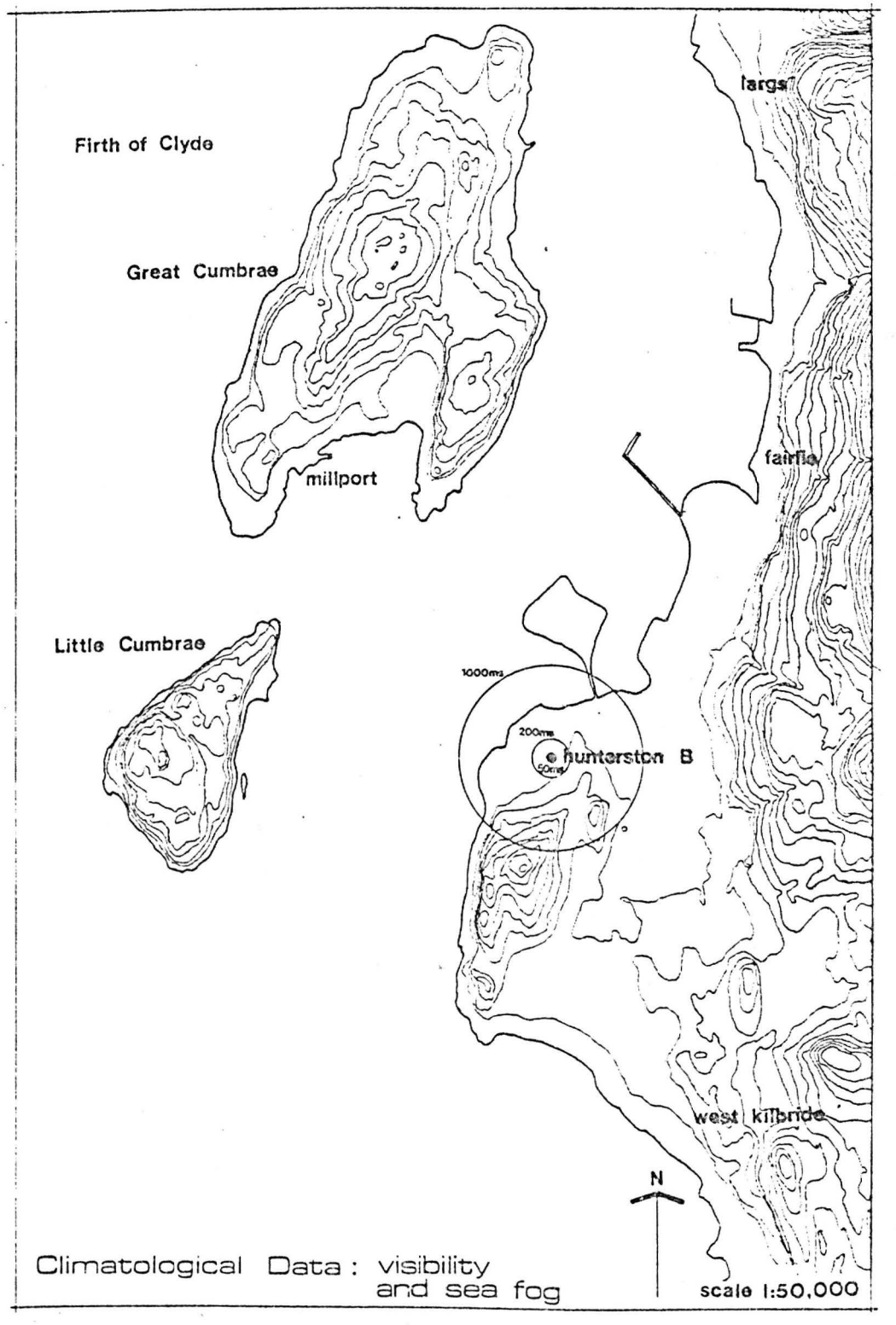
(G270) Climatological data, Hunterston. : mean daily temperature ^{o}c



(G271) Climatological data, Hunterston. Relative humidity, average monthly values.

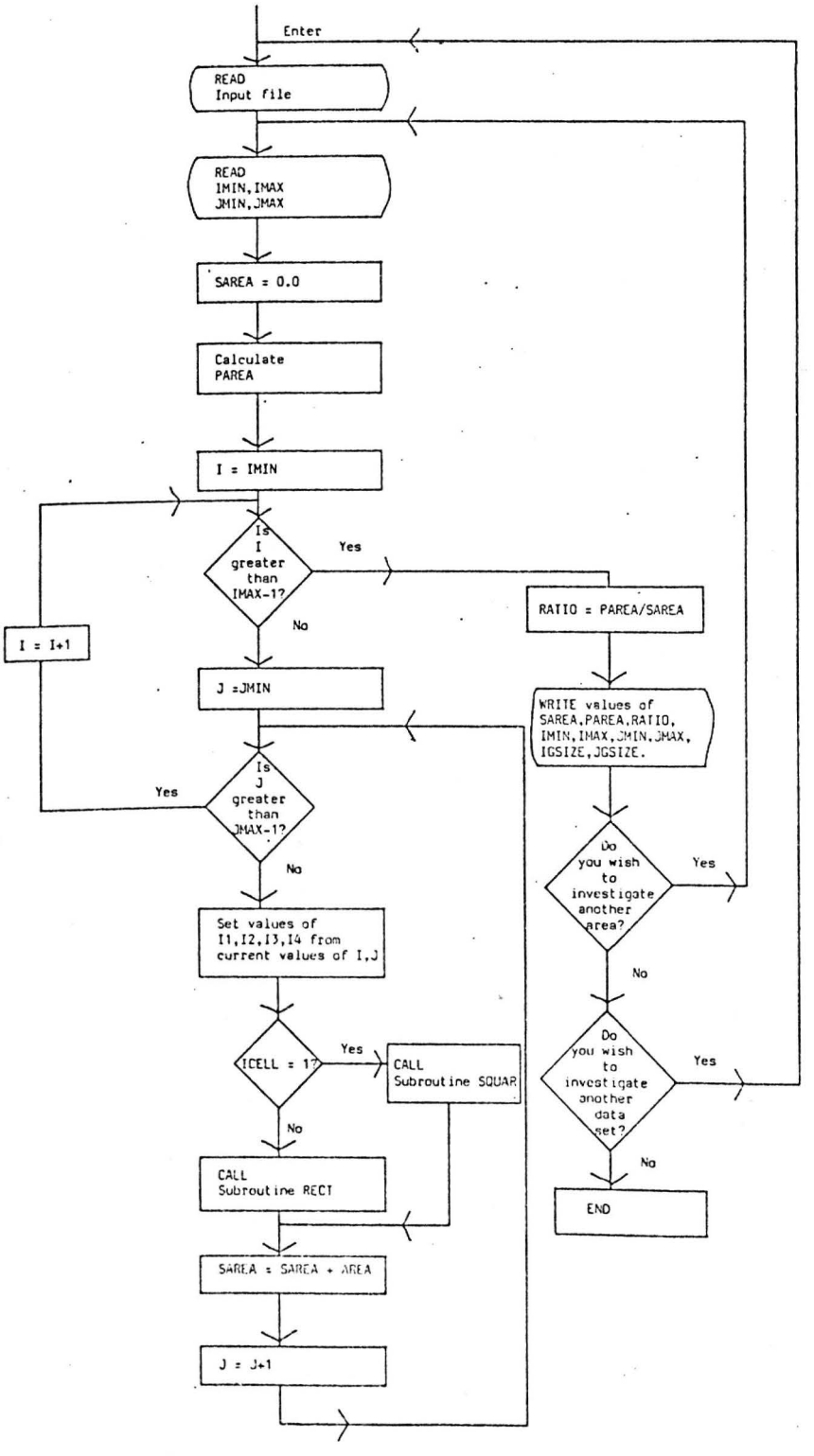


(G272) Climatological data, Hunterston. : wind rose at Hunterston 'B'.

