...ON CITY COUNCIL

...ilding Permit Application

...he City Engineer

...e undersigned hereby apply for permission to carry out the works described in ... attached plans and specifications deposited herewith and in accordance with ... bylaws of the Wellington City Council.

WORKS DEPARTMENT BUILDING INSPECTION BRANCH RECEIVED - 6 NOV 1986 REGISTRAR WELLINGTON

WORKS DEPARTMENT PLUMBING AND DRAINAGE BRANCH RECEIVED NOV 1986 ENGINEER

PAGES 1 & 2 TO BE COMPLETED BY THE APPLICANT

ADDRESS OF PROPOSED WORK

101 - 117.

Address Street No. and Name: Cuba street 111-117.

Suburb: town.

OWNER

Name: WWMC & LI

Address: 107 Cuba street.

LEGAL DESCRIPTION (from property rates demand if available)

Lot No. 1 D.P. No. 15298 Area M² 1375 m²

BUILDER (if owner builder, tick ☐)

Name of Company: Dixon & McKinlay

Postal Address: Box 40080 Upper Hutt

Phone No. 289789

Description of Proposed Work

New Building	✓	Conversion	
Addition	✓	Demolition	
Alteration	✓	Repile	

STAGE I

Description of Use and Main Purpose of Building

ie Dwelling: Flats: Business: Other Building:

OTHER BUILDING.

ESTIMATED VALUE OF WORK

Building $25,000.

		less materials	balance
Mechanical Services	$		
Drainage	$	−$	=$
Plumbing	$	−$	=$
Total	$25000	STAGE I ONLY.	

Note Plan Examination Fee: A plan examination fee based on the total estimated value above is payable upon lodging this application. This will be forfeited if the building permit is not collected or is cancelled for any reason, but will be deducted from any fees paid upon collection.

TURN TO PAGE 2

FOR OFFICE USE

1-500 Sheet No. P28 Drainage Plan No.

Building District TE Aro 3

CE B239

DETAILS OF PROPOSED BUILDING

Scope of Application

Complete project ☐ tick

Partial project ✓ tick

(state nature of partial work) Piling

Number of Dwelling Units 1 Number of Occupants 1

AREA OF BUILDING

NEW BUILDING

Area of Addition

Ground Floor	M²	210 N/A
1st Floor	M²	
2nd Floor	M²	
3rd Floor	M²	
4th Floor	M²	
5th Floor	M²	
6th Floor	M²	
Total		

If additions to existing building give area of new work here Area of Adds M² .....

APPLICANT (signed by person making application)

Name: Ivd Lee P.O. 304 27-349 Upper Hutt Wgtn.

Address: c/o Smith-Leuchars

Contact Phone No's 857-809 Signed [signature] 3.12.86

FOR OFFICE USE

DOCUMENTS ATTACHED AS PART OF THIS APPLICATION WHICH ARE APPLICABLE:

Drawings – two sets ✓ Specifications 2 ✓

Calculations ✓ Water Form ☐ Govt. Clearance N/A

Bracing Schedule N/A Drainage Plan N/A Architects Signature ✓

Parking Area N/A

Application Received By: Signed [signature]

Plans Show: Elevations ✓ Sections ✓ Construction ✓

Full Dimensional Site Plan ✓

Contour Plans & longitudinal section through vehicle access from kerb ✓

ACTION TAKEN ON ABOVE [signature]

SPECIAL LICENCES ETC. Refer to:

MISCELLANEOUS NOTES:

HISTORY SHEET

	REFER TO	APPROVED BY	DATE
1. Water Supply		*(1) refer a	6.11.86
2. Town Planning	Todd	[signature]	12/11/86
3. Plumbing & Drainage	Roger.	K Spiring	20.11.86
4. Streetwork Design		[signature]	6/11/86
5. Health Branch			
6. Parks & Recreation			
7. Structural		[signature]	7/11
8. Other			

REQUIREMENTS OF VARIOUS DEPARTMENTS

STRUCTURAL

TOWN PLANNING
Complies with conditions of initial planning consent.
SIGNED .....

*(1) The water supply shall be metered. The meter is to be located externally in a accessible position to the approval of the C' Engineer. or.

BUILDING EXTENTION WATER FORM NOT REQUIRED

SPECIAL FEES

Cellar Registration Fee	$ —
Reserves Contribution	$ 137.50
Water Fee	$ 25-00
Plan Examination Fee	$ 185

DISTRICT BUILDING INSPECTOR

Excavation ✓ Retaining N/A Disposal of Soil ✓

Ground Conditions Fill ✓ Natural ✓

Demolitions N/A Hoardings N/A Gantry N/A

Encroachments approved N/A Building Line Restrictions N/A

Egress Refer to .....

Signed by District Inspector: [signature]

Date 28-11-86

APPLICATION APPROVED

Signed [signature] pp [signature] Building Superintendent

Date 1/12/86

PLUMBING AND DRAINAGE REQUIREMENTS

N.P.R.

No plumbing or drainage work to be carried out under this piling only stage contract.

Drainage Branch Requirements Completed

Proposal acceptable

Approved [signature] 19-11-86

BUILDING REQUIREMENTS

WELLINGTON CITY COUNCIL WORKS DEPT. COPY OF APPROVED PLAN To be retained on Works and Produced on Request of Building Inspector. Date 7-1-87 [signature] Building Supt.

605-356
4532-50

BUILDING PERMIT
(Office Copy)

WELLINGTON CITY COUNCIL
WORKS DEPARTMENT

No. D 005354

Date Issued 8 / 1 / 87

OWNER

Name WELLINGTON WORKING MEN'S CLUB

Mailing Address & LITERARY INSTITUTE
107 CUBA ST
WGTN 1

BUILDER

Name DIXON, McKINLAY

Mailing Address BOX 40080
UPPER HUTT

PROPERTY ON WHICH BUILDING IS TO BE ERECTED/DEMOLISHED

SITE

Street No. 101 - 107

Street Name CUBA ST

Town/District CENTRAL

Riding

LEGAL DESCRIPTION

Valuation Roll No.

Lot 1 **D.P.** 15298

Section **Block**

Survey District

DESCRIPTION OF PROPOSED WORK AND MAIN PURPOSE OF USE

NEW BUILDING - STAGE I
(OTHER BUILDINGS)

FLOOR AREA

Whole Sq. Metres 210

DWELLING UNITS

Number Erected

ESTIMATED VALUES $

Building	25 000
Plumbing	–
Drainage	–
TOTAL	25 000

NATURE OF PERMIT (TICK BOX)

- [✓] **NEW BUILDING** — exclude domestic garages and domestic outbuildings
- [ ] **FOUNDATIONS ONLY**
- [ ] **ALTERED, REPAIRED, EXTENDED, CONVERTED, RESITED** — include installation of heating appliances
- [ ] **NEW CONSTRUCTION OTHER THAN BUILDINGS** — include demolitions
- [ ] **DOMESTIC GARAGES AND DOMESTIC OUTBUILDINGS**

	FEES APPLICABLE	$	c		FEES APPLICABLE	$	c
294-902	Water Fee	25		263-939	Sewer Connections		
065-955	Inspection of Work/Documents	345		263-939	Stormwater Connections		
061-902	Plumbing Permit Fee	–		263-941	Manhole/LH CE Raise/Lower		
061-902	Drainage Permit Fee	–		Dep. No.	Demolition Deposit Rd/Path		
704-902	Building Research Levy	25		263-940	Sewer Disconnections		
745-909	Reserves Contribution	137	50	263-940	Stormwater Disconnections		
Dep No.	Access Guarantee Deposit	–		294-940	Water Disconnections		
Dep No.	Footpath Damage Deposit	–			EXC GST	484	09
225-971	L.D. Crossing & Conc. Cutting	–			GST	48	41
225-971	Stormwater Alteration				TOTAL INC GST	532	50
225-970	H.D. Crossing						
225-972	Builders Road Fee						
225-972	Drainlayers Footpath Fee						
225-972	Drainlayers Road Fee						
Dep. No.	Drainlayers Deposit Road/Path						

Received From BUILDER

Address

Machine Receipt No. CB 55578 **Date** 7.1.87.

The above fees are payable in addition to the plan examination fee of $ 185 – **already paid. Refer receipt** CB 40492
Date 4.11.86

NOTICE TO APPLICANT

PERMISSION IS HEREBY GRANTED YOU, subject to conditions endorsed hereon, to carry out the work as proposed in your application, and in accordance with the Plans, Specifications, and other documents submitted to me. Such work is to be subject, at any time during progress, to my inspection, and to be carried out in strict compliance with all the requirements of the By-Laws of the City of Wellington, and with the attached "General Requirements for the Control of Building Construction Projects Affecting City Streets and Footpaths" and "General Requirements for Vehicular Access Construction".

NOTE THIS PERMIT IS VALID ONLY WHEN PAYMENT OF THE ABOVE FEES HAS BEEN MADE TO THE COUNCIL.

FOR CITY ENGINEER Elyptic

DATE 8.1.87.

BC/WG/01

Brickell Moss Raines & Stevens Ltd
Consulting Engineers, Planners, Surveyors and Valuers

181-189 Thorndon Quay
Wellington, New Zealand
PO Box 1591
Telephone (04) 729-589
Cables: 'BRICKMOSS',
Wellington
Telex: NZ 30347 'BRICMOS'

Robert L. Bishop, BE, MIPENZ, MIE Aust
Frank N. Blackwell, BE, MI Mech E, MIPENZ, CIBS, MASHRAE
William D. Champion, BE, FICE, FI Struct E, FIPENZ
Bruce A. Forbes, BE (Hons), BSc, MIPENZ
Keith H. Gillespie, BE, MICE, FIPENZ, MASCE, FHKIE
Wilson E. Lattey, MNZIS
Norman W. Lea MI Struct E, MIPENZ
John D. Moss, BE, FICE, FIPENZ, FIE Aust, FASCE, FHKIE

Robert J. Nelligan, BE, B Com, MIPENZ
Harry W. Priddey, MI Struct E, MIPENZ
C. Stuart Raines, ED, FI Mech E, FIPENZ
Geoffrey K. Sidwell, BE (Hons), MIPENZ
Kevin C. F. Spring, MI Struct E, MIPENZ, MIE Aust
E. Eric Stevens, BE, FI Mech E, FIPENZ, MASME, MSAE (Aust)
John H. Travers, ME, MIPENZ
Warwick S. Wyatt, MNZIS, MPMI

52512

26 Sept., 1986

Smith Leuchars Ltd.,
Consulting Engineers,
P.O. Box 27349,
WELLINGTON

Attention - Mr M. Orsman

Dear Sir,

LIMITED SUBSURFACE INVESTIGATION
PROPOSED REDEVELOPMENT
WELLINGTON WORKING MENS CLUB
CUBA STREET, WELLINGTON

This report presents the results of a one boring investigation of the subsoil conditions near the site for redevelopment of the Wellington Working Mens Club on Cuba Street, Wellington. The location of the site in relation to existing buildings is shown on the attached plate 1, Site Plan.

The area for redevelopment is rectangular in shape and is located at the rear (eastern side) of the existing Club buildings. The building is to be of multi level construction and have plan dimensions of about 10.0 metres by 13.6 metres. Structural loads imposed at ground level have been given in your Fax dated 12 September 1986. The perimeter columns will impose dead plus live loads up to 1850 KN. Under seismic loading the compression forces of columns are likely to be up to 2300 KN and tension forces some 130 kN.

At the time of our investigation the site was fully occupied by existing buildings which precluded drilling on the area for redevelopment. The only point where a drilling rig could be established near to the building was in a narrow service lane off Leed Street east of the site.

The boring was drilled using rotary wash equipment supplied and operated by Lemmon Piling and Drilling Limited of Seaview. The fieldwork was supervised on a full time basis by our field geologist who logged the soils encountered and specified the type and depth of insitu testing. A log of the boring as recorded in the field and amended where necessary from laboratory examination of the soils recovered, is given on Plate 2, Boring Log. Notes, abbreviations and symbols used on the Logs are given on Plate 2. The soils have been classified generally in accordance with the Unified System, a summary of which is given on Plate 3 Method of Soil Classification.

At the point explored by the boring, the subsurface soil conditions comprise alluvially deposited soils which extend beyond the depth explored. These soils comprise predominantly silty gravels which contain random inclusions of silt. These layers of fine grained soil were encountered at depths 3.3 metres, 6.3 metres and at 9.2 metres, and are generally between 0.3 metres and 0.5 metres thick. The surface gravels are moderately dense and become more dense with depth. At depth 4.7 metres, the gravels are dense.

Groundwater was encountered in the boring and at the time of drilling this was measured to be at depth 2.2 metres below ground surface.

You have advised us that design of the building is proceeding based on supporting the structure on a shallow founded raft slab. The alternative foundation option of supporting the proposed building on drilled cast-in-place piles has not at this time been discounted. Based on the results of the one boring drilled at the site, there is a third foundation system which may be appropriate to the site soils, that being a combination of isolated spread and strip footings. The three foundation alternatives are discussed under headings as follows:-

RAFT SLAB FOUNDATION

We understand the raft slab is likely to be about 0.6 metres thick with its upper surface comprising the ground floor. From the dead plus real live loads given, we estimate that a uniform rigid raft would apply a bearing stress of 83 kPa on the supporting soils.

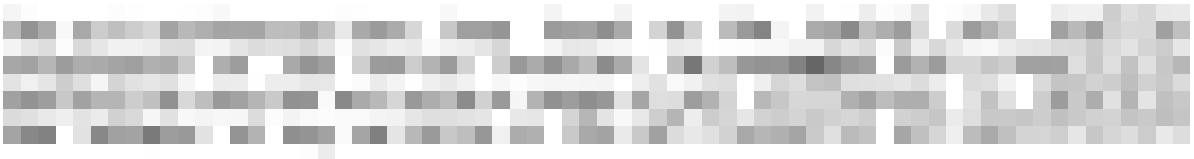
For the purposes of raft slab design, we recommend soil stiffnesses as follows:-

	Dead Plus Live Load	Factored Dead Plus Live Earthquake
Centre of raft	3 kPa/mm	12 kPa/mm
Edge of raft	6 kPa/mm	24 kPa/mm
Corner of raft	9 kPa/mm	36 kPa/mm

* It should be noted that the soil stiffnesses for dead plus live load conditions apply for stresses up to 85 kPa. Where permanently applied stresses exceed 85 kPa the soil stiffness should be reassessed by us. The effect of increased dead plus real live load pressure would be to reduce the design soil stiffness.

The soil stiffness increases towards the edges and corners of a uniformly loaded raft foundation and this is due to the localised edge effects. For the purposes of design, a linear variation may be taken over the centre to edge, edge to corner and centre to corner. This simplifies the correct distribution, however we expect this simplification to be within normal design tolerance.

The soil stiffnesses have been based on the typical soil profiles encountered at the boring location. We recommend that a sensitivity analysis be carried out using a range of soil stiffnesses to determine the effects of any variation on the raft foundation and superstructure



performance. For this analysis we suggest the range of values be 20 percent and 100 percent of the soil stiffnesses given above.

The excavation to underside of the raft slab foundation will expose naturally deposited gravels at the point explored. The uniformity and compactness of these gravels will have a large effect on the performance of the raft. We recommend that excavation and subgrade preparation works be carried out as follows:-

(i) Excavate for the raft slab to required depth with a tracked back-hoe fitted with a smooth edge ditching bucket. The excavator should operate from outside the excavation and trucks loaded on the upper level. The excavation should extend 150 mm below the underside of the bearing level or to sufficient depth to remove any unsuitable soils which are exposed at the bearing surface.

(ii) Geotechnical engineer to inspect.

(iii) Compact the exposed subgrade with several (not less than two) passes of a "Bomag" Tandem BW 100AD Vibrating Roller or equivalent.

(iv) Make up the subgrade to underside of the raft slab with NRB:M/4 1984 AP40 basecourse placed in one layer and compact with three passes of the Vibrating Roller referred to in (iii) above.

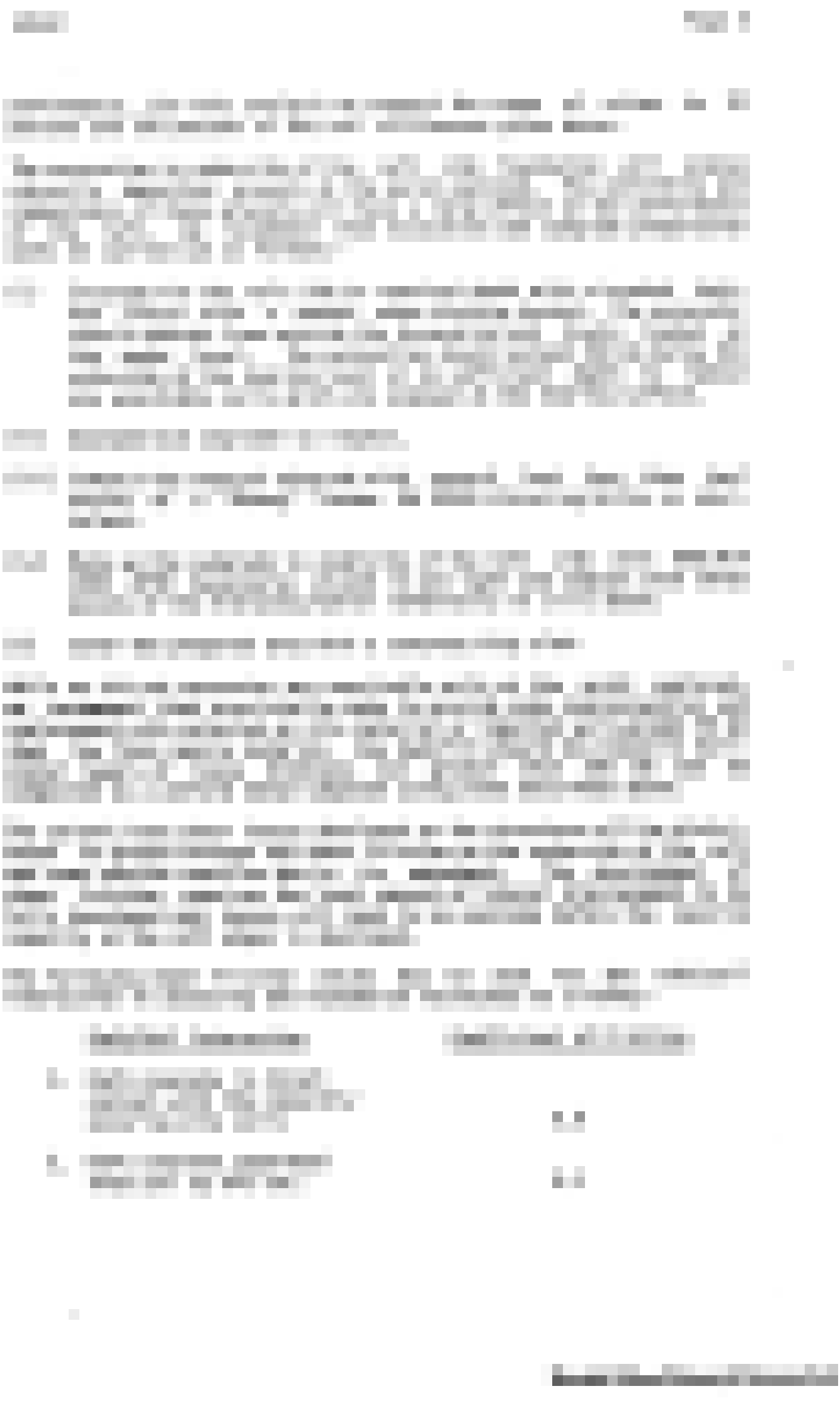
(v) Cover the prepared area with a concrete tidy slab.

While we did not encounter any unsuitable soils at the point explored, we recommend that provision be made to provide some overexcavation and replacement with selected on site material or imported well-graded 50 mm down low fines quarry material. Any backfill should be placed in horizontal layers of loose thickness not greater than 150 mm and be compacted to a uniform dense subgrade using plant described above.

The seismic base shear forces developed on the structure will be distributed to ground through the shear friction on the underside of the raft and some passive reaction due to its embedment. The development of shear friction requires the least amount of lateral displacement to be fully developed and, hence, will need to be overcome before the passive capacity at the raft edges is developed.

The following shear friction values may be used for the raft/soil interaction in assessing the foundation resistance to sliding:-

	Raft/Soil Interaction	Coefficient of Friction
1.	Raft concrete in direct contact with the naturally occuring site soils	0.6
2.	Raft concrete separated from soil by DPC etc.	0.1



SHALLOW FOOTINGS

As an alternative to a raft slab foundation, the structure may be supported on shallow footings constructed to derive foundation support from the gravels at depth 2.0 metres below the ground surface.

For the purposes of foundation design, isolated pads and strip footings may be proportioned for a maximum bearing pressure of 600 kPa provided the following conditions are met:-

(a) All foundations have minimum plan dimensions of at least 1.0 metre.

(b) The bearing surface of individual fotings is confined at least 0.5 metres below adjacent lowest final grade.

(c) All footing excavations are inspected by a geotechnical engineer to ensure that the material exposed meets the design criteria given in this report.

Appropriate factors of safety should be applied to the maximum bearing capacity for shallow pad foundations as given above. The recommended maximum bearing capacity should be divided by an appropriate factor of safety as follows:-

Design Procedure	Factor of Safety
Strength Method	1.8 for factored loads
Capacity Design	1.1
Alternative Method	3.0 for dead plus live load 2.0 for load combinations including earthquake and wind loads.

Footings should be dimensioned by considering all of the above criteria and using whichever gives the largest size.

The base shear forces transferred to ground through the foundations will apply inclined loads to the foundation bearing surfaces. The appropriate ultimate bearing pressures for inclined loads as applied to the full bearing surface reduces as the angle of force attack on the footing flattens. The following ultimate bearing capacities may be used for design:-

Eccentricity of Load (c/b)	Reduced Ultimate Bearing Capacity (kPa)
0	600
0.2	500
0.4	320
0.5	260
0.6	200

Settlement of foundations supporting columns on shallow footings is likely to be about 20 mm. The superstructure frame should be designed for differential settlement causing an angular rotation of 1:500 between adjacent columns.

PILED FOUNDATIONS

Large diameter piles may found on the gravel stratum at RL 2.0 metres at boring B1, and these piles may be either straight sided shafts for moderate compression loads or belled piles for high compression and tension loads. The depth to founding for belled piles required to resist tension forces may need to be deepened below the minimum elevations given above to provide resistance to pull-out. Both straight sided and belled cast-in-place piles may be designed for a suitably factored ultimate bearing capacity of 3.0 MPa provided the following parameters are included in the pile design:-

(a) The stem diameters are at least 0.9 metres and the bell diameters to stem diameter ratio does not exceed 2.0.

(b) The ratio of pile depth (i.e. net confinement below measured adjacent ground surface) to the bell diameter, is not less than 4.0.

(c) Each pile bearing surface is proven by drilling investigation before the shaft is excavated and the results are interpreted by us in context with this report.

(d) Each shaft base is inspected by us when it is at the design depth and before the bells are cut.

For design purposes the ultimate end bearing capacity for drilled piles as given above should be reduced by dividing by the appropriate factor of safety as given under shallow footings above.

The rupture uplift capacities for belled piles may be determined from the chart given on Plate 4, Ultimate Uplift Capacities for Belled Piles. The appropriate factor of safety as given above for bearing should also be applied to the rupture uplift capacity determined.

The lateral base shear developed on the structure due to seismic attack may be resisted by the piles acting laterally against the surrounding soil.

Piles subject to lateral load may be designed according to the "Reese and Matlock" analysis which is summarised on Plates 5A, 5B and 5C, Design Procedure for Laterally Loaded Piles. A coefficient of variation of soil modulus with depth (f) of 7 KPa/mm is appropriate.

SUBSOIL FLEXIBILITY

In terms of the criteria specified in Clause 3.4.3 of NZS 4203:1984 "Code of Practice for General Structural Design Loadings for Buildings", the site is "flexible".

FURTHER SUBSURFACE INVESTIGATION

The geotechnical recommendations contained in this report are based on the results of one boring drilled near to the site.

The feasibility of the raft slab foundation to support the building is dependent on the gravel stratum encountered in the boring occurring at similar depths over the entire site. If these gravels are discontinuous

and/or at irreglar depths across the site, then the displacement performance of the raft slab foundation may be significantly affected.

We recommend that, on completion of demolition, a series of relatively shallow borings be drilled on the vacant site to confirm the founding stratum for the raft slab and/or shallow footings. Three investigation borings should each extend to depth 8 metres and the soils encountered should be observed and sampled by a geotechnical engineer.

This additional investigation work should be carried out as soon as practically feasible to enable any changes to be made to the foundation in the event that below ground conditions are found to differ from those expected.

GENERAL

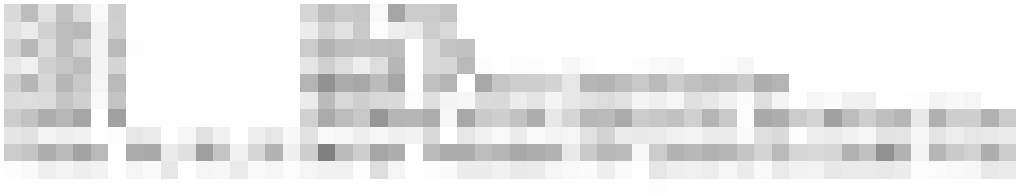
The following plates are attached to complete this report:-

Plate 1	Site Plan
Plate 2	Boring Log
Plate 3	Method of Soil Classification
Plate 4	Ultimate Uplift Capacities for Belled Piles
Plates 5A, 5B, 5C	Design Procedure for Laterally Loaded Piles

Yours faithfully,
pp BRICKELL MOSS RAINES & STEVENS LTD

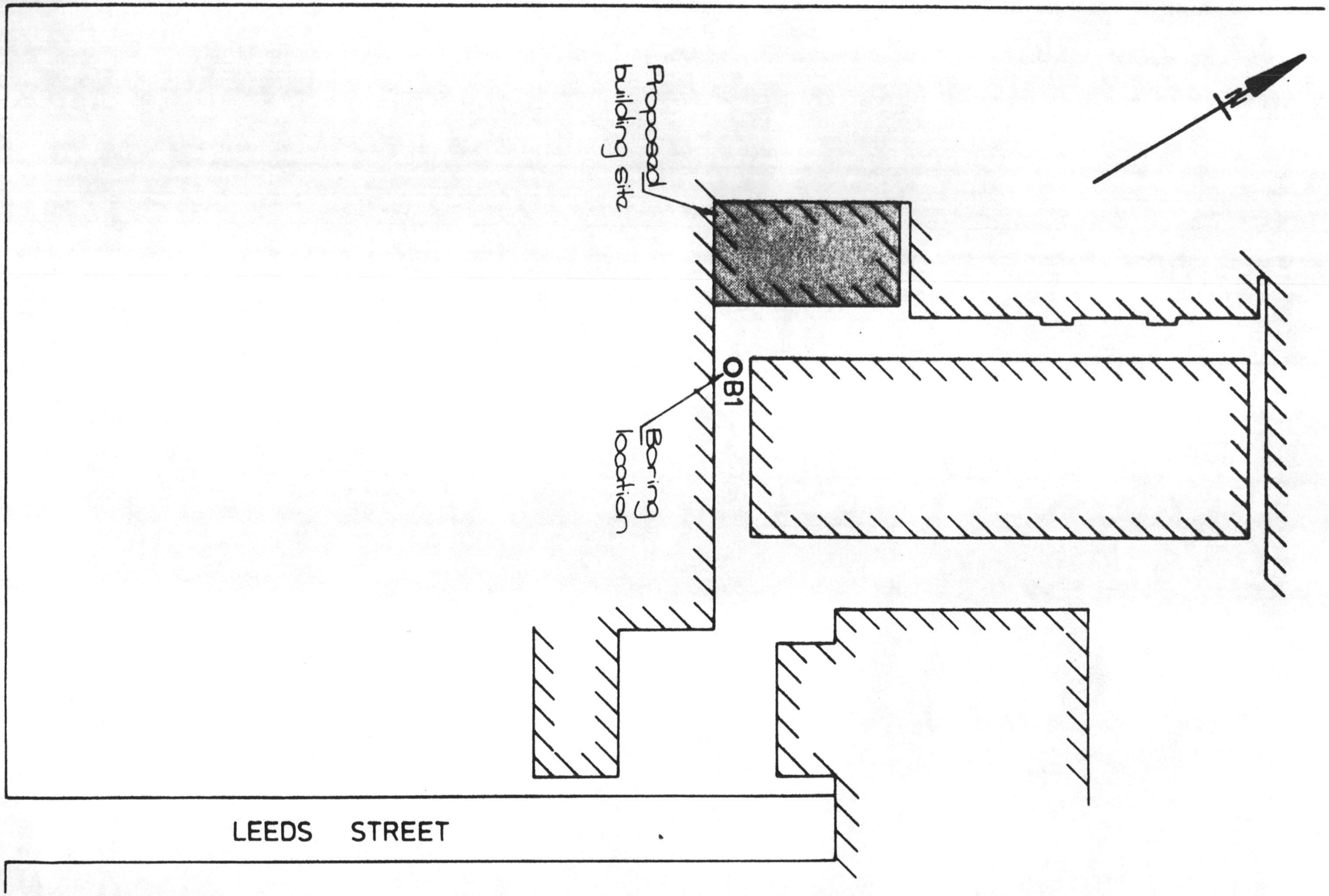
J. H. TRAVERS

GCA:JHT:lcs



JOB No: 52512 CLIENT: Smith Leuchars LOCATION: Leeds St. BY: J.E.P. DATE: Sept. '8

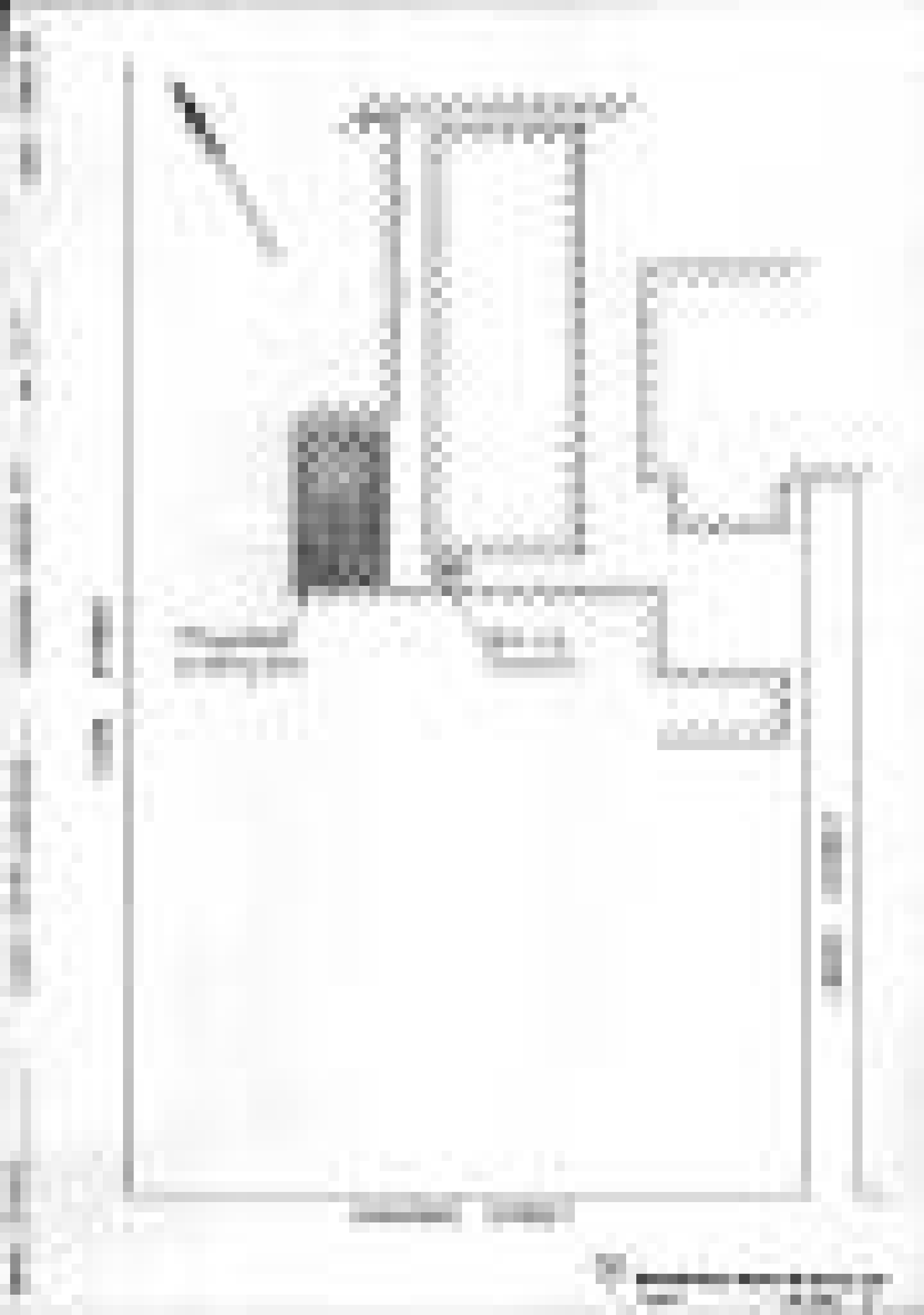
CUBA STREET



Bicknell Moss Raines & Stevens Ltd

1:450

PLATE: 1



CLASSIFICATION DATA			STRENGTH DATA			WATER - DENSITY DATA		FIELD DATA
% FINES (-63μm)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF TEST	TEST SURCHARGE PRESSURE KPa	SHEAR STRENGTH K Pa	NATURAL WATER CONTENT %	DRY DENSITY kg/m³	PENETRATION RESISTANCE
								N = 16
								N = 21
								N = 31
								N = 19
								N = 41
								N = 21

BORING B1

ELEVATION: 8.5 METRES

DEPTH IN METRES

0 — Brown SILTY GRAVEL (GM) (moderately dense, coarse, weathered, sub-angular)

1

2 — (grades more dense)

3 — (layer brown SANDY SILT (ML) (firm)

4

5 — (grades dense)

6 — (layer grey CLAY (CL)(firm)

7 — Pile founding.

8

9 — Grey SANDY SILT (ML) (firm)

10

BORING DEPTH : 9.5 METRES

CASING DEPTH : 3.0 METRES

1. The boring was drilled on 11 September 1986 with truck mounted rotary wash equipment.
2. 100 mm size casing was used in the borings.
3. ▽ Standard Penetration Test (SPT), performed in accordance with standard ASTM D1586-67.
4. 50/285 Number of blows with SPT hammer and penetration (mm) of sampler.
5. • Disturbed observation sample.
6. Observed ground water level.
7. The elevations of the borings refer to New Wellington City Datum.
8. Indicated depths are in metres below the existing ground surface.