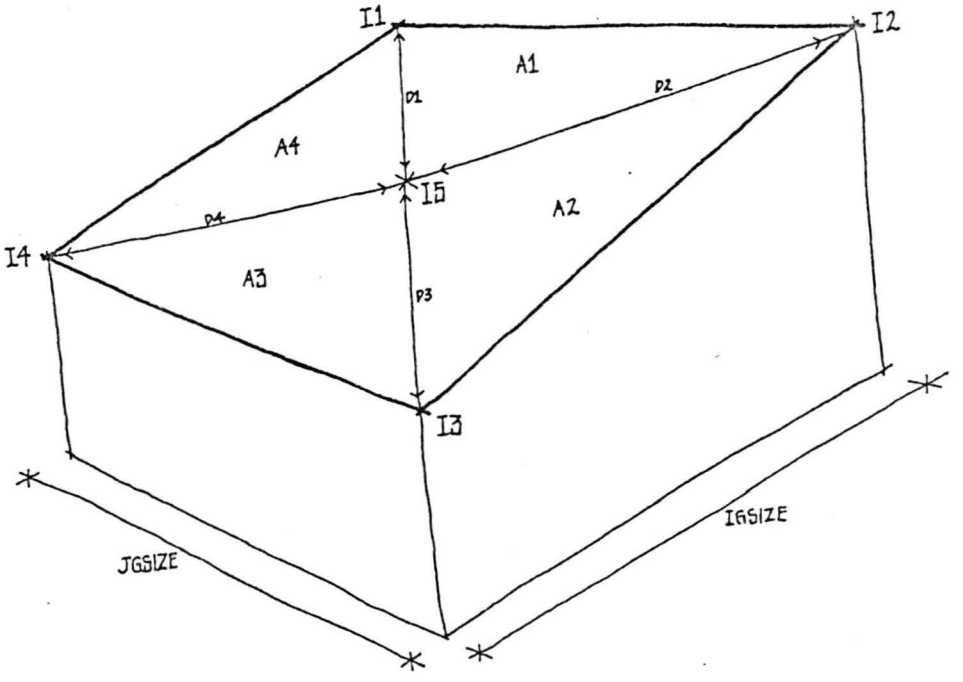


(G273) Climatological data, Hunterston. : visibility and the instance of sea fog.

APPENDIX 3

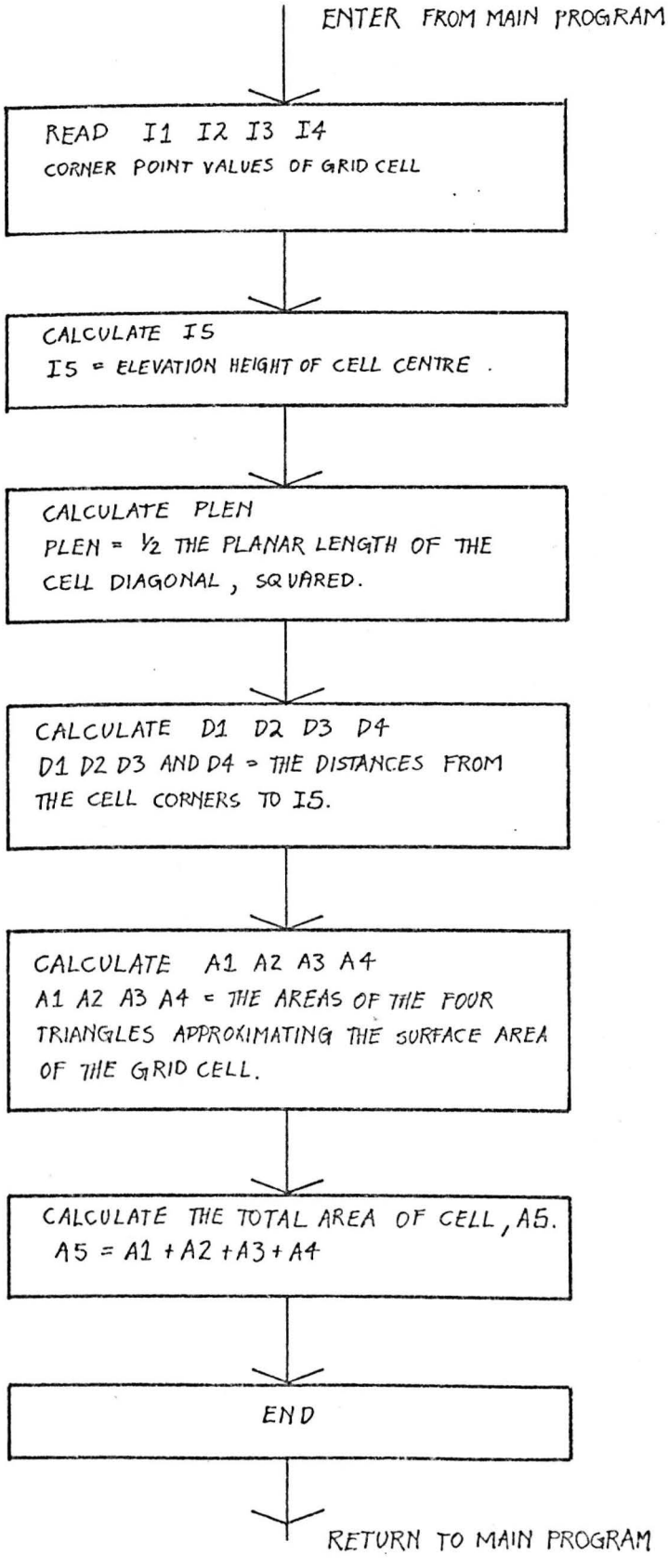


(G274) Algorithm flow chart - program SURFAC.

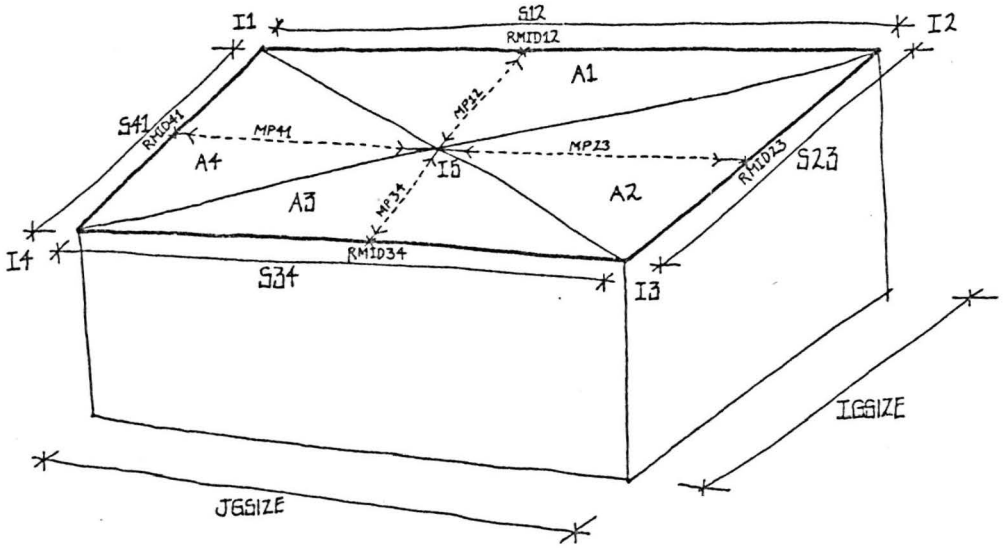


PLEN = Half the planar length of the main diagonal, squared.
I5 = (I1+I2+I3+I4)/4
D1 = I5 - I1 distance
D2 = I5 - I2 distance
D3 = I5 - I3 distance
D4 = I5 - I4 distance
A1 = Area of triangle I5,I1,I2
A2 = Area of triangle I5,I2,I3
A3 = Area of triangle I5,I3,I4
A4 = Area of triangle I5,I4,I1
Surface area of grid cell = AREA = A1+A2+A3+A4

(G275) Naming convention in subroutine SQUAR.

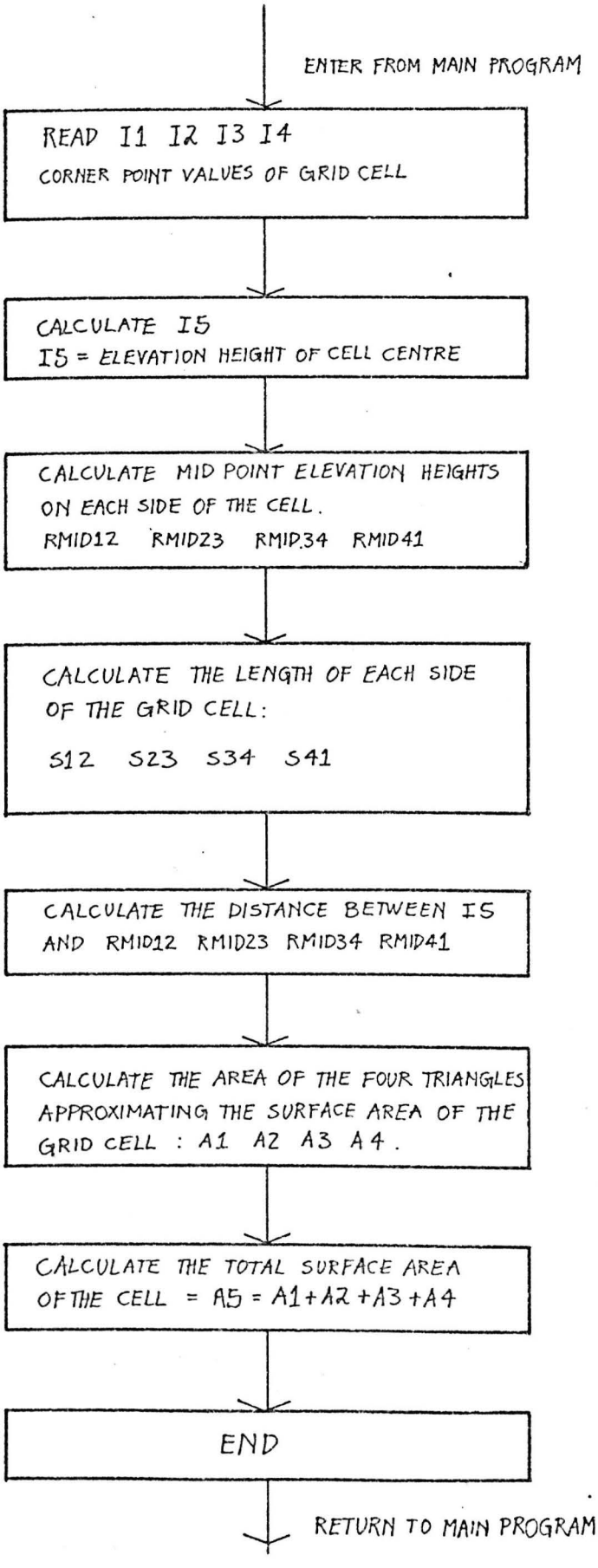


(G276) Algorithm flow chart - subroutine SQUAR.



I5 = (I1+I2+I3+I4)/4
RMID12 = Elevational value of the mid point between I1 and I2.
RMID23 = Elevational value of the mid point between I2 and I3.
RMID34 = Elevational value of the mid point between I3 and I4.
RMID41 = Elevational value of the mid point between I4 and I1.
S12 = I1-I2 distance
S23 = I2-I3 distance
S34 = I3-I4 distance
S41 = I4-I1 distance
MP12 = I5 - RMID12 distance
MP23 = I5 - RMID23 distance
MP34 = I5 - RMID34 distance
MP41 = I5 - RMID41 distance
A1 = Area of triangle I5,I1,I2
A2 = Area of triangle I5,I2,I3
A3 = Area of triangle I5,I3,I4
A4 = Area of triangle I5,I4,I1
Surface area of grid cell = AREA = A1+A2+A3+A4

(G277) Naming convention in subroutine RECT.



(G278) Algorithm flow chart -subroutine RECT.

APPENDIX 4

TOWER LIBRARY

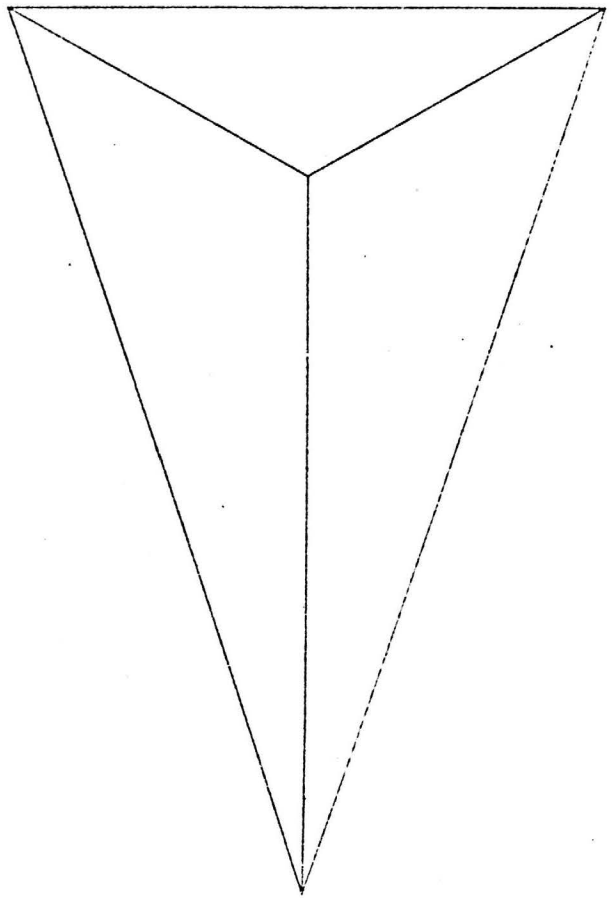
Pylon Building Component

Primitive Tetrahedron representing 1/4 of K-Unit in pylon base

File Name: DQK16

Plot File Name: CALCØ3.PLT

6m High Component : DQK16
9m " " : DQK19
12m " " : D6QSTD (for PYLON TYPE D60°STD)



(G279)