BORING LOG NOTES

BORING LOG

Brickell, Moss & Partners

PLATE 2

REQUIREMENTS FOR BUILDING OVER LARGE DRAINS

Throughout the city, there are a number of old, large sewer and stormwater drains. These were usually of double brick construction though some were constructed using concrete. Before permission can be granted for building over a large drain, whether old or new, the Council will inspect the drain at its cost. If the drain is in poor condition, it must be strengthened or preferably replaced at the cost of the developer. If the developer elects to replace the drain, then the Council will pay for the pipes. If the existing drain is in good condition or if the developer wishes to build over a replaced drain, then the following requirements shall be met:

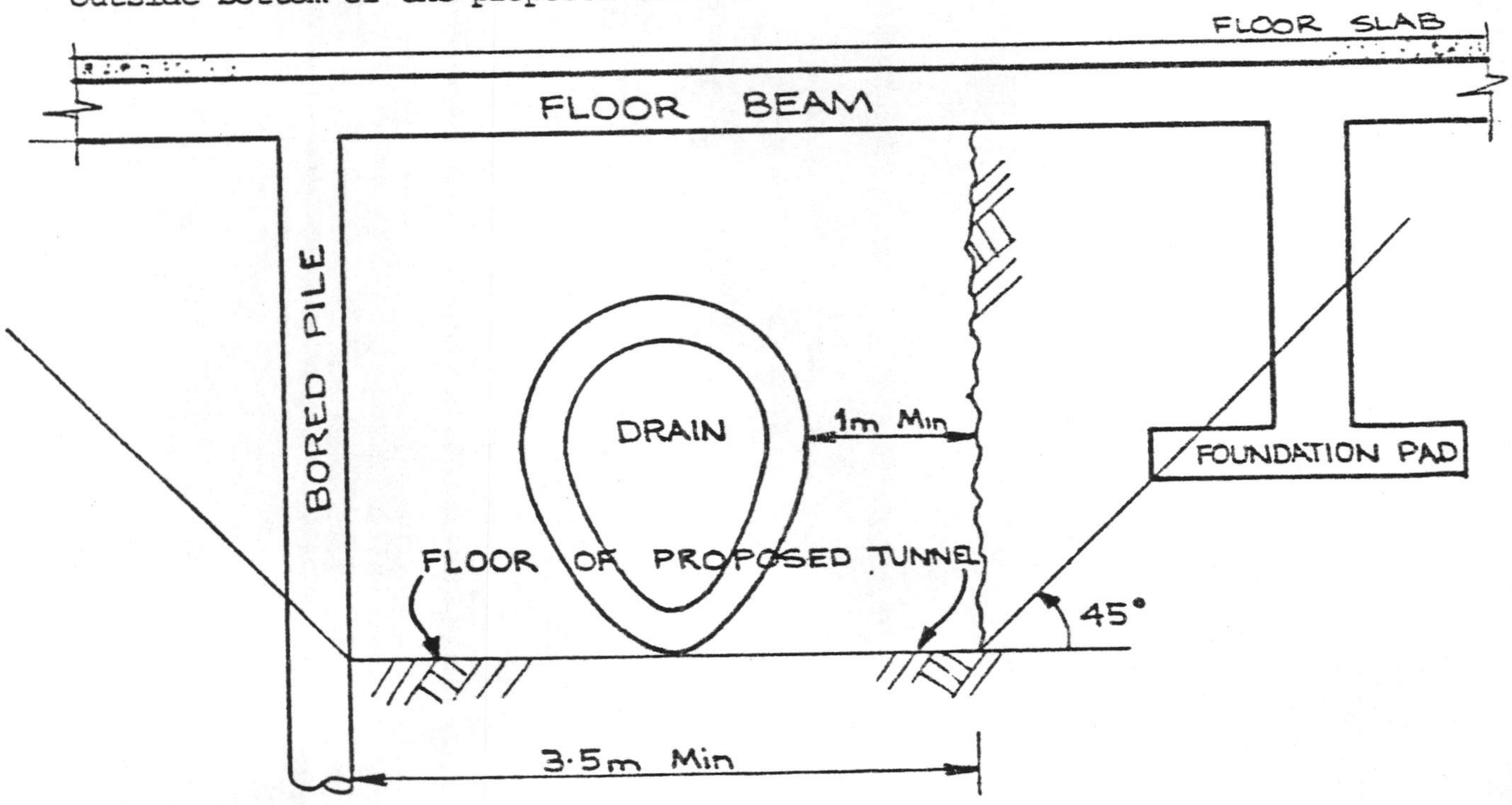
1. No load shall be transfered directly or indirectly to the drain.

2. The drain shall not be disturbed by piling or other construction activities. If the drain is damaged, then the full cost of repairs will be borne by the developer.

3. The foundations of the building shall be designed in such a way that the Council will be able to tunnel under the building along the line of the drain at a later date without the necessity of under-pining the building or carrying out any other protective measures of any kind. The required minimum width for this tunnel is the greater of 3½ m or 1m either side of the existing drain.

4. Piles bored close to the edge of the proposed tunnel shall be designed to allow for the removal of the adjacent fill from one or more sides during tunnelling operations.

5. No foundation pad, or part of pad, may be inside a 45° line drawn from the outside bottom of the proposed tunnel.



CONTRACTORS FULL NAME: Dixon & McKinaly Ltd

UPLIFTED BY: G.A. Wright.

DATE: 7.1.87

The tubular steel soldier piles are to be driven to the depths indicated with a maximum deviation from a vertical plumb line of 1 in 80 and a maximum deviation in plan position perpendicular to the boundary of 50 mm.

C3.7 PLACING AND VIBRATION OF CONCRETE

The mix design and full details of the proposed method of placing the concrete must be submitted to the Engineer for his approval before commencing work on the site, and shall be such that the reinforcing is not displaced and the completed pile contains no voids, and provides complete protection for the reinforcement.

The top concrete surface of the first stage of pouring is to be treated as a construction joint as described in NZS 3109, Section 5.6. This also applies to any other concrete surface where the placed concrete sets so that it cannot be made plastic by revibration.

6/2100 PR:MD

Building Branch
Works Department
WELLINGTON CITY COUNCIL

28 November 1986

A D D E N D A S H E E T

PILED FOUNDATIONS (STAGE I)
101-117 CUBA STREET, TE ARO
FOR THE WELLINGTON WORKING MENS CLUB

1. Prior to excavation for foundations etc being commenced, the validity of the site boundaries is to be established to the satisfaction of the City Engineer in writing by notification from a registered surveyor that the site boundaries have been accurately defined by the correct placing of required pegs with offset reference marks where necessary.

2. The Contractor shall, before any rinforcing steel is placed, or concrete poured, satisfy the City Engineer that the building is correctly set out and adequate notice must be given to the Building Inspector concerned to enable the setting out to be checked to ensure no encroachment on Council or other adjoining properties.

3. The Contractor shall ensure that the official stamped copy of the plans and specifications as approved for permit purposes by the Wellington City Council are available on the site at all times during the period of the contract and that no deviation from the approved documents will be permitted until revised drawings and/or specifications have been submitted to and approved by the Building Branch, Works Department.

4. The Contractor is responsible for the location and protection of any services within the affected area or on Road Reserve and is to notify the respective Authority including the Municipal Electricity Department, the Transport Department, Waterworks and Drainage Branches, Post Office and Wellington Gas Company of any services that may be affected at least 7 days prior to the commencement of the work, to enable the necessary disconnecting to be carried out.

5. Should the source of power to operate cranes be diesel, or any combustion type motor, adequate muffling must be provided to ensure no noise nuisance is created.

6. A Public Liability Insurance Policy for not less than $500,000 for any one accident in the name of Dixon McKinlay Ltd and extended to the Wellington City Council as per the specified endorsement arranged with the Underwriters Association is to be taken out by and at the expense of Dixon & McKinlay Ltd.

7. Engineer to supervise.

8. No Plumbing or Drainage work to be carried out under this Stage I Permit.

Where reinforcement is not particularly specified or detailed for concrete, the Contractor shall ask the Engineer for his instructions.

Review of any placing drawings and lists by the Engineer shall in no way relieve the Contractor of his responsibility for the accuracy of these drawings and for the correctness of the fabrication and placing, setting out and erection of the reinforcing steel, and the cost of rectifying any errors shall be at the Contractor's sole expense.

Supply and incorporate in the work all reinforcement complete with tie wire, spacer bars, support bars and bar chairs and the like all as necessary to complete the work.

Where concrete spacers are used these are to be manufactured from structural concrete as used in the work with embedded ties which are to be of stainless steel or non-corrosive wire.

Supply copies of the steelworks test certificates for the piling reinforcement to the Engineer for check against design criteria.

C2.5 STORAGE AND HANDLING

Storage and handling of materials shall be to the requirements of NZS 3109 and related documents.

C2.6 READY MIXED CONCRETE

The use of ready mixed concrete for the production of any concrete elements associated with the works shall be permitted provided it is from a supplier who has satisfied the Engineer that the production of his concrete complies in all respects with the requirements of NZS 3104 and of this specification. Before any concrete is placed in the works the various mix designs shall be submitted to the Engineer for review.

C3.0 CONCRETE

C3.1 CONCRETE GRADES AND STRENGTHS

Concrete grades and strengths for the various parts of the building shall be as noted on the drawings and shall be in accordance with NZS 3109 (1980) in respect to design, placing and testing, except where modified by this specification.

Unless otherwise specifically stated slump values shall not vary from the values given in Table 6 of NZS 3109 (1980) by more than + 25 mm.

C3.2 SAMPLING AND TESTING OF CONCRETE

C3.2.1 Concrete Testing

Compression tests and slump tests shall be carried out during the progress of the work generally to the requirements of NZS 3109 9.5 except that four cylinders are to be cast. One cylinder shall be tested at 7 days and the other three at 28 days and this latter will constitute a 28 day set. Allow for an additional five comparison tests (four cylinders each) to be prepared as and when directed by the Engineer. The Contractor shall provide at his own cost sufficient standard moulds for concrete specimens 100 mm diameter x 200 mm high, one standard slump mould and any other apparatus required to carry out the tests and shall be responsible for maintaining all apparatus in good order and condition. On completion of the contract all apparatus will remain the property of the Contractor. the Contractor shall be responsible for the casting, marking, advice and delivery to the laboratory of the concrete specimens to the satisfaction and under the supervision of the Engineer. All compression tests shall be carried out in an independent testing laboratory and the 7 day strength shall be at least 70% of the 28 day strength called for on the drawings. The cost of the compression and slump tests is to be allowed for in the basic concrete rates.

C3.2.2 Certificates

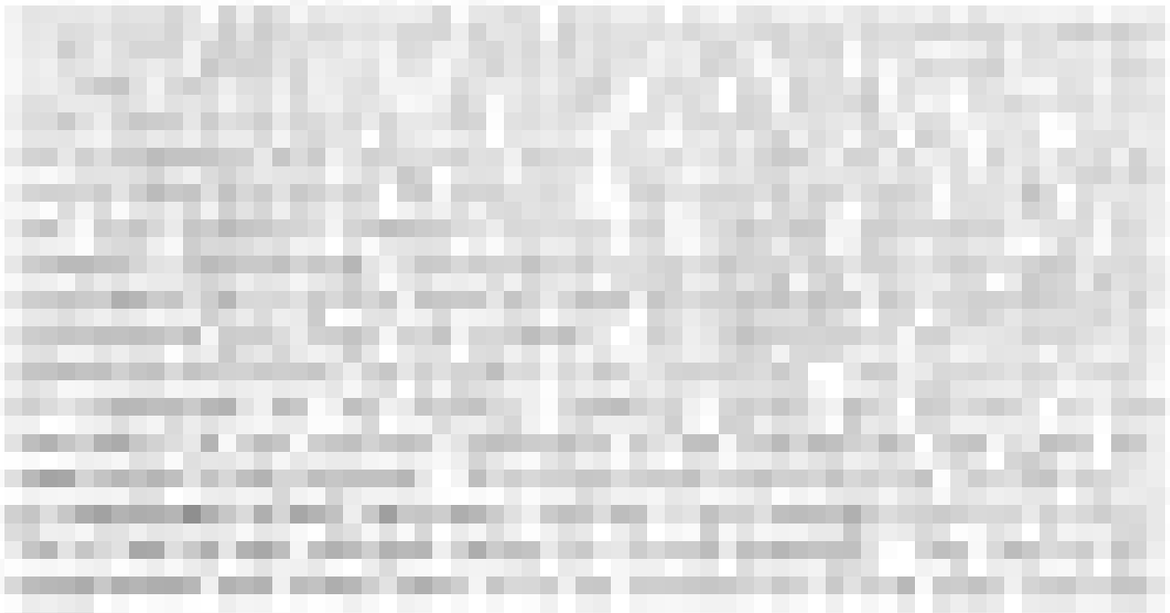
Retain on site one copy of the manufacturer's certificate for each batch of ready-mix concrete delivered to site.

C3.3 REJECTION

The Engineer may reject any concrete because of failure to conform with the requirements of this specification.

Upon request, the Engineer's approval may be given for the Contractor to carry out suitable tests on the rejected concrete and the Contractor shall

.../



bear the cost of such tests and of all labour and materials required for the provision of such tests and making good on completion of the tests.

Rejected concrete for which testing approval was sought and not approved, for which testing approval was not sought, which failed to withstand suitable tests, and which it was impracticable to test, shall be cut out within the limits defined by the Engineer removed from the site and replaced with new concrete conforming to the requirements of this specification at the Contractor's expense.

The Engineer may reject any truckload of ready mixed concrete because of failure to conform with the requirements of this specification or failure to provide or complete the concrete manufacturer's delivery docket.

C3.5 PLACING REINFORCEMENT

The reinforcing for each pile shall be of the sizes given and fabricated in rigid cages as shown on the drawings. If practicable main longitudinal bars shall be supplied in single lengths but when necessary laps in the main bars shall be 60 diameters unless shown otherwise on the drawings. Lapped bars must be tied to the spiral binding at sufficient points to ensure that the whole cage is rigid, and can be handled without distortion or damage. The specified cover shall be maintained by welding approved steel spacers to 100 mm x 10 mm stiffened hoops. The cages shall be adequately supported at the top to hold the bottoms of the main bars 75 mm above the final founding level. The cages will not be permitted to extend into any spigot that may have been formed. Welding of grade 380 steel shall be subject to the Engineer's approval, providing a welding supervisor is engaged and provided the bars are preheated and treated to the steel manufacturers specifications. Tenderers shall allow for all shop drawings and bar bending schedules that may be required for the production of the cages.

C3.6 TOLERANCES

The reinforcing cage shall be nowhere less than the nominal diameter given on the drawings. The maximum and minimum diameters of the pile cage measured at any given level shall not differ by more than 50 mm.

When a plumb line is passed through the centre of the pile at the top of the casing then:

(a) This line shall pass within 75 mm of the pile's design vertical axis as given on the drawngs.

(b) The line shall pass within 50 mm of the centre of the reinforcing cage at any point within 3.0 m of the casing top and 75 mm at any point lower down the pile.

C2.0 MATERIALS

C2.1 AGGREGATES

Coarse and fine aggregates shall comply with the requirements of NZS 3121. Coarse aggregate shall have a maximum size of 20 mm.

C2.2 CEMENT

Cement shall comply with the requirements of NZS 3122 Portland Cement (ordinate and rapid hardening) and all subsequent amendments. All cement shall be delivered in the original sealed bags of the manufacturer or in bulk container approved by the manufacturer. Rapid hardening cement may be usd only when the brand and the proposed method of use are approved by the Engineer.

When cement is stored it shall be protected to prevent deterioration. Any damp, lumpy or otherwise defective cement shall not be used. The system or storage shall be such that cement consignments are used in order of delivery and each consignment is to be kept separate and distinguished from other deliveries. If, in the opinion of the Engineer, cement has been damaged in transit or during storage, then it shall be immediately removed from the site.

C2.3 WATER

Use only fresh clean water of drinking quality for concrete, mortar, grout, cleaning out and wetting formwork, washing materials and for curing.

C2.4 REINFORCEMENT

Reinforcement steel shall be to the varying requirements of type as shown on the drawings. Steel shall comply with the following standards or their metric equivalents:

NZS 3421: 1975	Hard drawn mild steel wire concrete reinforcement.
NZS 3402P: 1973	Hot rolled steel bars for concrete reinforcement.
NZS 3422: 1975	Welded fabric of drawn steel wire for concrete reinforcement.

Steel reinforcement shall be free from all paint, grease, mill or rust scale or other coatings that will destroy or reduce the bond. Steel which has been allowed to oxidise to the extent that resultant pitting has reduced the effective cross sectional area to less than the permitted rolling minimum shall be rejected.

.../

supervision and labour involvement between the hours of 9 am and 5 pm Monday through Friday to allow a decision on the founding levels.

Concrete placing shall be co-ordinated with the withdrawal of casings to achieve the minimum 75 mm cover outside the spiral reinforcement, avoid ground water ingress, and ensure full compaction for the full diameter and length of every pile.

.../

The Related Documents listed on page 6 of NZS 3109 (1980) (for their current metric equivalents) shall also be taken to be requirements of this specifications.

Where there is any conflict in requirements between this section of the specification and NZS 3109 (1980) the former shall take precedence.

C1.5 ORDER OF WORK

The order of carrying out the Concretor's work shall be agreed with the Engineer and shall conform to the agreed programme for the work as a whole and the Contractor shall adhere to this schedule.

C1.6 DRAWINGS

All concrete work specified hereafter shall be carried out in strict accordance with the drawings and instructions as issued.

C1.7 ADMIXTURES

Incorporate no admixtures in the concrete unless specified or otherwise approved in writing by the Engineer. If approved, use strictly in accordance with the Manufacturer's directions and carefully measure the correct quantities under expert supervision. Calcium chloride or any derivative thereof will not be permitted under any circumstances.

C1.8 DRILLING PROCEDURES

Before drilling starts on any pile the positions of all piles and steel sections shall be set out and checked and certified by an Engineer or Registered Surveyor employed by the Contractor for this purpose. No work on any pile is to proceed until this certification has been delivered to the Engineer.

The pile shafts shall be drilled by machine to not less than the diameters shown on the drawings and to such depths that the bells if any are formed in material which is firm enough to stand safely after the sloping sides of the bells have been formed and, at the same time, the bases of the piles are founded on material which is capable of maintaining the design loadings.

Estimated founding depths have been determined from boring information and are shown on the drawings. The design pressures at these estimated founding depths have been based on the assumption that pile bases will be located in a layer of colluvium comprised primarily of grey wacke debris.

Every second pile shall be proof tested prior to drilling, under the supervision of approved Soils Engineering Consultants.

If the assumed conditions are not observed within the proving depth, the piles shall be deepened accordingly on the written instruction of the Engineer. The base of each pile shaft shall be hand cleaned and inspected prior to pouring concrete.

Final founding depths and levels shall be determined by the Engineer from the inspections of the founding materials and/or tests in each pile position.

All safety precautions necessary shall be provided to allow the Engineer to inspect the excavation, this shall include an air supply to the base of the shaft, electric light, assistance and full time attendance at the shaft by an experienced foreman. Pumps used in shafts shall have explosion proof electric motors. The Contractor shall be responsible for the stability of the excavation and safety of his own workmen or other persons who may have to enter the excavation and shall comply with the requirements of the Construction Regulations 1967 and amendments.

Tenderers shall allow in their tender for the supply and driving of temporary protective steel casing or other temporary ground support if necessary extending from the level from which the piles are drilled down to the top level of the bells or rock below. The temporary support may be withdrawn or removed after concrete has been placed.

The protective casing shall be sufficiently strong to hold the surrounding material and to withstand being driven.

The casing shall be driven as drilling proceeds.

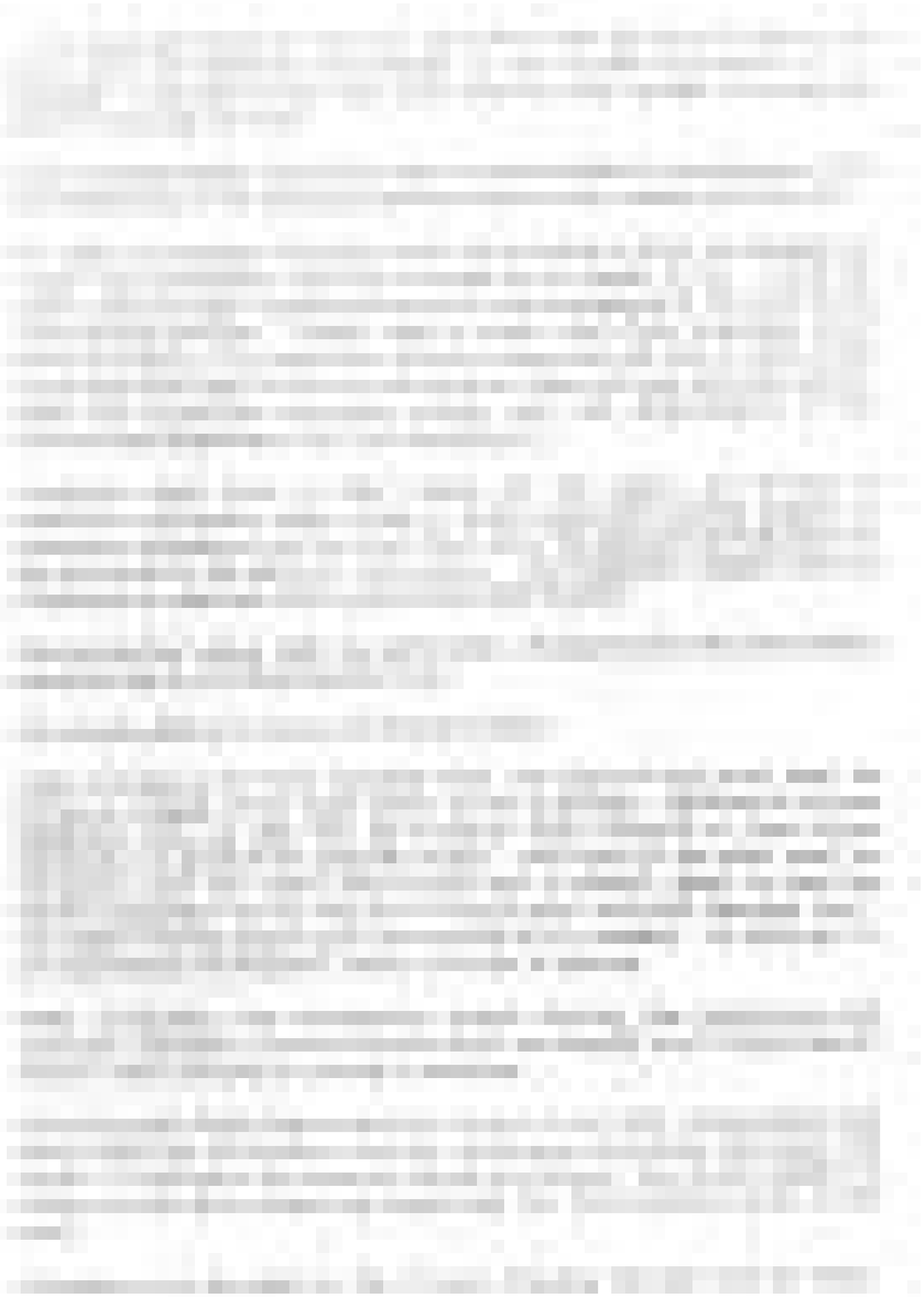
After drilling to the final founding level the bases of the piles shall be belled or shaped to the sizes shown on the drawings. Mechanical belling equipment may be used and the material then trimmed by hand where necessary to achieve the specified slope. The bases of the piles shall be horizontal over the whole area except that a central spigot to hold the belling equipment will be allowed to extend below the final founding level. The edges of such spigots shall be chamfered or rounded. All piles are to be inspected by the Engineer before concrete is poured.

After excavation and immediately before placing the reinforcing and concrete, the base of the excavation shall be cleaned of all loose maerial and all water removed by bailing or pumping.

The Contractor shall keep a complete record of each pile showing dates and times taken for excavation, driving, casing and concreting, the types and depths of materials encountered during excavation, the actual lengths of casing driven and reinforcing placed and the final founding level of the piles.

Allowance is to be made for the 12 hours standing time per pile for plant,

.../



C. CONCRETE PILES

C1.0 GENERAL

C1.1 SCOPE

This section includes but is not limited to the supply in place of all reinforced concrete piles, including reinforcing, as detailed on Smith Leuchars Ltd drawing 1868/P1 and summarised below:

(i) the boring and installation of reinforced concrete foundation piles, including belled bases, to various depths;

C1.2 SAFETY

Notwithstanding the requirements of this specification, nothing contained herein shall absolve the Contractor from responsibility for the temporary and permanent safety of the concrete work.

Where, in the opinion of the Contractor anything contained in this specification, the drawings or Engineer's instructions would impair the safety of the work, he shall immediately inform the Engineer in writing requesting further instructions, and shall thereafter carry out such instructions.

C1.3 SUPERVISION

The Contractor shall be wholly responsible for producing concrete with the specified properties. Produce and place all concrete under the supervision of a foreman experienced in this class of work, under the control of a registered Engineer all as described in NZS 3109 (1980).

No concrete placing shall commence until the Engineer is satisfied that all provisions of this specification with respect to foundations, formwork, reinforcing, construction joints, etc. have been complied with. The Contractor shall give the Engineer at least 24 hours notice of intention to pour.

C1.4 STANDARDS

Unless noted to the contrary in this specification materials for and the construction of reinforced concrete shall be in accordance with NZS 3109 (1980) (metric version) including all current amendments.; a copy of this standard shall be kept on site.

The Related Documents listed on page 6 of NZS 3109 (1980) (for their current metric equivalents) shall also be taken to be requirements of this specifications.

Where there is any conflict in requirements between this section of the specification and NZS 3109 (1980) the former shall take precedence.

.../

B. EXCAVATION AND FILLING

B1.1 SCOPE

This section of the specification covers excavation and filling for building works and foundations.

B1.2 PROTECTION

Be responsible for the safety and the sufficiency of all temporary works.

Maintain and support as necessary all roadways and footpaths which may be affected in any way by the works of this contract.

Preserve from damage all public and private services.

B1.3 PUMPING

Keep all excavated areas free from water during the progress of the works by pumping or other suitable means. Provide adequate means of disposing of such water to the approval of the Engineer and the Local Authority.

B1.4 HAND EXCAVATION

Excavate for the foundations to the levels shown on the drawings and cart away surplus materials so removed. Sides shall be plumb unless otherwise indicated.

B1.5 PROTECTION OF SUBGRADE

Excavation to the required subgrade levels shall be performed by hand such that the final subgrade is not disturbed by these or any other operations of the Contractor.

Should the bottom of the excavation be weakened or damaged due to carelessness or negligence of the Contractor then he shall make good the subgrade by excavation and replacement with imported filling as specified later placed in accordance with this specification all at his own cost.

B1.6 UNDERCUTTING OF SUBGRADE

Any naturally weak or unsuitable soils exposed at and extending below final subgrade level shall be removed if so directed by the Engineer. The lateral extent and depth of such undercutting shall be instructed to the Contractor by the Engineer before or during the work. When each area of undercutting has been completed the resultant void shall be backfilled immediately using materials and procedures as described in Section Filling. Payment for

.../

undercutting and backfilling to the subgrade levels shown on the drawings shall be at the rates of the relevant provisional item in the Schedule.

B1.7 EXCESSIVE EXCAVATION

Should the Contractor take any excavation to a greater depth or width than required, he shall fill to the correct profile with hardfill at his own expense.

B1.8 INSPECTION

Give the Engineer and the Local Authority ample notice of completion of excavations to enable inspections to be made. Do no further work in these excavations until they have been approved.

B1.9 DISPOSAL OF SPOIL

Surplus material from excavations and clearing shall be carted away from the site.

B1.10 APPROVED SUBCONTRACTORS

The Contractor shall not sublet the work of this trade or any section of this trade without the approval of the Engineer.

B1.11 NUISANCE

Rubbish, rubble and excavated material shall be sprinkled with water and kept damp as necessary to prevent dust arising.

B1.12 FILLING

B1.12.1 Definitions

Wherever the term "Maximum Dry Weight Density" or the term "Optimum Moisture Content" are referred to in this specification, the same shall be determined by the methods described in Test No. 12, British Standard 1377: 1975. The relative compaction of any filling is the ratio of the field dry weight density of any part of the filling to the maximum dry weight density of like material expressed as a percentage.

B1.12.2 Approvals

No excavation in which construction has been finished shall be backfilled until the work has been inspected by the Engineer and/or tested and approved by the Authority having jurisdiction over the work.

.../

B1.12.3 Materials

General Filling

Material for filling shall comprise sound evenly graded pit run or river gravel. The maximum particle size shall not exceed 100 mm and not more than 10% by weight shall pass through a 150 micron B.S. test sieve. The material shall be completely free of organic matter and lumps of silt or clay. Site material shall not be used as backfill except where specifically allowed elsewhere in the contract documents.

Sand

Sand shall be clean sharp river sand free from deleterous material.

B1.12.4 Placement of Filling

Backfill and fill as shown on the drawings with general filling as specified above. Place in horizontal layers not exceeding 150 mm loose depth and compact to give relative compaction not less than 95%.

.../

SPECIFICATION

FOR

PILING AND EXCAVATION

FOR

STRENGTHENING & EXTENSIONS

AT

111-117 CUBA STREET
WELLINGTON

FOR

WELLINGTON WORKINGMEN'S CLUB & LITERARY INSTITUTE

CONSULTING ENGINEERS & PRINCIPAL CONSULTANT

SMITH LEUCHARS LTD
212-214 WILLIS STREET
P.O.BOX 27-349
WELLINGTON

ARCHITECT

KEITH WILSON ARCHITECTS
P.O.BOX 12-321
WELLINGTON

QUANTITY SURVEYOR

KNAPMAN CLARKE & CO.
P.O.BOX 358
WELLINGTON

NOVEMBER 1986

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868 PAGE 0

JOB STAGE II STRENGTHENING & EXTENSIONS BY MJO.

WELLINGTON WORKINGMEN'S CLUB. DATE 31/10/86.

STRUCTURAL CALCULATIONS.

INDEX.

INTRODUCTION (refer to sketch over).

These calculations are submitted primarily in support of an application for a Piling Permit.

The final pile positions has yet to be determined & is dependent on the exact location of a WCC stormwater culvert which runs under the site. The location of the SW culvert will not be ascertained until the existing rear buildings are demolished, at which time the WCC drainage dept. will set out the line of the culvert on the cleared ground. The piles & ground beams can then be designed for the final conditions.

The project involves strengthening the existing 3 Storey (brick) masonry building (south side) by tying it to a new concrete framed 6 Storey extension to be erected in place of the 1 Storey building located at the rear of the site.

The new building consists of north-south perimeter beams & east-west concrete shear walls at each end. The flooring is Stahlton timber infill.

The combined building has been designed to resist seismic loads to 2/3 that required under ~~NZS~~ NZS 1900 chap 8: 1965, and also to deflect in unison with the already strengthened North Building. Limited ductility detailing has also been applied.

SMITH LEUCHARS LTD

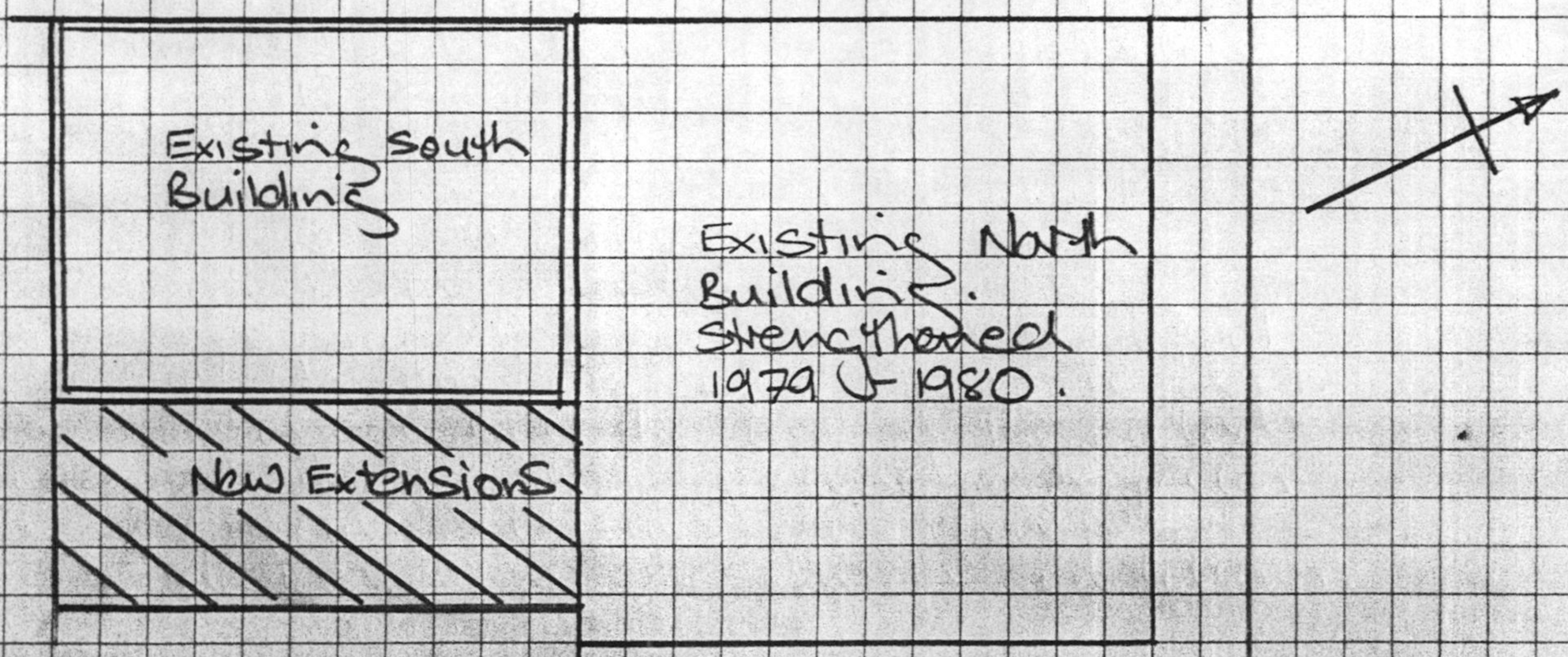
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868 PAGE I/2

JOB BY MJO.

DATE 10/86.

The new building is supported on raft cast-in-place belled piles & concrete framed beams founded in alluvial gravels. A foundation investigation was carried out & a copy of the report is attached.



109 - 117 CUBA ST.

Design Codes:

NZS 1900 chap 8: 1965

NZS 4203 1984

NZS 3101 : 1982.

NZS 3404 : 1977

NZS 4230P: 1985

MJO

(M.J. ORSMAN MIPENZ).