TOWER LIBRARY

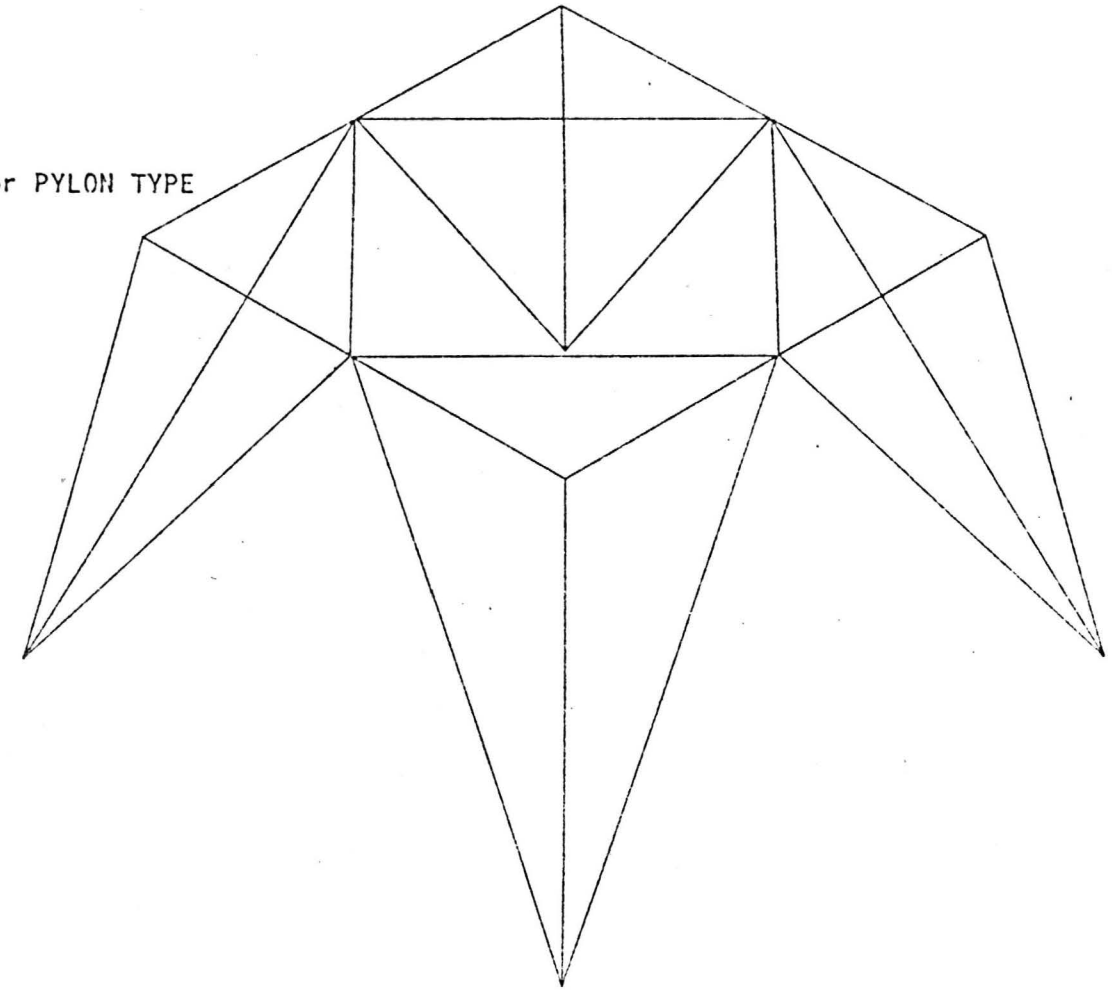
Pylon Bilding Component

K-Unit in Pylon Base

File Name: DK16

Plot File Name: CALCØ4.PLT

6m High Component: DK16
9m " " : DK19
12m " " : D6BSTD (for PYLON TYPE D60°STD)



(G280)

TOWER LIBRARY

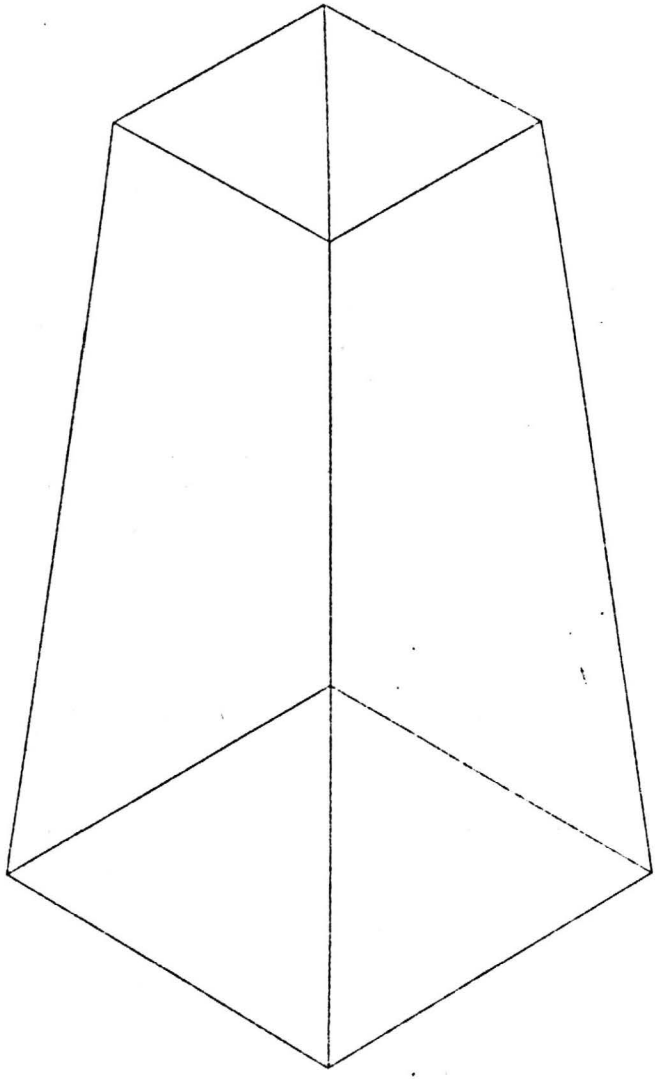
Pylon Building Component

MID SECTION

File Name: DMS

Plot File Name: CALCØ6.PLT

8.11m High Section : D3MS
8.2 m " " : DJTMS
13.6 m " " : DMS
8.11m " " : D6MS (for PYLON TYPE D60°STD)



(G281)

TOWER LIBRARY

Pylon Building Component

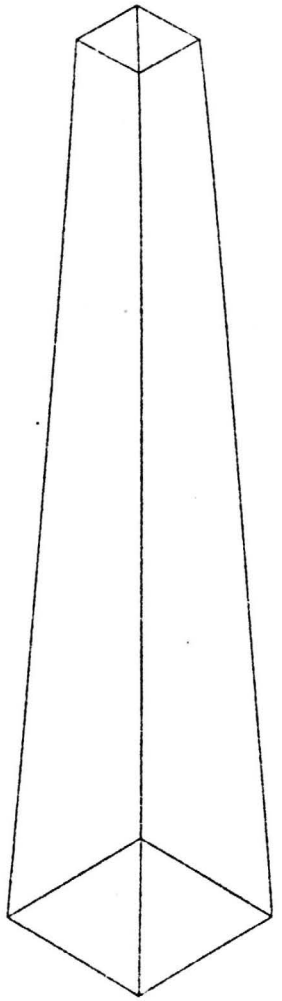
UPPER SECTION

File Name DUS

Plot File Name: CALCØ7.PLT

25m High Component : DUS
28.4m " " : D3US
31m " " : DJTUS
31.5m " " : D6US

(G282)