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 1

JOB _____ BY WJM

_____ DATE 18/8/86

Seismic Loading Masses

D Walls N 24 x .45 x 1 x 15 = 648

Conc. Internal 4 x 21 x .23 x 2 x 15 = 696

S 648

Wall W 6 x 24 x 2.3 x .8 x .5 = 1132

W 24 x .6 x 2 x 21 = 605

Int Walls .5 x 2.1 x 40 = 42

Floor 1 x 21 x 15 = 315

3086

L L/3 = 1 kPa 315

2nd floor

D Walls N&S 2 x 24 x .45 x 3.0 x 15 = 648

N&S 2 x 24 x .35 x 1.8 x 15 = 454

W 24 x .6 x 3.8 x 21 = 1149

Tbr .5 x 2.1 x 40 = 42

.5 x 1.8 x 40 = 36

Floor 315

2644

L 315

3rd floor (roof)

D Walls N&S 2 x 24 x .35 x 1.8 x 15 = 454

N&S 2 x 24 x .23 x 2.5 x 15 = 414

W 24 x .6 x 5 x 21 = 1512

Tbr .5 x 1.8 x 40 = 36

Roof .5 x 21 x 15 = 158

2573

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 3

JOB _____ BY WJM

_____ DATE 18/8/86

Main Bldg

Mezz. Floor

			S	24 x .15 x 2.5 x 9	=	81
D		Walls	E	4 x 2.5 x 21	=	210
			Hor.	.5 x 2.5 x 20	=	25
		floor		4 x 21 x 9	=	756
		beams		2 x 24 x 1 x .6 x 20	=	576
		cols		10 x 24 x 1.0 x .6 x 2.5	=	288
						1936
L				1.67 x 21 x 9	=	316

1st floor

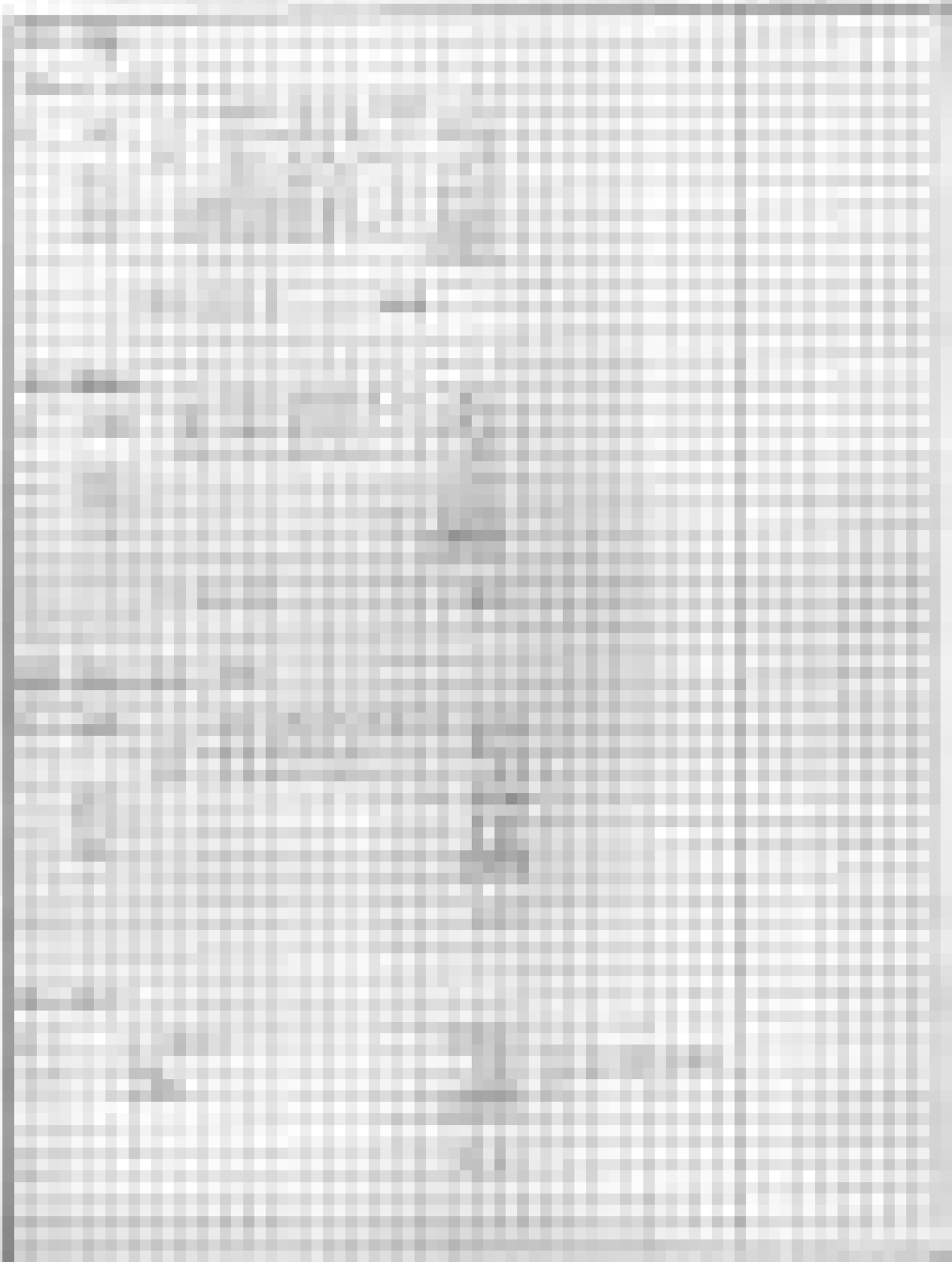
			S	24 x .15 x 3 x 9	=	97
D		walls	E	4 x 3. x 21	=	252
			Hor	.5 x 3 x 20	=	30
		floor				756
		beams				576
		cols				288
						1999
L				1 x 21 x 9		189

2nd floor, 3rd floor

D		walls	S	24 x .15 x 3.7 x 9	=	120
			E	4 x 3.7 x 21		311
			Hor	.5 x 3.7 x 20		37
		floor			=	756
		beams				576
		cols				288
						2088
L						189

4th floor

D		as above				2088	
		roof				95	} ÷ 10% ⇒ ok
		walls				120	}
						2303	
L						316	



SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 3

JOB _____ BY WJM

_____ DATE 18/8/86

Final Seismic Masser

LEVEL	OLD BLDG D	OLD BLDG L/3	NEW BLDG D	NEW BLDG L/3	Wt
4	—	—	2303	316	2619
3	2573	—	2088	189	4850
2	2644	315	2088	189	5236
1	3086	315	1999	189	5589
M	—	—	1936	316	2252
					20546

Seismic Coefficient

Design to 2/3 1965 code rqmts

$V = KCW_t$

$2/3\ KC = 2/3 \times 1.25 \times .12 = 0.1$

$V = 0.1\ W_t = 2055$ kN

FRAME DESIGN FORCES

LEVEL		h_x	W_x	$W_x h_x$	F_x	TOTAL V_x	F_x	V_x
4		3.7	16.4	2619 42952	476	476	238	238
3		3.7	12.7	4850 61595	682	1158	341	579
2		4.0	9.0	5236 47124	522	1680	261	840
1		2.4	5.0	5589 27945	310	1990	155	995
M		2.6	2.6	2252 5855	65	2055	33	1028
				185471				

$F_x = \dfrac{V W_x h_x}{\Sigma W_x h_x}$

$h/l = 16.4/21 = .8 < 3$

$\Rightarrow$ No 0.1 V @ top.

Have two identical frames & torsion will be taken out by shear walls in opposite dirn

$\Rightarrow$ Design forces for frame are 50% of total

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 4

JOB _____ BY WJM

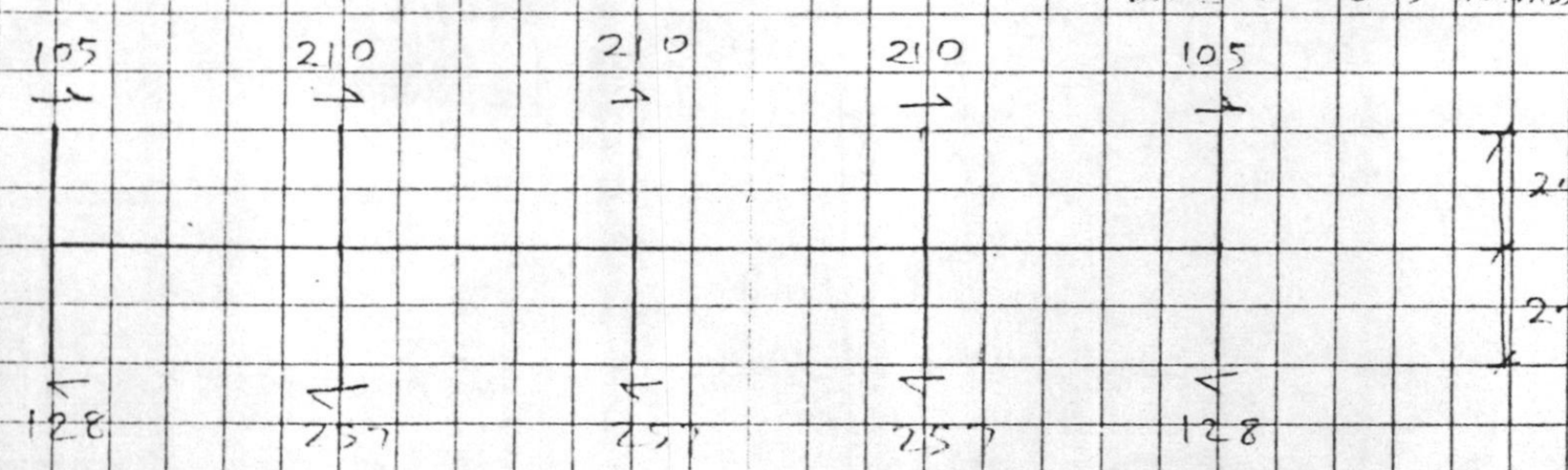
_____ DATE 18/8/86

Ex 1 cont:-

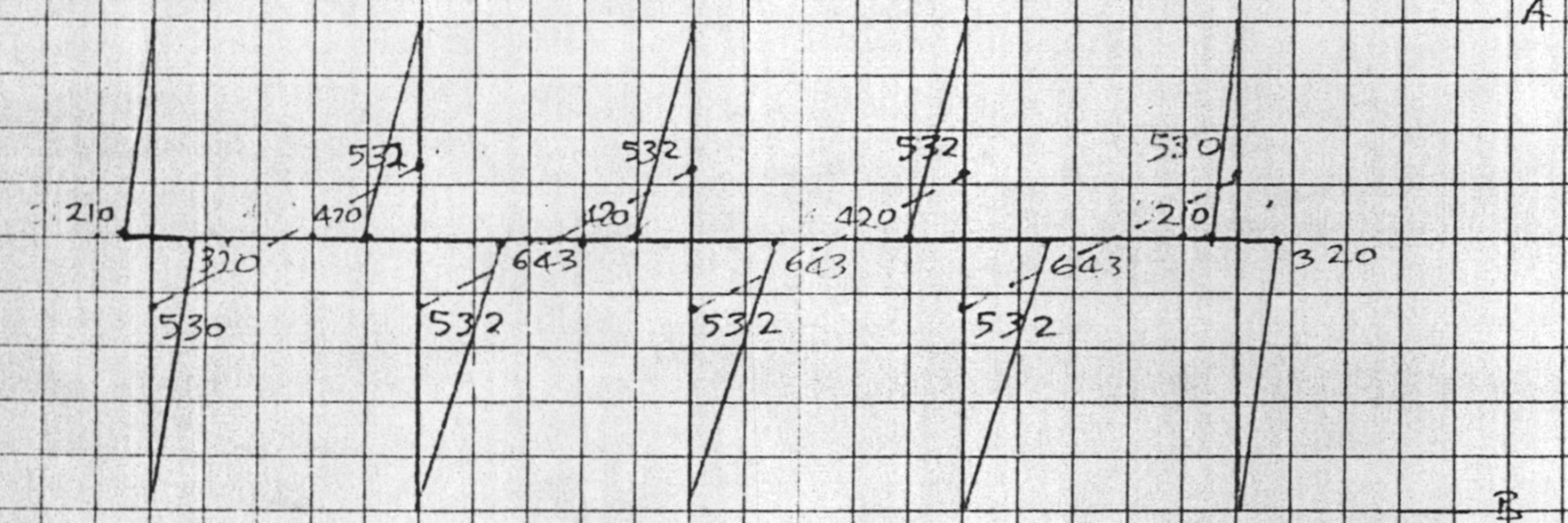
Assume pt. of contraflexure @ mezzanine level
(Ignore roof level for purpose of scheme)

Floor Forces Levels: G, 1, 2

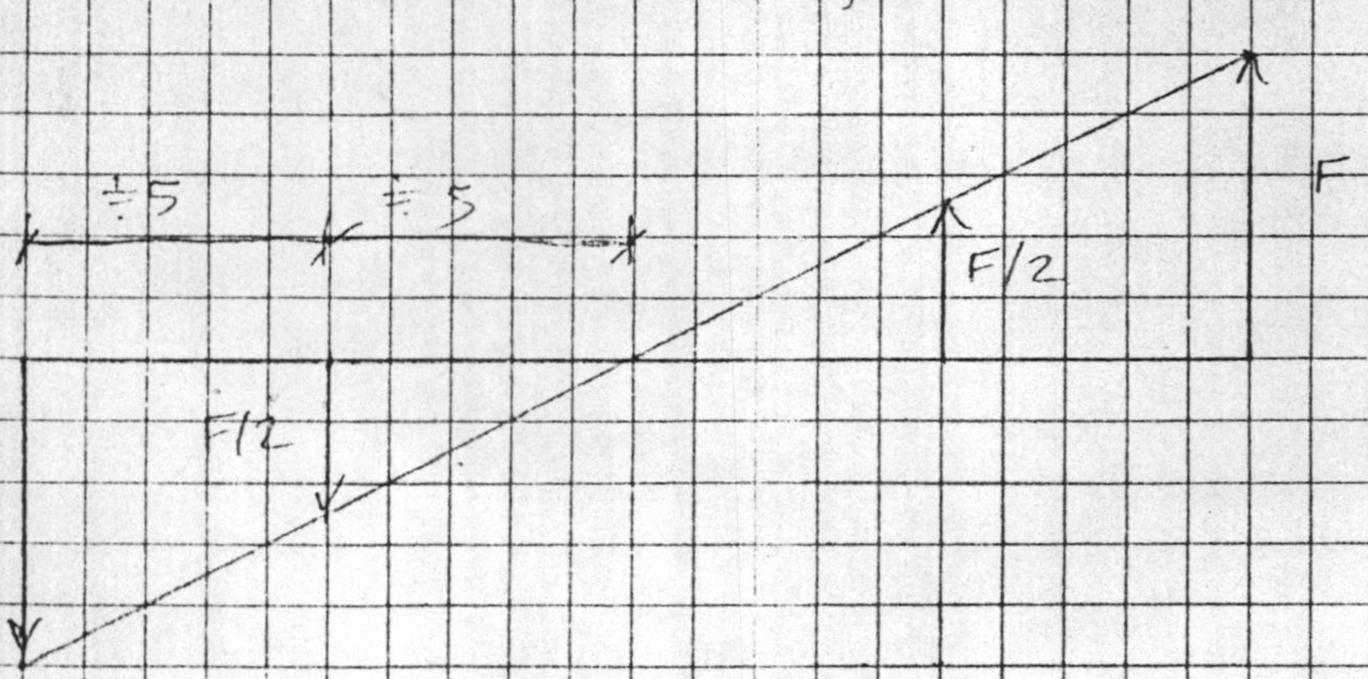
Assume end cols have I = 0·5 internal cols ∴ Equivalent of 8 cols



END



Axial Forces in cols – assume axial forces in cols are proportional to distance from centroid of cols.



$[(F \times 10) + (F/2 \times 5)] \times 2 = 2.5\,F$

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 5

JOB _____ BY WJM

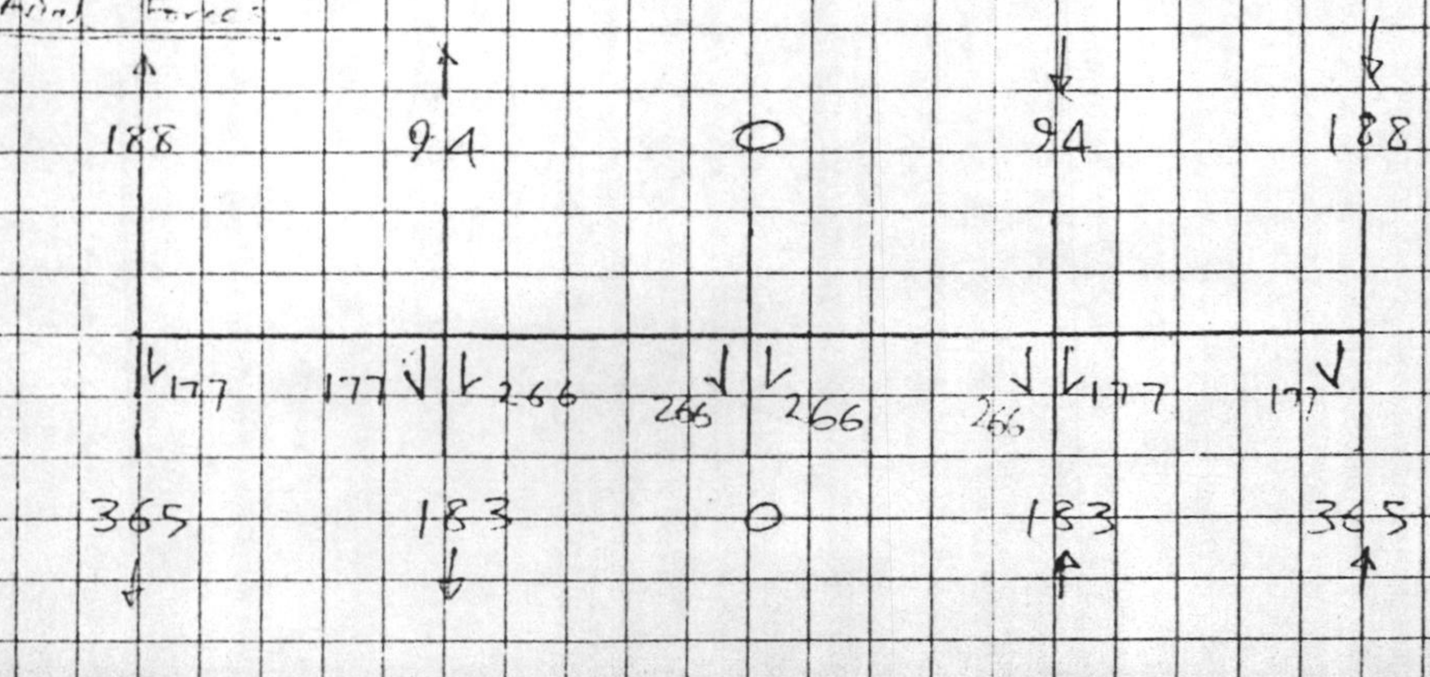
_____ DATE 18/8/86

Moment @ F = 238 x 9.4 + 241.57 + 261 x 2 = 4703 kNm/frame

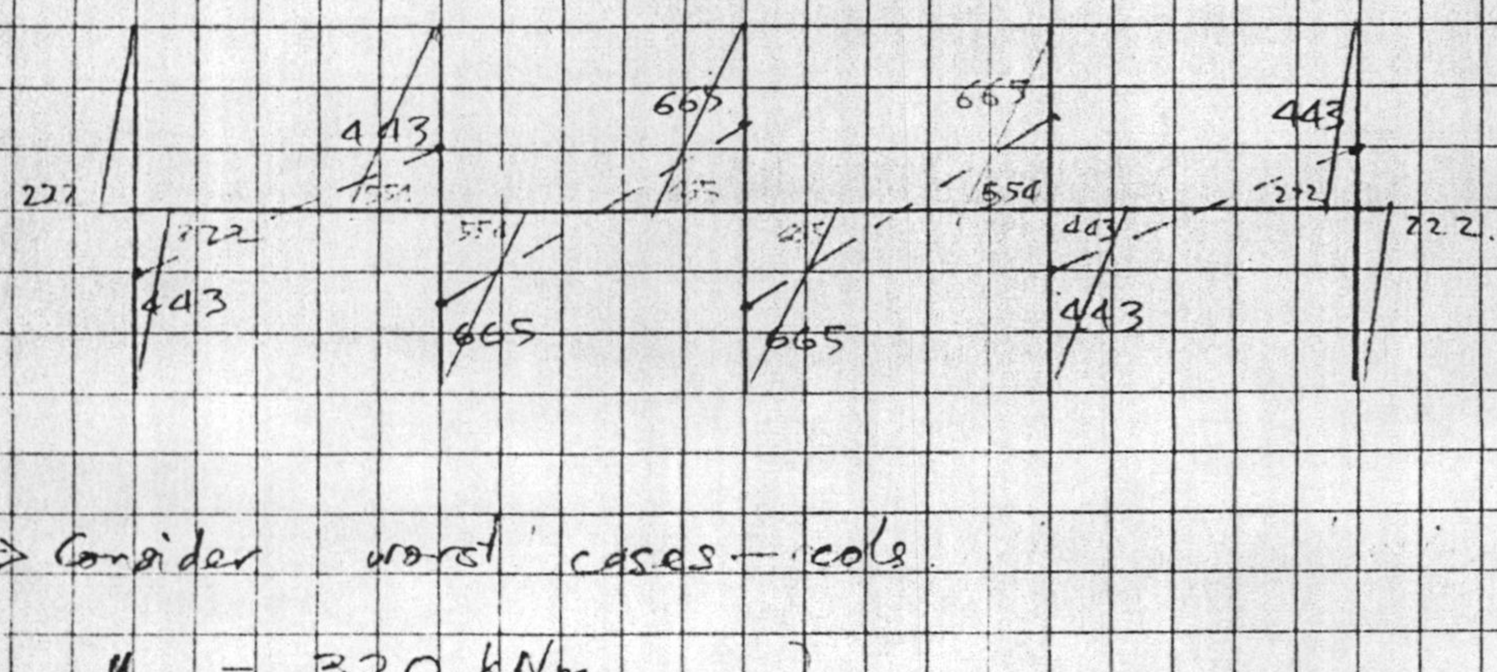
Moment @ B = 238 x 13.9 + 341 x 10.2 + 26 x 7.5 + 155 x 2.5
= 9131 kNm/frame

⇒ At F, ΣF = 470 ⇒ E = 188 F/2 = 94 kN
913 565 183

Axial Forces:



BMD (Check only)



⇒ Consider worst cases — cols

M_E = 320 kNm
P_E = 365 kN tension

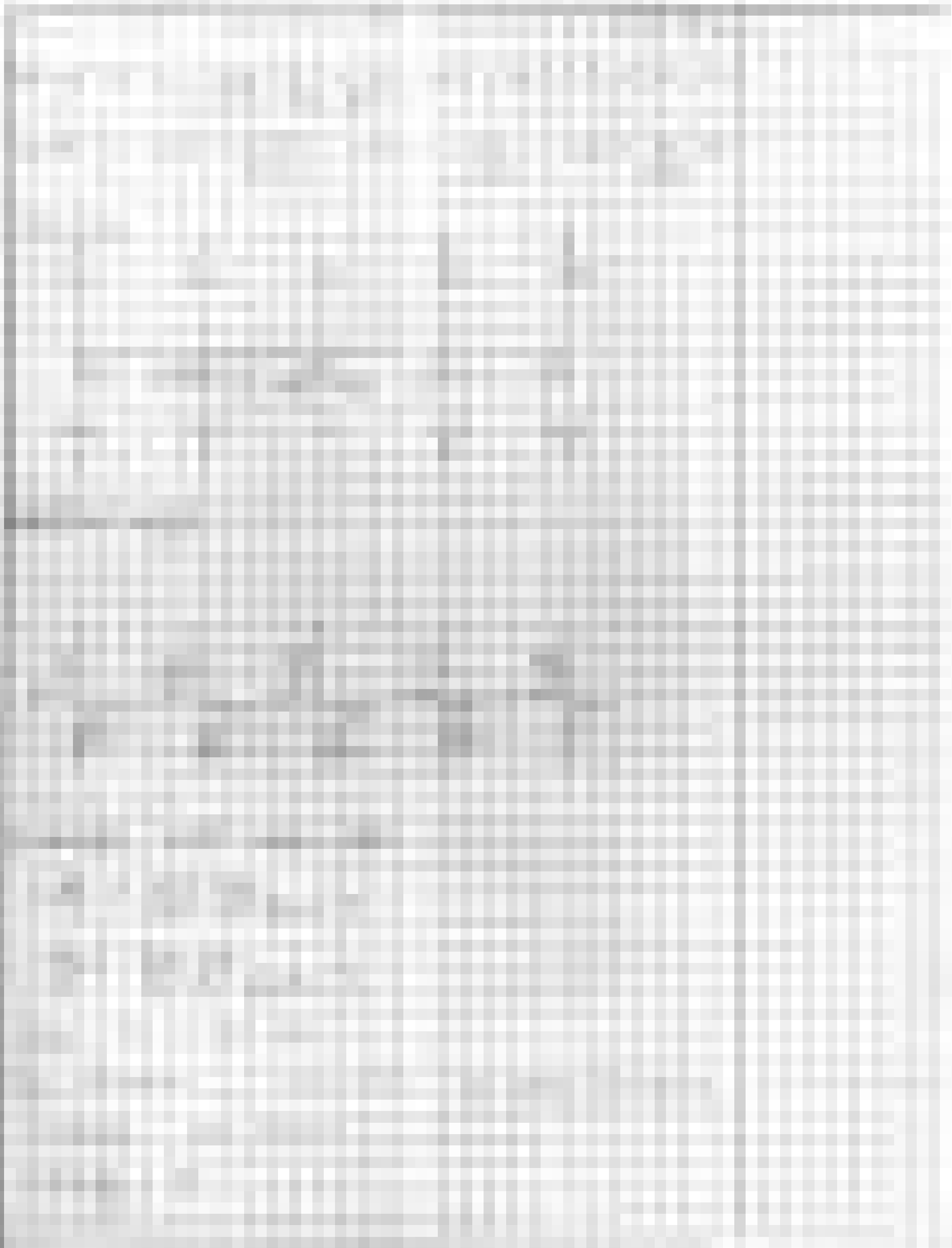
M_E = 665 kNm
P_E = 183 kN tension

Beams — M_E = 665 kNm

Try 250 x 500 R_u = 2.77 ρ = .008 A_s = 2930
f = .01 $(f_c = 30)$ f_y = 380

⇒ 4HD 32 or 5D32

⇒ Probably O.K.



Grid C

Inland beam - level 2

Span = 11.0 m

Includes SDL 0.5 kPa

D	floor (900 ⌂ 250)	3.2 x 4.5 x 11 =	158	
	beam	24 x 1.2 x .5 x 11 =	158	
			316	
D	PL - floor	1 x 1.8 x 5.7 =	10	
	- beam	24 x .5 x .3 x 1.8 =	6	
			16	
L	UDL	3 x 5 x 1 = 165	A = 55	R = .67
	PL	3 x 1.8 x 5.7 = 31	A = 10	

			LR = 111
			LR = 21

D	166	D	166
LL	98	LL	98
LR	66	LR	66
1.4D+1.7LR	345	1.4D+1.7LR	345

5.5 — 5.5

FEM

D	290 + 22 = 312	145 + 22 = 167
LR	102 + 29 = 131	51 + 29 = 80
1.4D+1.7LR	660	370

Ends: $\Rightarrow M_u^- = .7 \times 660 = 462$ kNm

$M_u^+ = 568$ kNm

$P_u = 568 \times 10^6 / .9 \times 500 \times 730^2 = 2.37$

$\Rightarrow$ 800 x 500 OK as for seismic

Cols

Typ 800 x 500 cols

$M_i/f'_c bh^2 = 565\times10^6/.9\times25\times500\times800^2 = .092$
$P_i/f'_c bh = -183\times10^3/.9\times25\times500\times800 = -.02$ } $f_t.m = 30$
$\rho = 660/800 = .8$

$M_i/f'_c bh^2 = 320\times10^6/.9\times25\times500\times800^2 = .044$
$P_i/f'_c bh = -365\times10^3/.9\times25\times500\times800 = -.04$ } $f_t.m = 16$

$\rho_t = .0168$ $A_s = 6720\ mm^2 \Rightarrow$ 10 HD 32

$\Rightarrow$ 800 x 500 col. OK

Gravity loadings

West frame

Lev 4

D roof .5 x 4.5 = 2.3
walls .5 x 4 = 2.0
floor 3.2 x 4.5 = 14.4
beam 2.4 x .8 x .5 = 9.6
28.3 kN/m

L 3.25 x 5 = 16.3

Lev 3

D floor 14.4
beam 9.6
roof .5 x 7 = 3.5
walls .5 x 3.7 = 1.9
29.4

L 3 x 5 = 15.0
.25 x 7 = 1.8
16.8

Levs 2 & 1

D floor 3.2 x 4.5 = 14.4
beam 9.6
24.0 kN/m

PL 16.0 kN

L 3 x 5 = 15 kN/m

PL 31 kN

Lev M

D floor 3.42 x 4.5 = 15.4 (900 T, 300)
beam 9.6
walls .5 x 2.4 = 1.2
26.2 say 27

L 5 x 5 = 25 kN/m

Levs 4 & 3 D 30 kN/m
L 17 kN/m

*Note
PL ≒ midspan @ lev 2 but @ lev. 1 PL is just away from col. pos^n under

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 9

JOB _____ BY WJM

_____ DATE 19/8/86

East Frame

Lev 4.

D roof 2.3
walls 4 x 4 = 16.0
floor 14.4
beam 9.6
42.3 say 43 kN/m

L 16.3 say 17 kN/m

Levs 3, 2 & 1

D floor 14.4
beam 9.6
walls 4 x 3.2 12.8
36.8 say 37 kN/m

L 15.0

Lev M

D floor 15.4
beam 9.6
walls 4 x 1.6 = 6.4
31.4 say 32 kN/m

L 5 x 5 = 25 kN/m

Shear Walls

Torsion $e_{max} = .1b = .1 \times 25 = 2.5$ m from COM

Centre of Stiffness = midway b'tn frames $x = 20$ m

Assume COM @ mid-way of bldg = 12.5 m

N-S

$\Rightarrow$ Torsional Moment $= V \times (7.5 + 2.5) = 10V \Rightarrow T = (10/21)V = .48V$

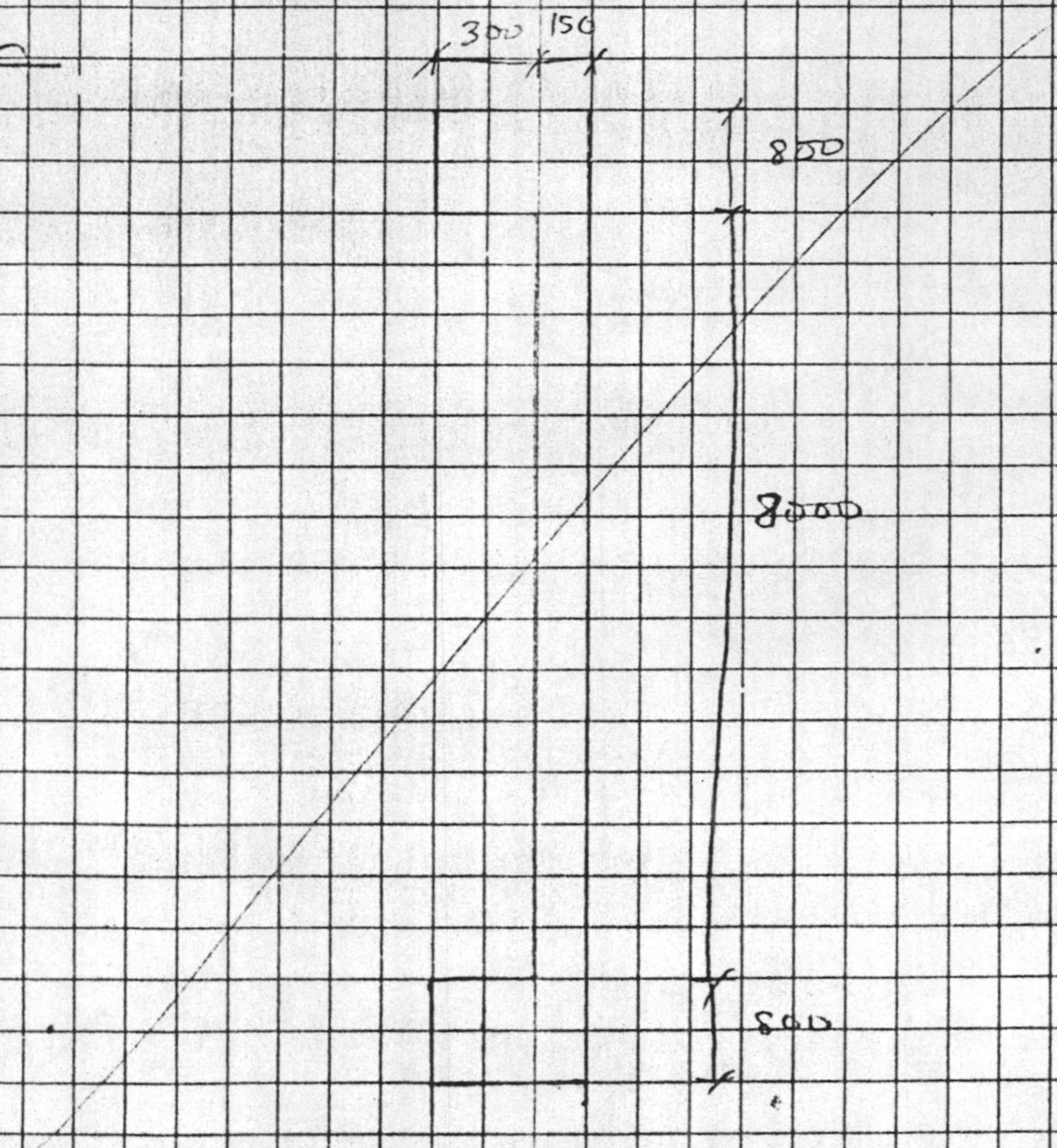
$\Rightarrow$ E-W $TM = V \times 2.1 \Rightarrow T = 2.1/21 = .10V$ $\Rightarrow$ Design Force $= 0.60V$

LEV	Total Force	Design Force	h	M_{eq} (MNm)	V_{eq} (kN)
4	476	286	16.4	——	286
3	682	409	12.7		695
2	522	313	9.0		1008
1	310	186	5.0	7.662	1194
M	65	39	2.6		1233
				13.733	

$l_w = 9600$ } End region $= 9600$
$H/6 = 2733$ }

Try 150 R.C.