TOWER LIBRARY

Pylon Building Component

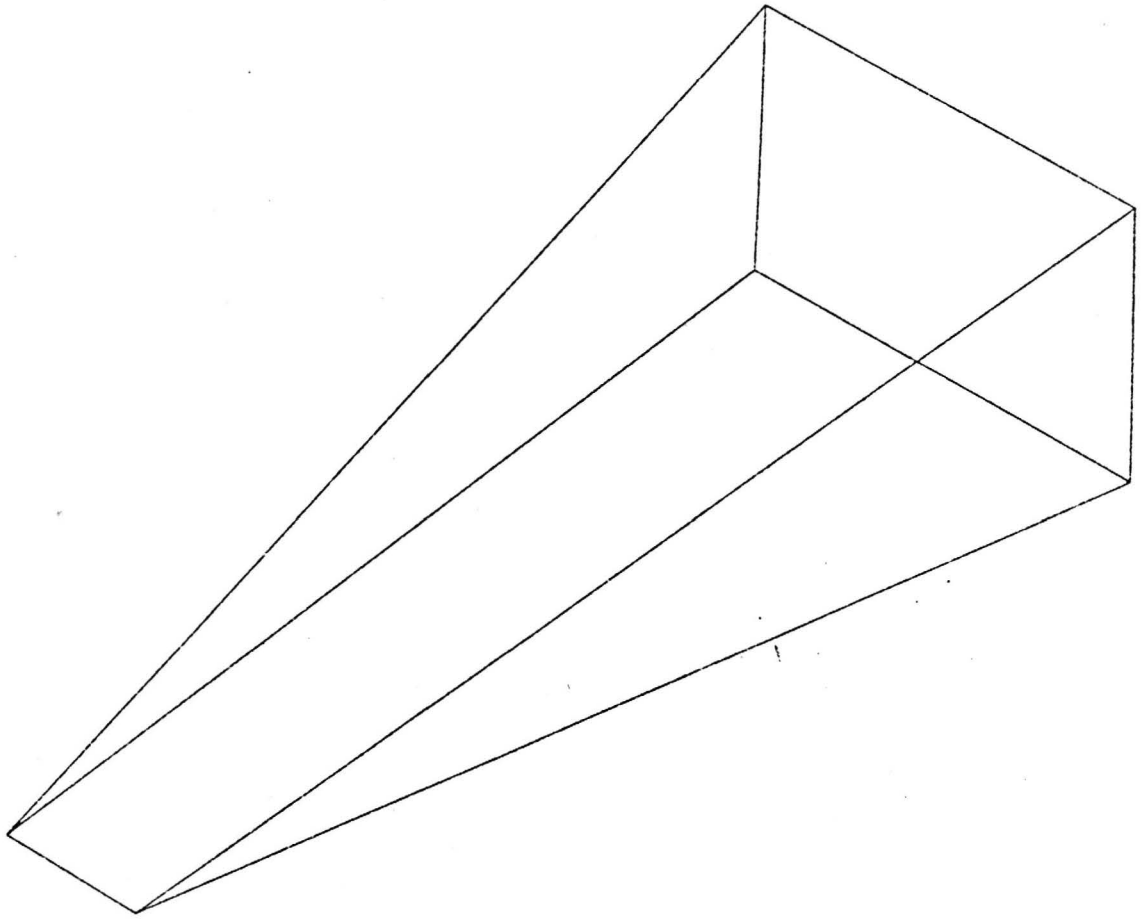
PYLON BRANCH

File Name: DJBSQA

Plot File Name: CALCØ8.PLT

BRANCH TYPES SQUARED: DJBSQA
: DJBSQB
: DJBSQC

BRANCH TYPES TAPERED: DBRA
: DBRB
: DBRC



(G283)

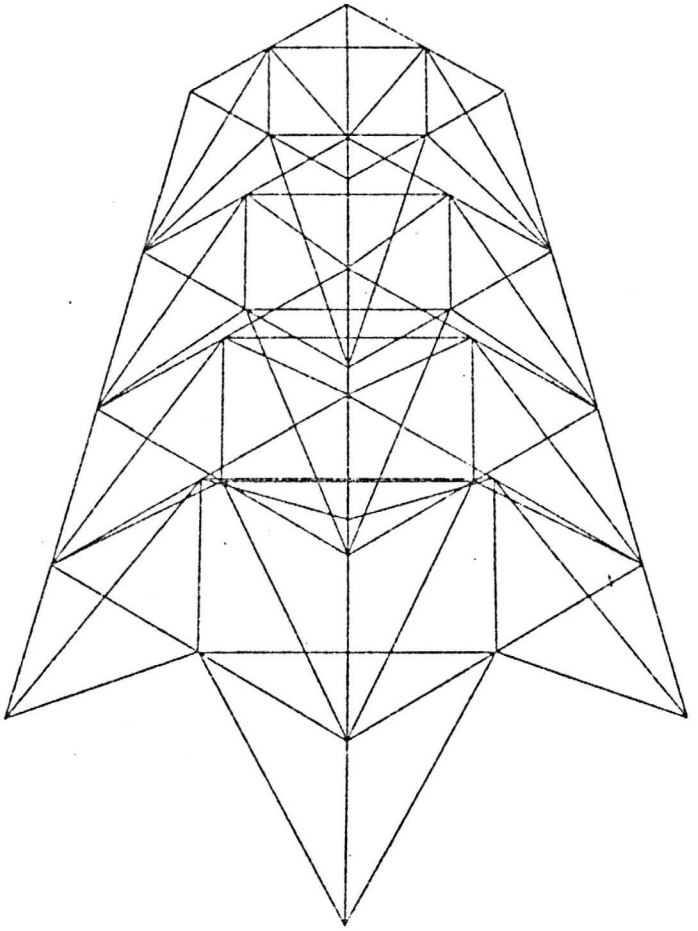
INTERMEDIATE PYLON CONSTRUCTION STAGE

Full K-Unit Pylon Base

File Name: DBE12

Plot File Name: CALCØ5.PLT

TYPICAL VIEW



(G284)

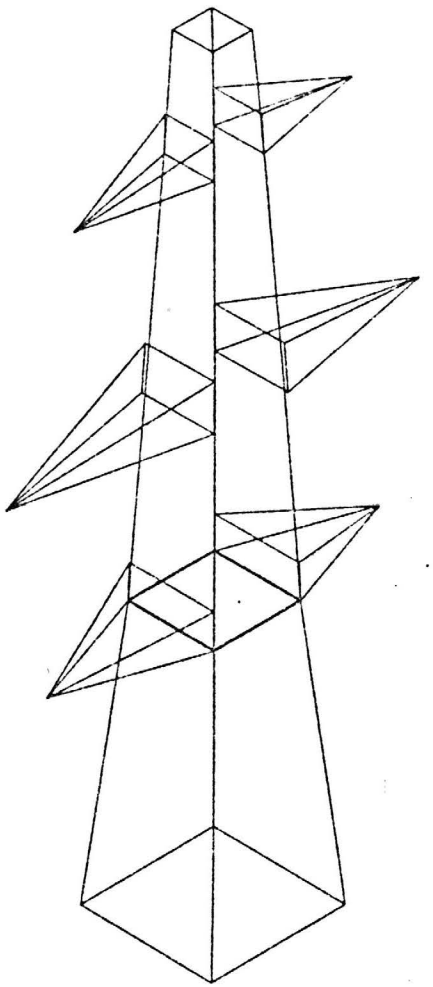
INTERMEDIATE PYLON CONSTRUCTION STAGE

UPPER SECTION OF PYLON WITH BRANCHES

File Name: DP

Plot File Name: CALCØ9.PLT

TYPICAL VIEW



(G285)