Effective Section



$\bar{x} = \int x\,da / A$

$= 4800$

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 11

JOB _____ BY WZM

_____ DATE 22/8/86

Flex. Capacity

Assume $P_i = D/L_i/\phi = 0$

$\Rightarrow C = T$

$C_{max} = .3 f'_c w = 3830 \quad 10 S 2$

Try $c = 800$

$C_c = .85 f'_c ab = .85 \times 25 \times .85 \times 800 \times 450 = 6.50$

$C_s = 3968 \times .380 = 1.51$

$T_{tot} = 1.51$

Wall - min steel 2 HD10 @ 300 ($s_{max} = 2t = 300$)

(Use HD16 @ 300)

$T_{wall} = 2 \times 78.5 \times 8/.3 \times 380 = 1.59$

$C = 6.50 + 1.51 = 7.51$

$T = 1.51 + 1.59 = 3.10$

Try $c = 400$

$C_c = 3.25$

Assume $C_s = T_s$ (Cal)

$T_{wall} = 1.59$ } 3.10

$T_{col} = 1.51$ }

Try $c = 390$

$C_c = 3.09$ } ok

$T = 3.10$ }

Take moments about centroid

$M_u = 3.09 \times (4.8 - .85 \times .38/2) = 14.33$

$1.59 \times 0 = \quad$

$1.51 \times (4.8 - .4) = 6.64$

20.97

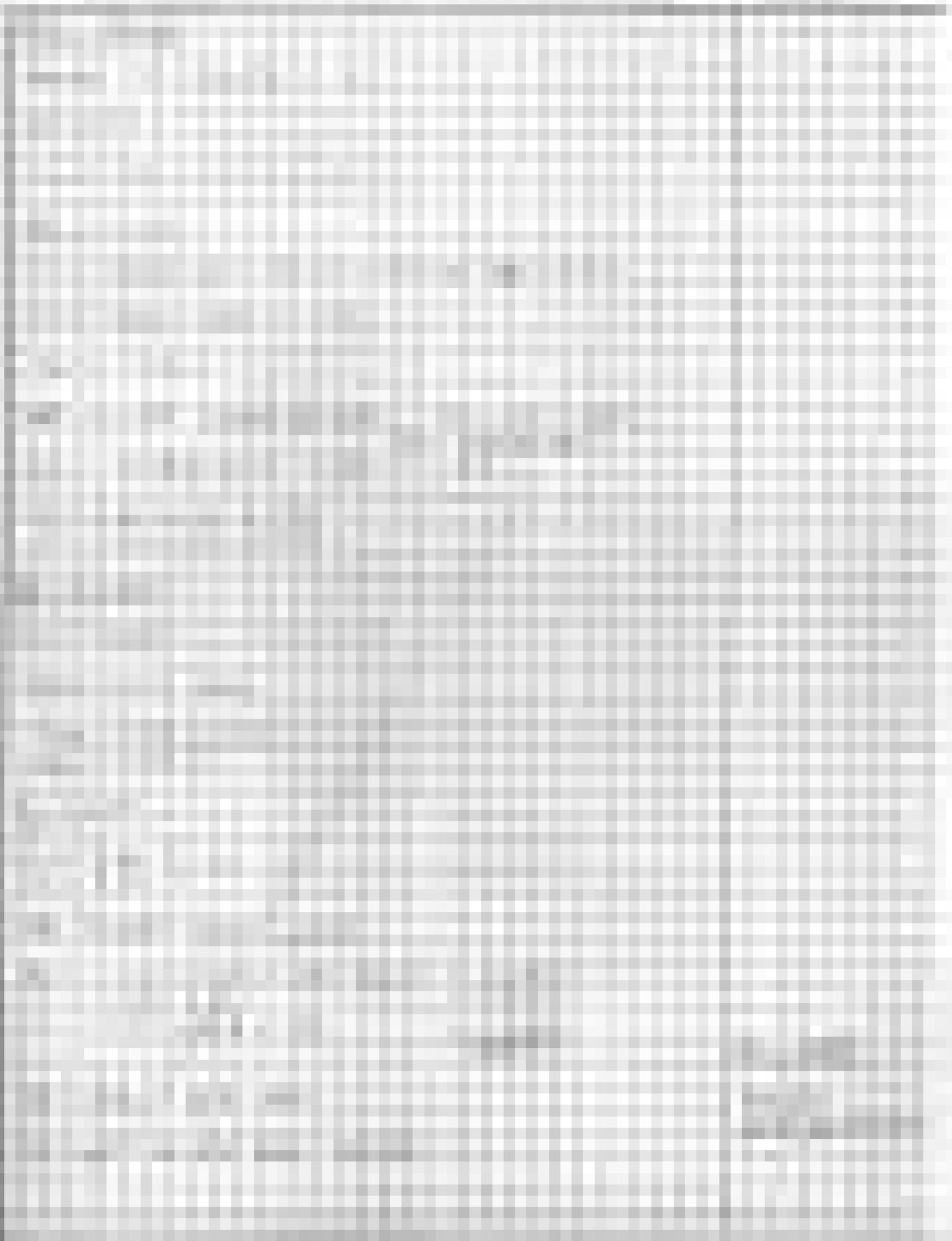
$M_d = \phi M_u = 18.9$ kNm

M_d rqd = 12.59 kNm $\Rightarrow$ OK

Shear Walls

150 RC

HD 16 @ 300 vert.



Shear

$v_i = 113 \times 10^3 / .85 \times 150 \times (.8 \times 9600) = 1.16$ MPa

$.2 f'_c = 5$ MPa → OK

$.3 \sqrt{N f'_c} = 1.5$ MPa $\quad v_i > 1.5 \Rightarrow$ 8 layers of rod

$v_c = 0.6 \sqrt{\frac{P_o}{A_g}}$ $\quad A_g = 1.92 \text{ m}^2$

$P_o = D = 24 \times 16.4 \times [(.15 \times 8) + (2 \times .45 \times .8)] = 756$ kN

$v_c = .6 \sqrt{\frac{756000}{1.92 \times 10^6}} = .38$ MPa

$v_s = 1.16 - .38 = 0.78$

$A_v = v_s \, b_w \, s / f_y$ $\quad A_{v\,min} = .7 b_w s / f_y$

$s_{max} = .201 \times 380 / .078 \times 150 = 653$

→ HD16 @ 300 horiz. OK

Shear Walls

150 R.C

HD16 @ 300 horiz.

Total reo for walls

HD16 @ 300 BW

11 kg/m²

(Total 1500 kg)

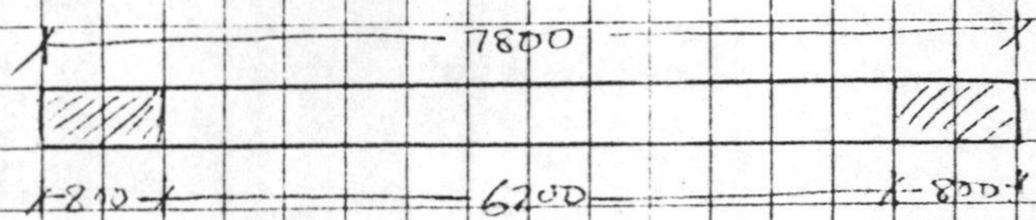
SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 13

JOB _____ BY WJM

_____ DATE 28/9/86

Effective Section



Flex. Capacity

Try c = 500

$C_c = .85 f'_c ab = .85 \times 25 \times .85 \times .500 \times .150 = 1.35$ MN

$T_M = 1.58$
$T_{col} = 1.51$ } 3.09

Try c = 600

$C_c = 1.63$
$C_s = 1.03$ } 2.66
$T_s = .34$
$T_M = 1.58$
$T_{col} = 1.37$ } 3.29

HD24 @ 200 c/c

Try c = 700

$C_c = 1.90$
$C_s = 1.20$ } 3.1
$T_s = .14$
$T_M = 1.58$
$T_{col} = 1.37$ } 3.09

$M_i = 1.9 \times (3.9 - .85 \times .7/2) = 6.84$
$1.2 \times (3.9 - .35) = 4.26$
$- .14 \times (3.9 - .75) = - 0.44$
$1.58 \times 0 =$
$1.37 \times (3.9 - .4) = 4.80$
15.46

$M_u = \phi M_i = 13.91$

M_u req'd = 13.73 MNm $\Rightarrow$ OK

Lcw 1

Try 8HD20, HD12 @ 300

Try c = 500

C_c = 1.63 } 2.35
C_s = .72 }

T_s = .24
T_w = .89 } 2.09
T_{conc} = .96

Try c = 550

C_c = 1.49 } 2.15
C_s = .66 }

T_s = .30
T_w = .89 } 2.15
T_{conc} = .96

M_i 1.49 x (3.9 − .85 x .55/2) = 5.46
.66 x (3.9 − .275) = 2.39
− .30 x (3.9 − .675) = −0.97
.89 x 0 =
.96 x (3.9 − .4) = 3.36
10.24

M_u = 9.22

M_u rqd = 7.662 ⇒ ok.

North Wall

150 RC
25 MPa.
Vert Reo
Lers G−1
8HD24 @ 100
beside door
HD16 @ 300 web
Lers 1→
8HD20 @ 100
beside door
HD12 @ 300 web
Horiz Reo
Lers G−1
HD16 @ 300
Lers 1→
HD12 @ 300

SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 15

JOB _____ BY WJM

DATE 28/9/86

Lev 5-M

$v_i = 11.3 \times 10^3 / .85 \times 150 \times .8 \times 7800 = 1.42$

$.2\sqrt{f'_c} = 5$ MPa $\Rightarrow$ OK

$.3N\sqrt{f'_c} = 1.5$ $v_i < 1.5 \Rightarrow$ One layer OK

$P_e = D = 461 + 11$ $v_c = .6\sqrt{\frac{P_e}{A_g}} = .6\sqrt{\frac{461\,000}{1.17 \times 10^6}}$

$v_c = .38$

$v_s = 1.04$

$A_{v\,min} = .7 b_w s / f_y$ $s_{max} = 2t = 300$

HD16 $s_{max} = 201 \times 380 / 1.04 \times 150 = 490$.

Lev 1-2

$v_i = 1.16$ $v_c = .25$ $v_s = .91$

HD12 $s_{max} = 315$.

South Wall.

$A_{h\,min\ horiz} = .002 \times 175 \times 1000 = 350$ mm²/m

$\Rightarrow$ Detail as for North wall.

Door Opening

Trim with HD16 bars

South Wall

175 RC
25 MPa
Levs G—1
HD16 @ 300 BW
Levs 1—0
HD12 @ 300 BW

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 16

JOB _____ BY WJM

_____ DATE 26/8/86

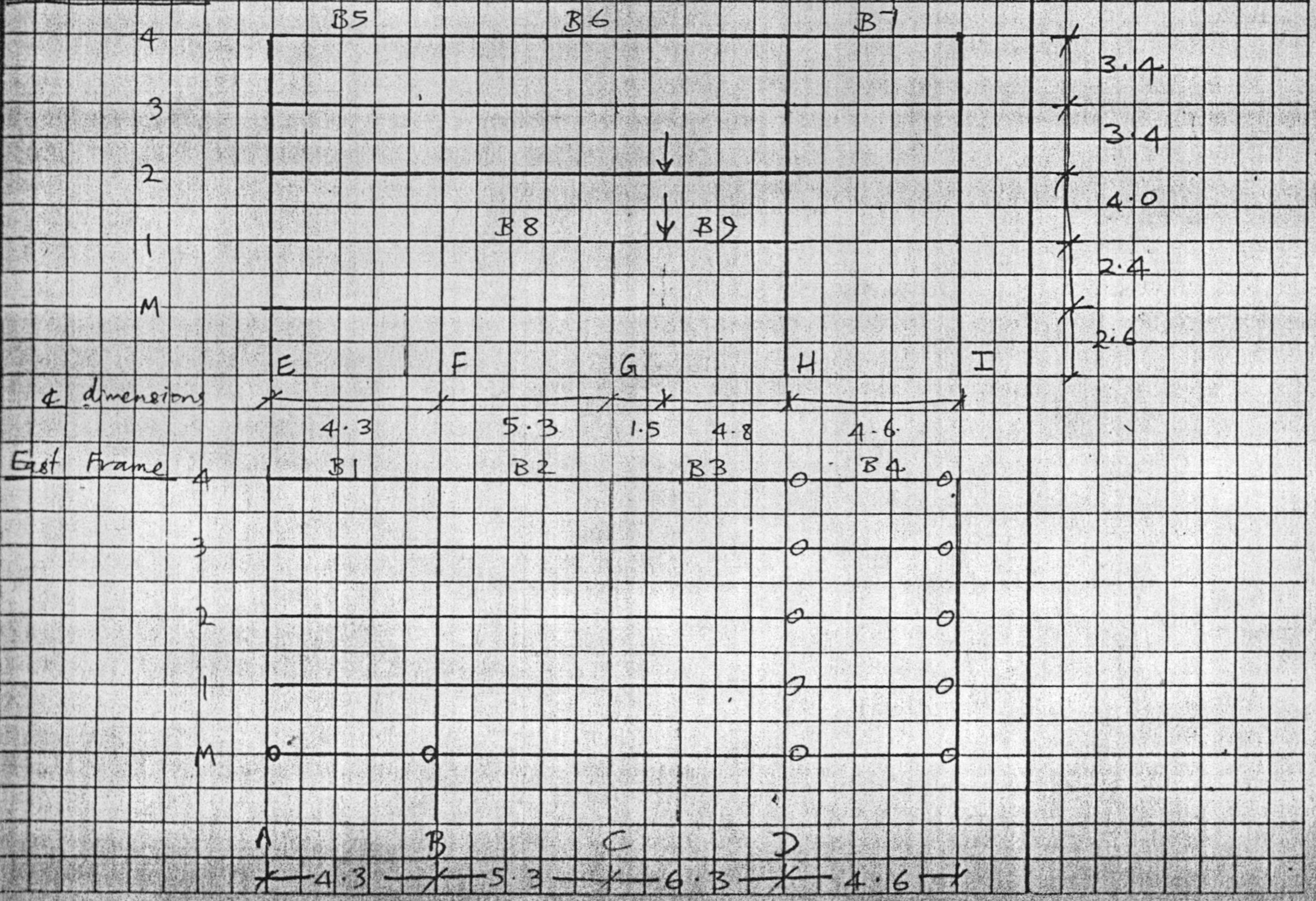
Frame Analysis

Gravity Loadings

A = 10)

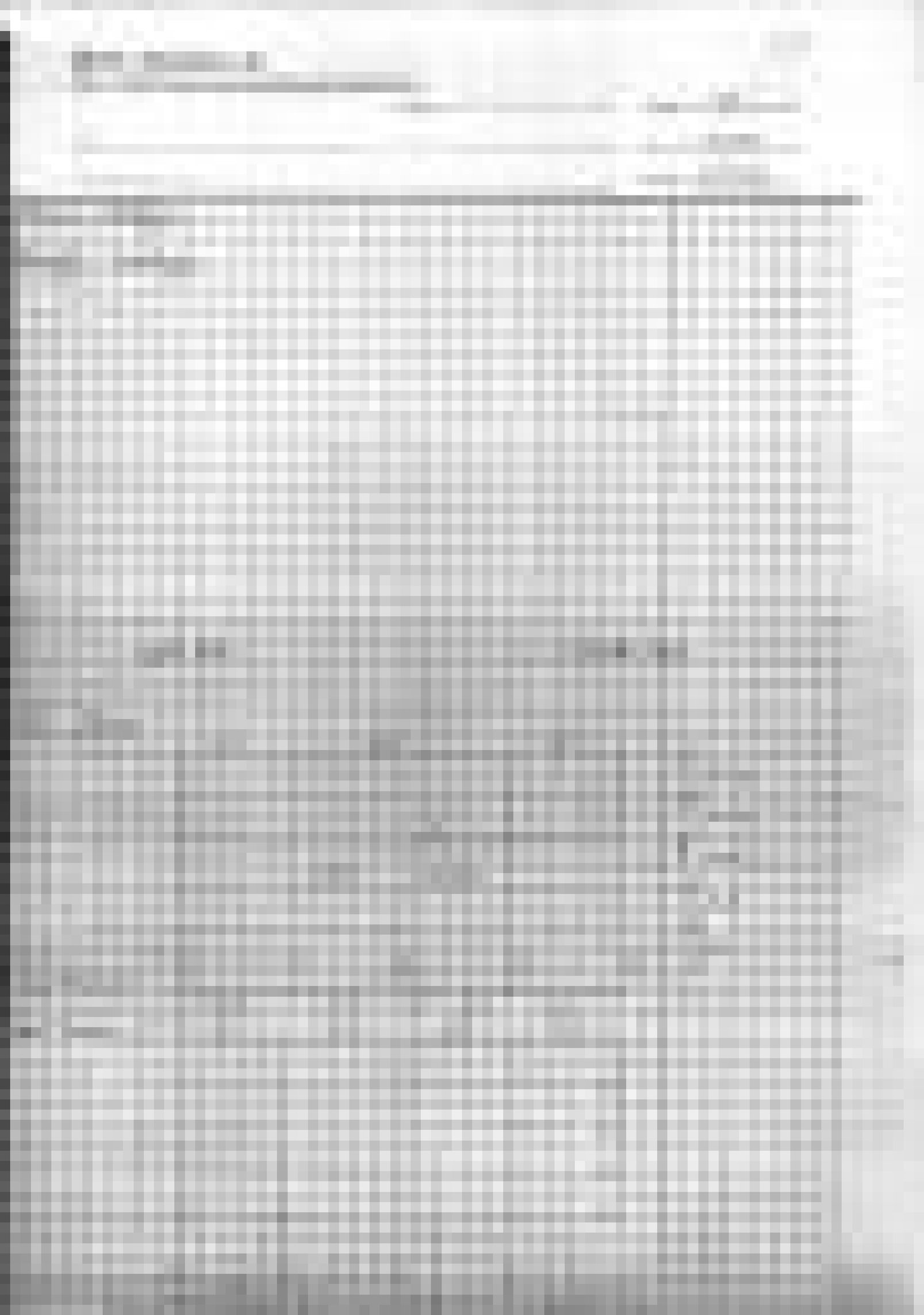
North End South End

West Frame



& dimensions

East Frame



SMITH LEUCHARS LTD

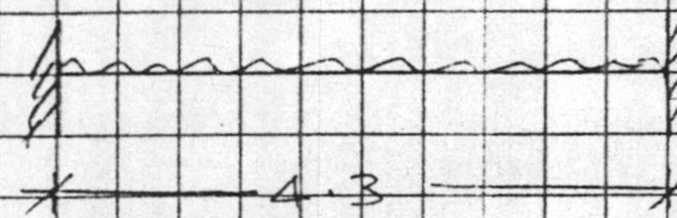
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 17

JOB _____ BY WJM

_____ DATE 26/8/86

Beams 4-1B1, 4-MB5



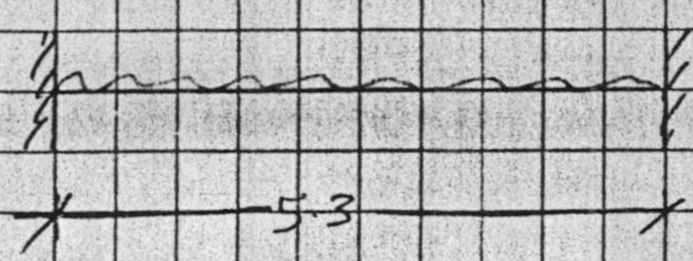
D	93
LL	54
L_R	52
$1.4D+1.7L_R$	219
$D+1.3L_R$	161
$.9D$	84