TOWER LIBRARY

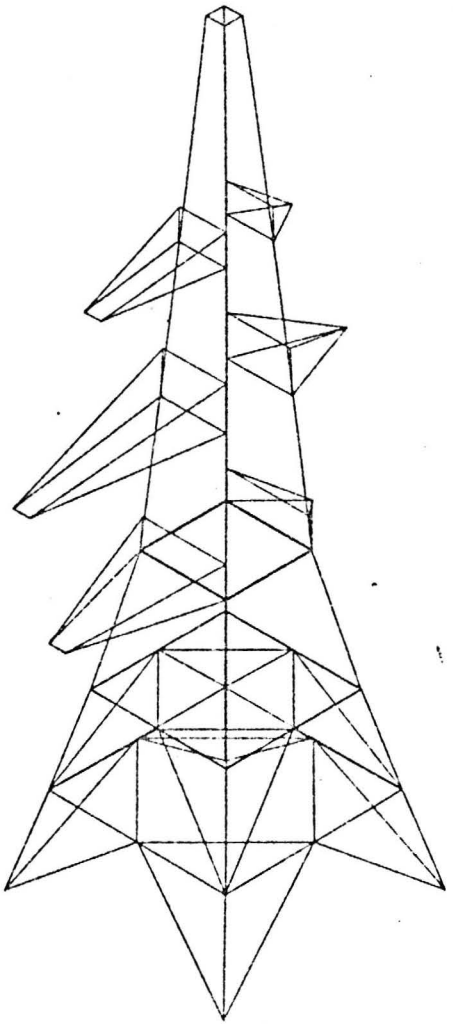
Pylon Types

DJTSTD

File Name: DJTSTD

Plot File Name: CALC11.PLT

TYPICAL VIEW



(G286)

TOWER LIBRARY

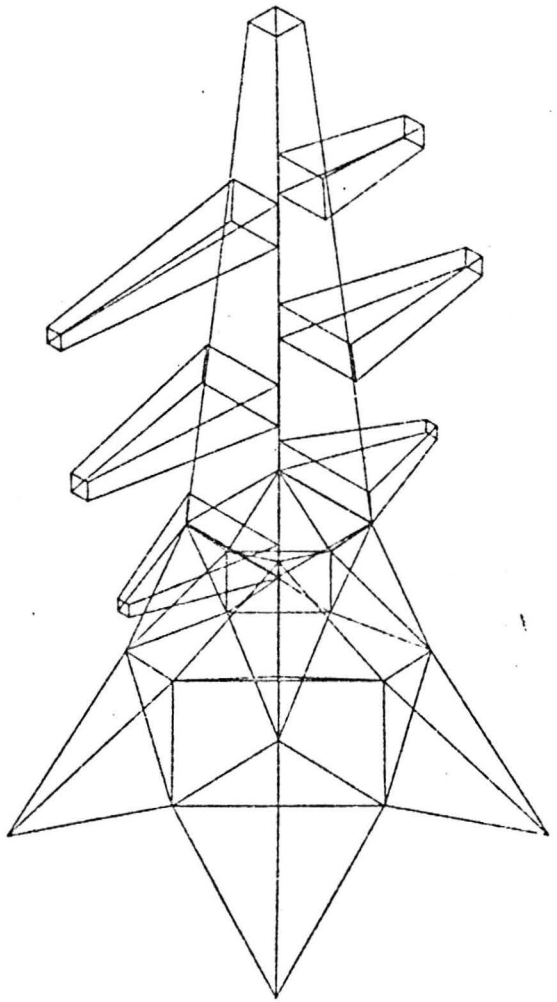
Pylon Types

D60°STD

File Name: D6STD

Plot File Name: CALC21.PLT

TYPICAL VIEW



(G287)

TOWER LIBRARY

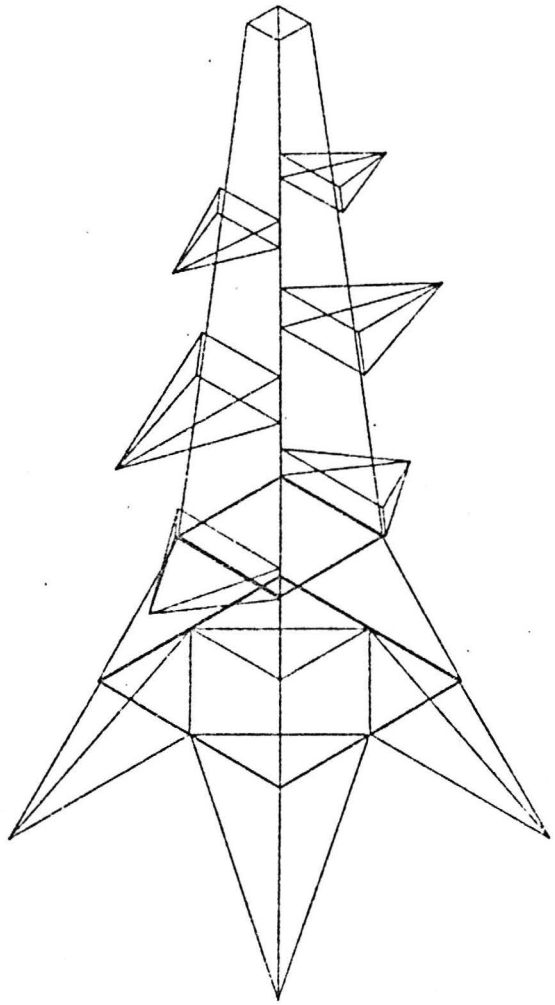
Pylon Types

D30°M3

File Name: D3M3

Plot File Name: CALC12.PLT

TYPICAL VIEW



(G288)

TOWER LIBRARY

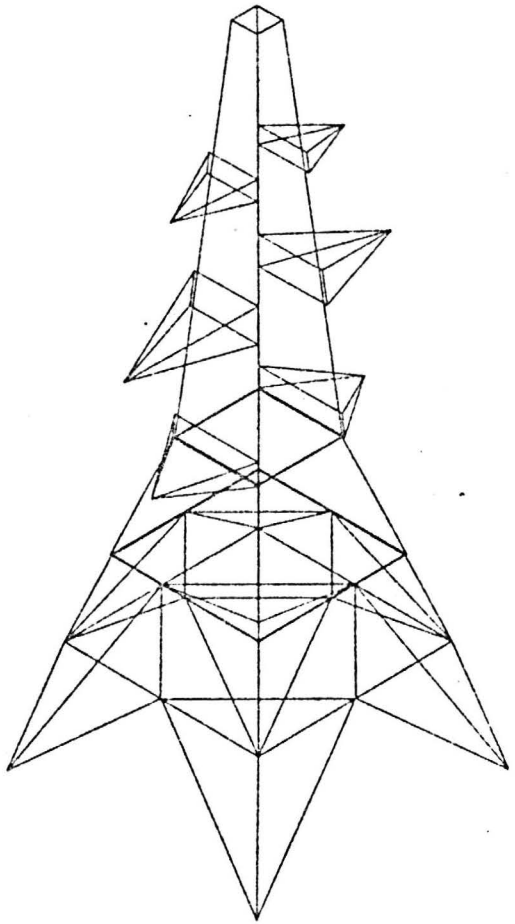
Pylon Types

D30°E3

File Name: D3E3

Plot File Name: CALC14.PLT

TYPICAL VIEW



(G289)

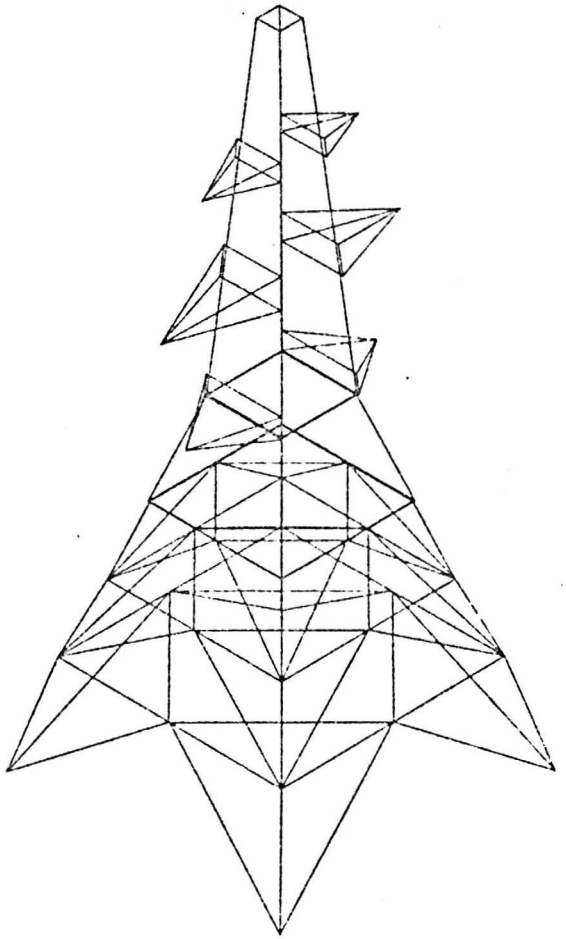
TOWER LIBRARY Pylon Types

D30°E9

File Name: D3E9

Plot File Name: CALC13.PLT

TYPICAL VIEW



(G290)

TOWER LIBRARY

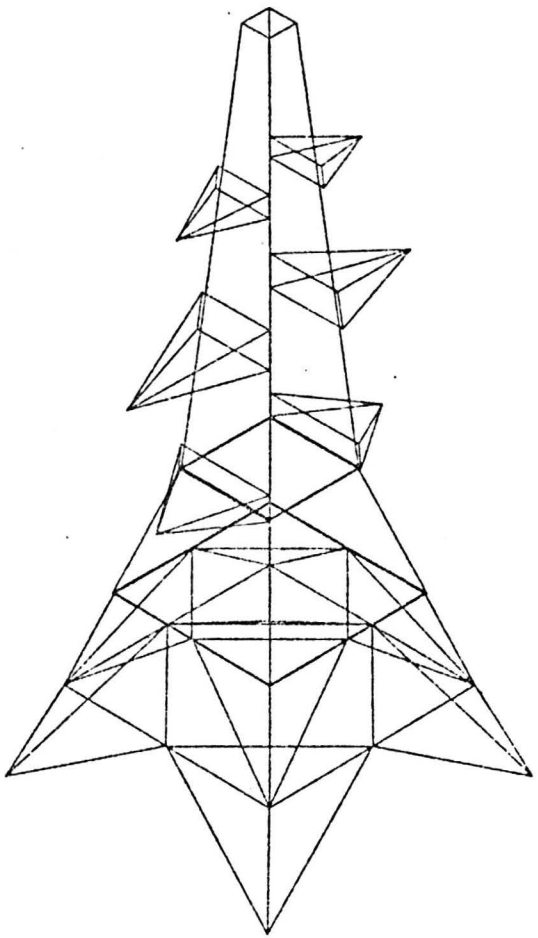
Pylon Types

D30°STD

File Name: D3STD

Plot File Name: CALC15.PLT

TYPICAL VIEW



(G291)

TOWER LIBRARY

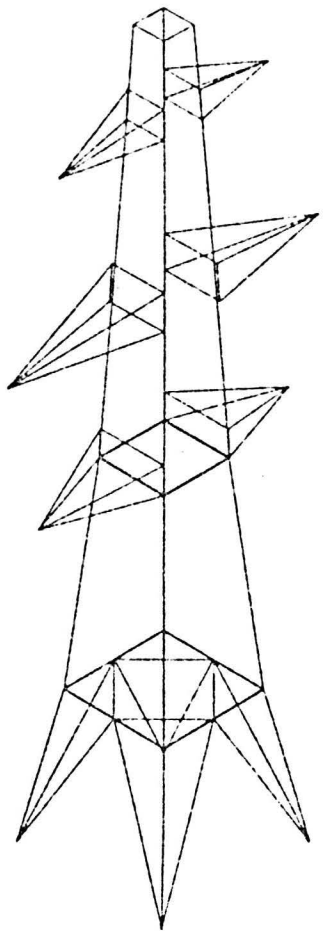
Pylon Types

DM3

File Name: DM3

Plot File Name: CALC2Ø.PLT

TYPICAL VIEW



(G292)

TOWER LIBRARY

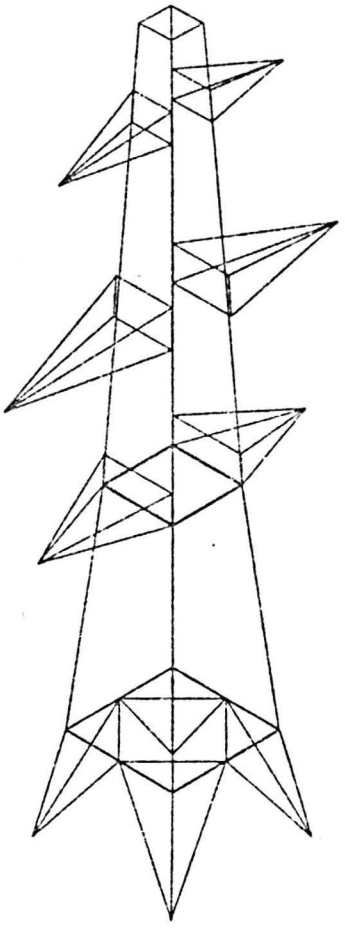
Pylon Types

DM6

File Name: DM6

Plot File Name: CALC19.PLT

TYPICAL VIEW



(G293)

TOWER LIBRARY

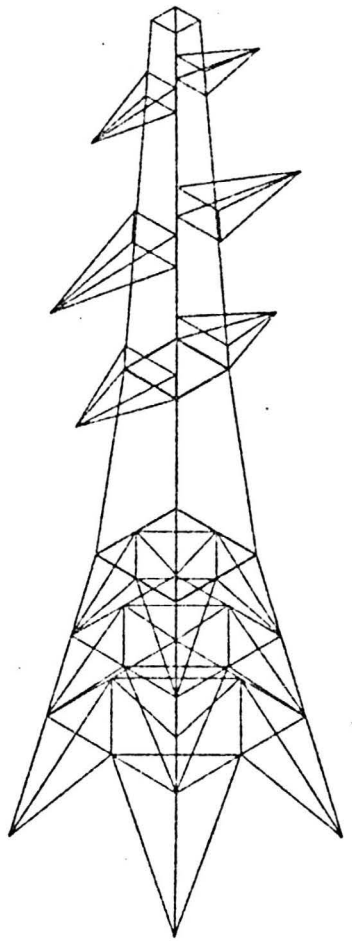
Pylon Types

DE9

File Name: DE9

Plot File Name: CALC18.PLT

TYPICAL VIEW



(G294)

TOWER LIBRARY

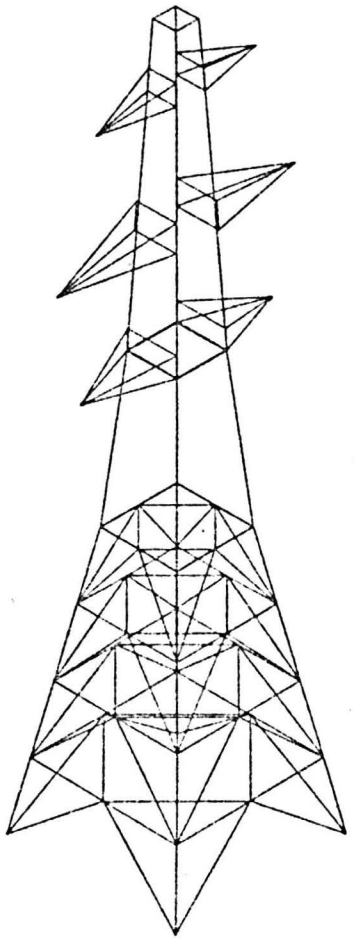
Pylon Types

DE12

File Name: DE12

Plot File Name: CALC17.PLT

TYPICAL VIEW



(G295)

TOWER LIBRARY

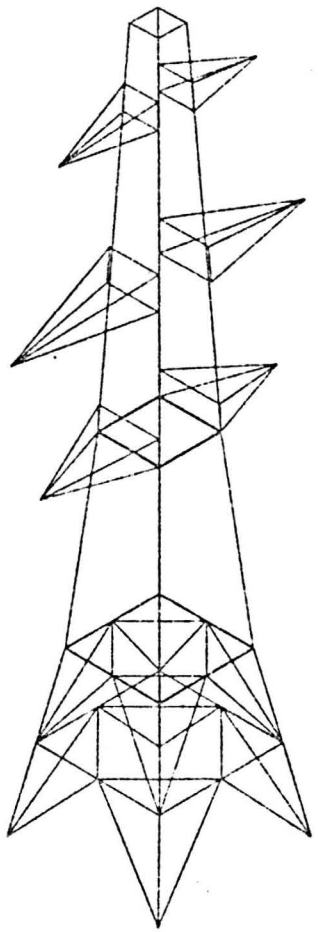
Pylon Types

DSTD

File Name: DSTD

Plot File Name: CALC16.PLT

TYPICAL VIEW



(G296)

TOWER LINE MODELLING

Torness-Dalkeith Route (G297)

File Name: TA

Plot File Name: CALCØØ.PLT

AERIAL VIEW OF THE PYLON LINE

TOWER TYPES

1. DJT
2. D 30°M3
3. D 30°M3
4. DSTD
5. DE12
6. D 30°E9

TOWER LINE MODELLING

Torness-Eccles Circuitous Route (G298)

File Name: TC

Plot Fiel Name: CALCØ.PLT

AERIAL VIEW OF THE PYLON LINE

TOWER TYPES

A. DJTSTD
B. D30°E3
C. D60°STD
D. D30°E3
E. D60°STD
F. D30°E9
G. DSTD
H. DSTD
J. DSTD
K. D60°STD

TOWER LINE MODELLING

Torness- Eccles Direct Route (G299)

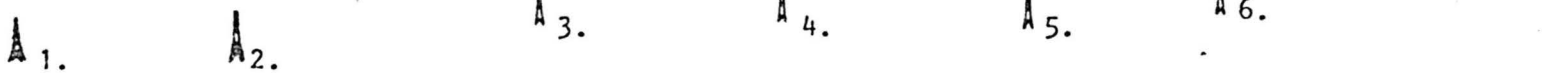
File Name: TD

Plot File Name: CALCØ2.PLT

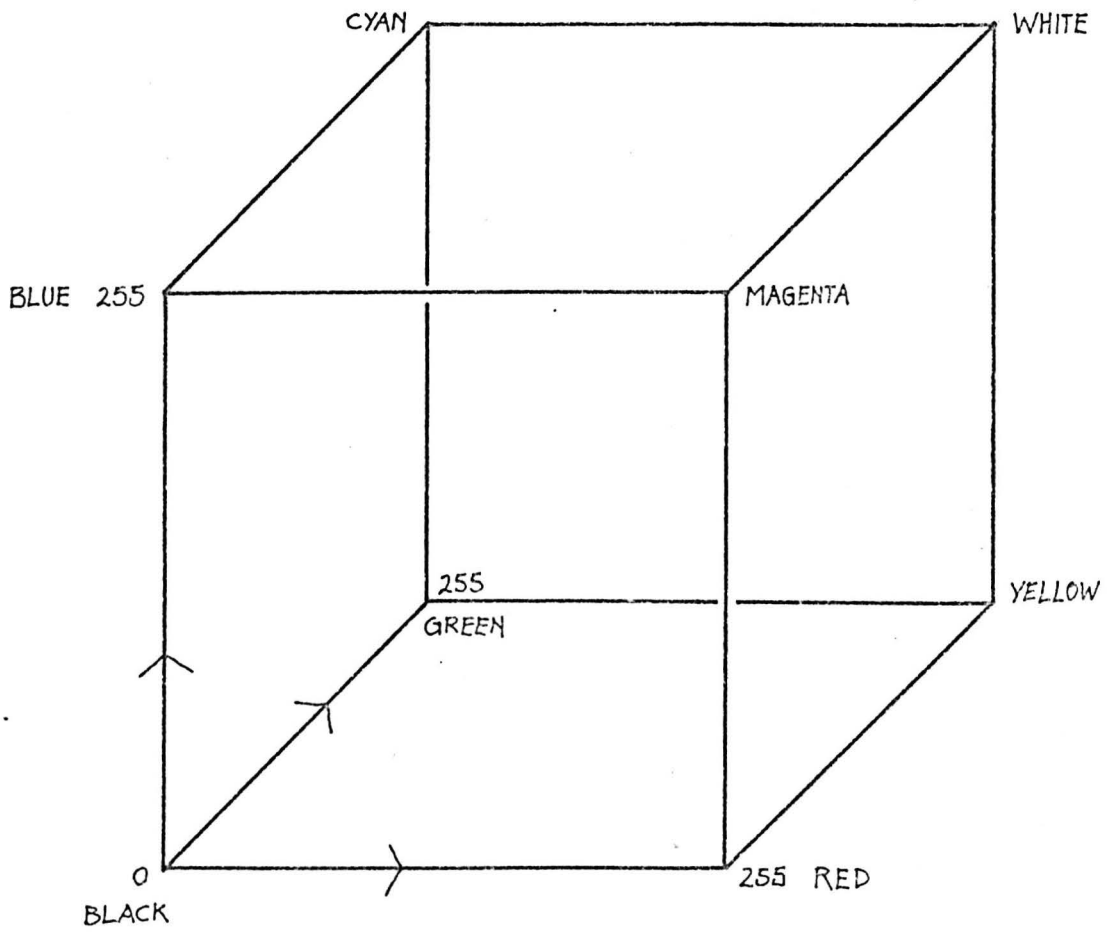
AERIAL VIEW OF THE PYLON LINE

TOWER TYPES

1. DJTSTD
2. DE9
3. DM6
4. DM6
5. DM3
6. DM6
7. D30°STD



APPENDIX 6



(G300) RGB (Red/Green/Blue) Colour Model Box. (STEA83).