D 43 x 4.3 = 185 kN

LL 25 x 4.3 = 108 A = 21.5 R = .95 L_R = 103 kN

	FEM	MSM
D	66	33
L_R	37	18
$1.4D+1.7L_R$	155	77
$D+1.3L_R$	114	56
$.9D$	59	30

4- MB2, 1- MB8



D	114
LL	67
L_R	59
$1.4D+1.7L_R$	260
$D+1.3L_R$	191
$.9D$	103

D 43 x 5.3 = 228

LL 25 x 5.3 = 133 A = 26.5 R = .88 L_R = 117

	FEM	MSM
D	101	50
L_R	52	26
$1.4D+1.7L_R$	230	114
$D+1.3L_R$	169	84
$.9D$	91	45

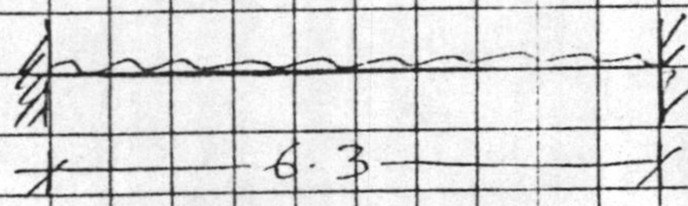
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 18

JOB _____ BY WJM

_____ DATE 26/8/86

4-MB3, MB9



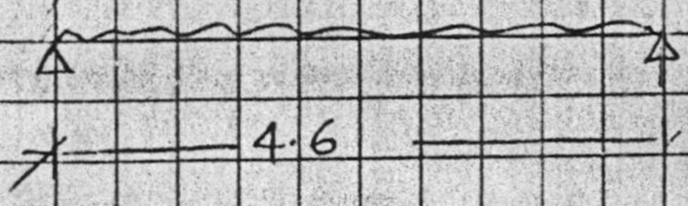
D	136
LL	79
LR	66
1.4D+1.7LR	303
D+1.3LR	222
.9D	122

D 43x6.3 = 271

LL 25x6.3 = 158 A = 31.5 R = .83 LR = 131

	FEM	MSM
D	142	71
LR	69	34
1.4D+1.7LR	316	157
D+1.3LR	232	115
.9D	128	64

4-MB4, MB1

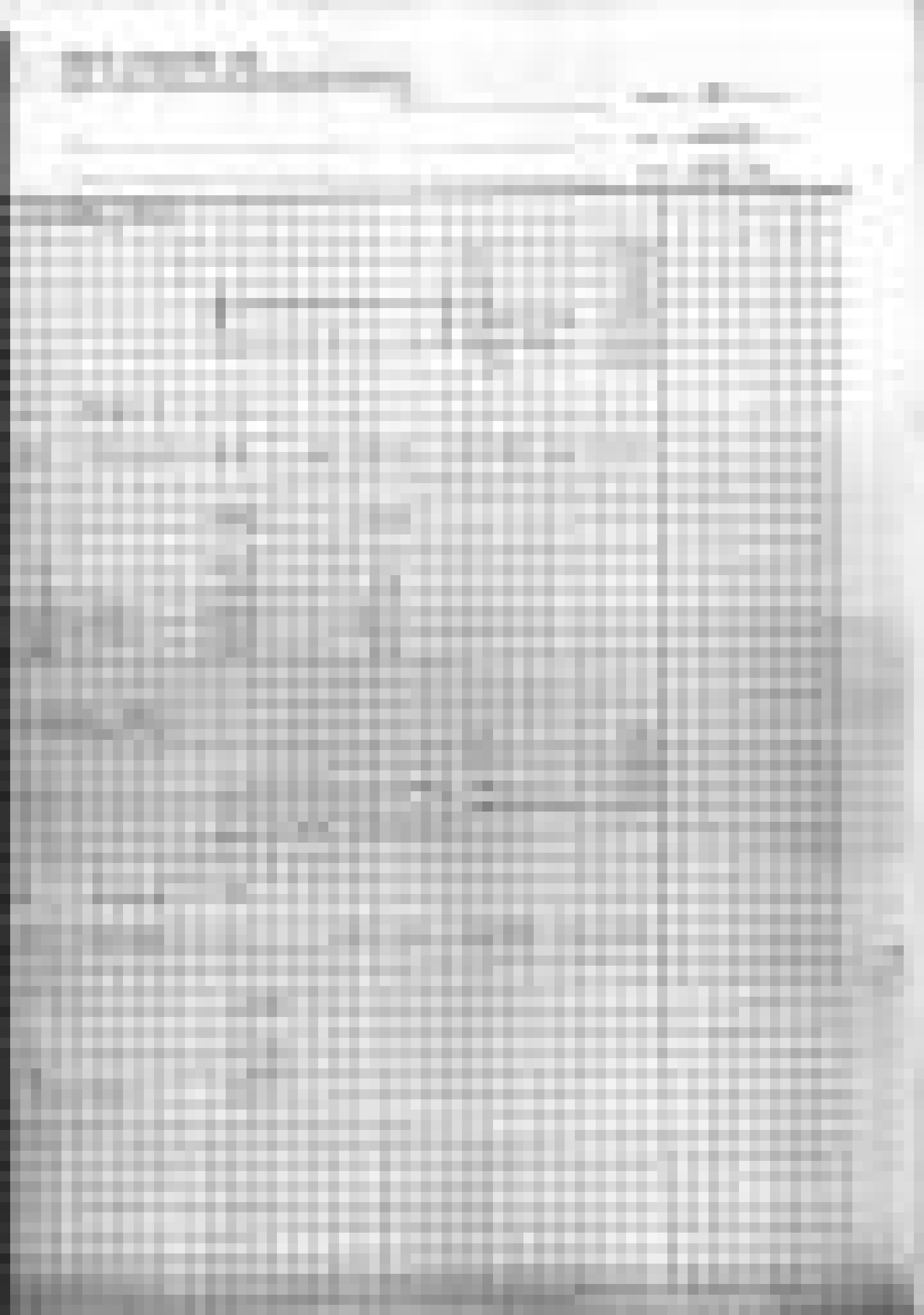


D	99
LL	58
LR	54
1.4D+1.7LR	230

DL 43x4.6 = 198

LL 25x4.6 = 115 A = 23 R = .93 LR = 107

	SSM
P	114
LR	62
1.4D+1.7LR	265



SMITH LEUCHARS LTD

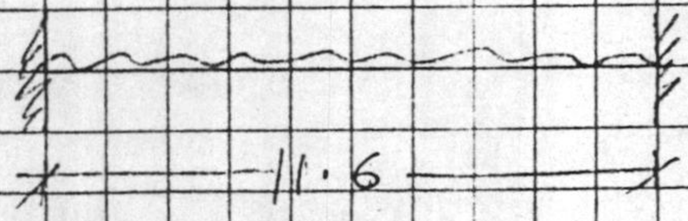
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 19

JOB _____ BY WJM

_____ DATE 26/8/86

Beams A-3 B6



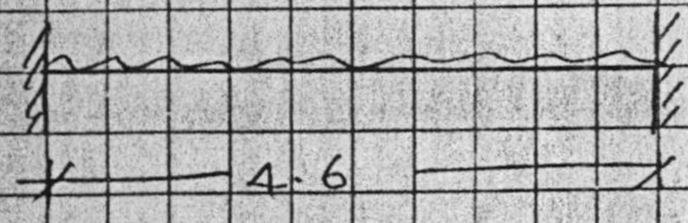
D	174
LL	99
L_R	68
1.4D+1.7LL	359
D+1.3L_R	262
.9D	157

DL 30 x 11.6 = 348 kN

LL 17 x 11.6 = 197 A = 58 R = .69 L_R = 136

	FEM	MSM
D	336	168
L_R	131	66
1.4D+1.7L_R	693	347
D+1.3L_R	506	254
.9D	302	151

Beams 4-MB7



D	69
LL	58
L_R	54
1.4D+1.7L_R	188
D+1.3L_R	139
.9D	62

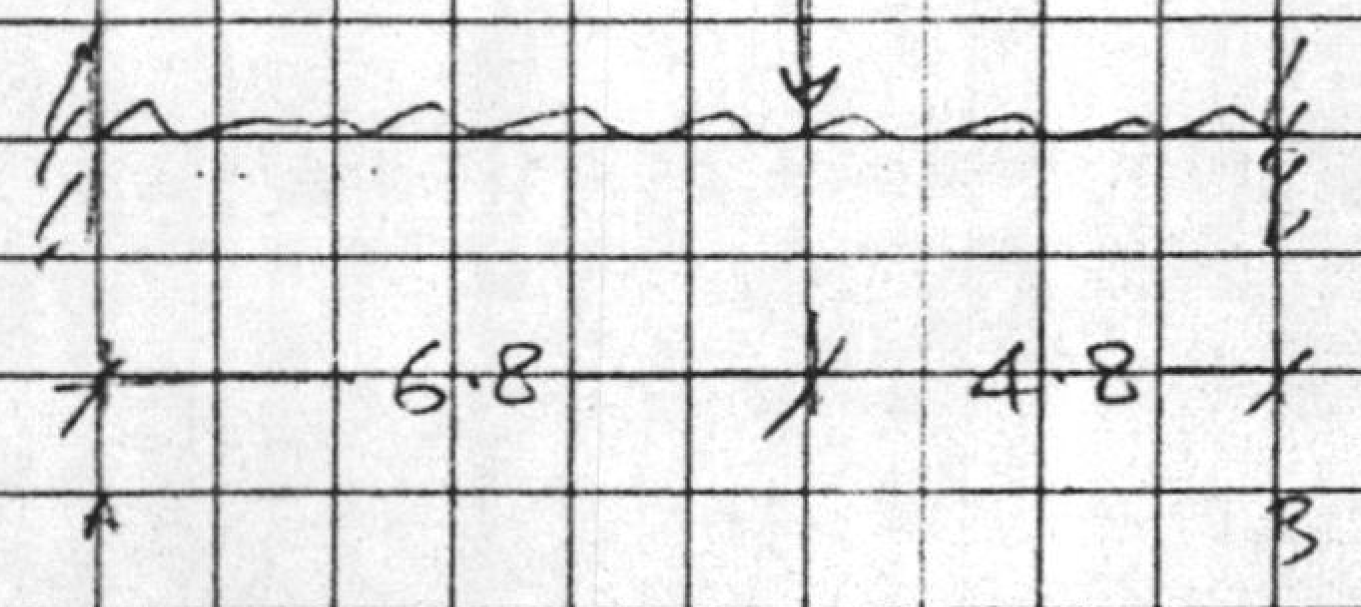
DL 30 x 4.6 = 138

LL 25 x 4.6 = 115 A = 23 R = .93 L_R = 107

	FEM	MSM
D	53	26
L_R	41	21
1.4D+1.7L_R	144	72
D+1.3L_R	106	53
.9D	48	23

Beam 2B6

D	146	D	148
LL	100	LL	105
L_R	66	L_R	69
1.4D+1.7L_R	317	1.4D+1.7L_R	325
D+1.3L_R	232	D+1.3L_R	238
.9D	131	.9D	133



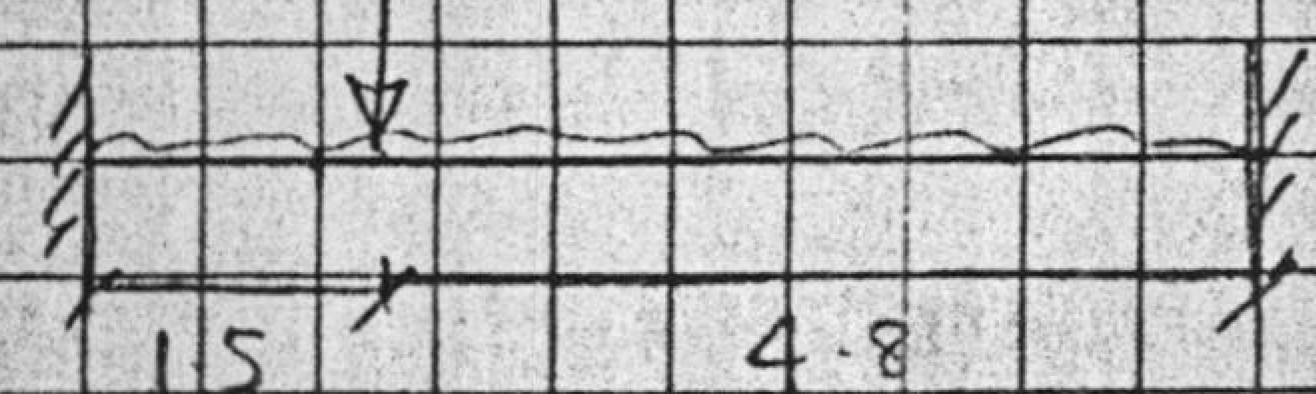
DL - UDL 24 × 11.6 = 278
 - PL 16
 294

LL - UDL 15 × 11.6 = 174 L_R = 115
 - PL 31 20
 205 A = 68 R = .66 .15

	FEM_A	FEM_B	MSM
D	284 + 19 = 303	284 + 26 = 310	142 + 22 = 164
L_R	168 + 36 = 204	168 + 51 = 219	84 + 42 = 126
1.4D+1.7L_R	771	806	444
D+1.3L_R	568	595	328
.9D	273	279	148

Beam 1B9

D	88	D	79
LL	71	LL	55
L_R	54	L_R	42
1.4D+1.7L_R	215	1.4D+1.7L_R	182
D+1.3L_R	158	D+1.3L_R	134
.9D	79	.9D	71



DL UDL 24 × 6.3 = 151
 PL 16
 167

LL UDL 15 × 6.3 = 95 72
 PL 31 24
 126 A = 42 R = .76 L_R = 96

	FEM_A	FEM_B	M_C	MSM
D	79 + 14 = 93	79 + 4 = 83	10 + 7 = 17	40 + 5 = 45
L_R	38 + 27 = 65	38 + 8 = 46	5 + 13 = 18	19 + 9 = 28
1.4D+1.7L_R	241	194	54	111
D+1.3L_R	178	143	40	81
.9D	84	75	15	41

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

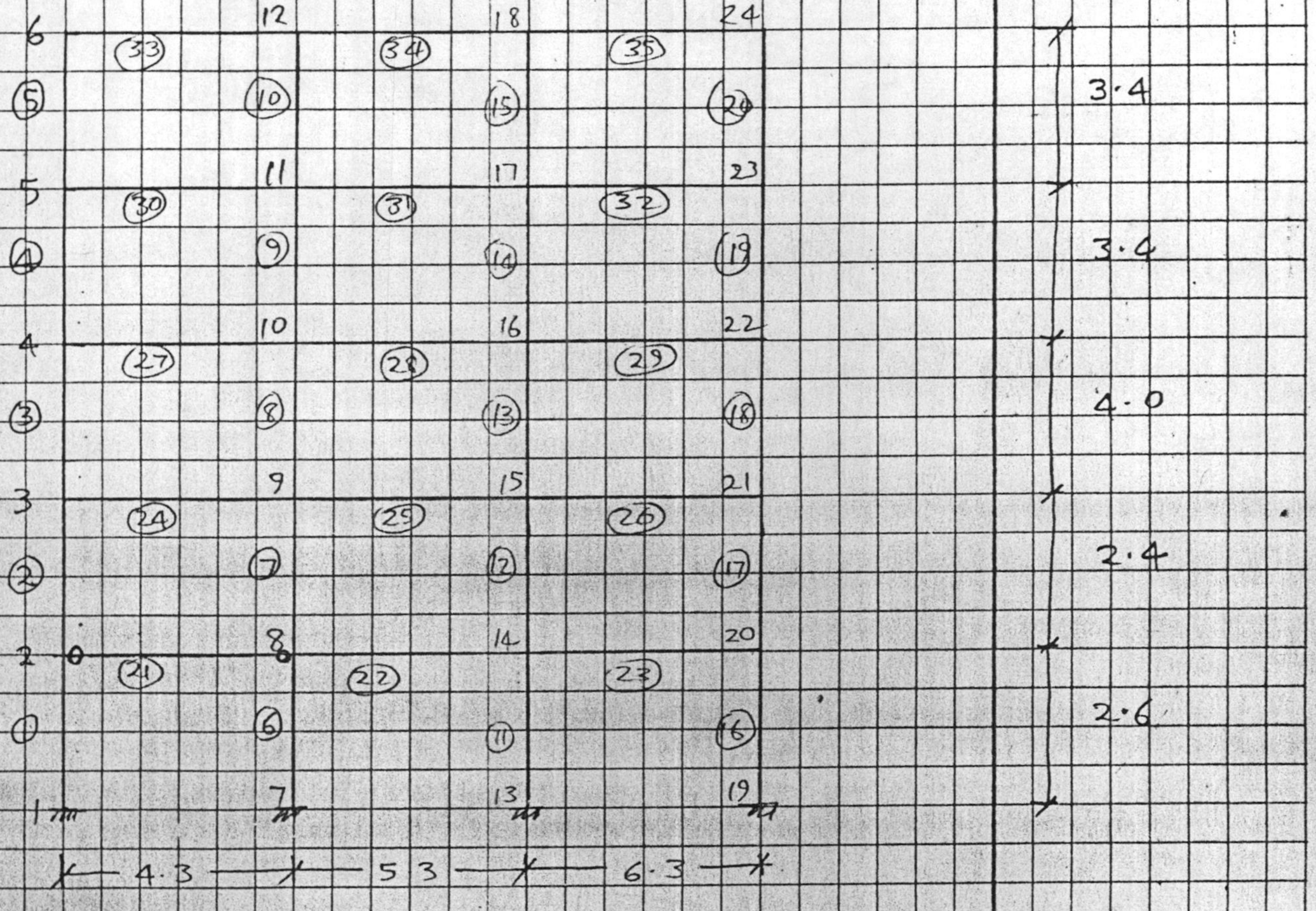
JOB No. _____ PAGE 21

JOB _____ BY W.J.M.

_____ DATE 28/8/86

Computer Model - Frame 80

East Frame



24 joints
35 mbrs
4 supports

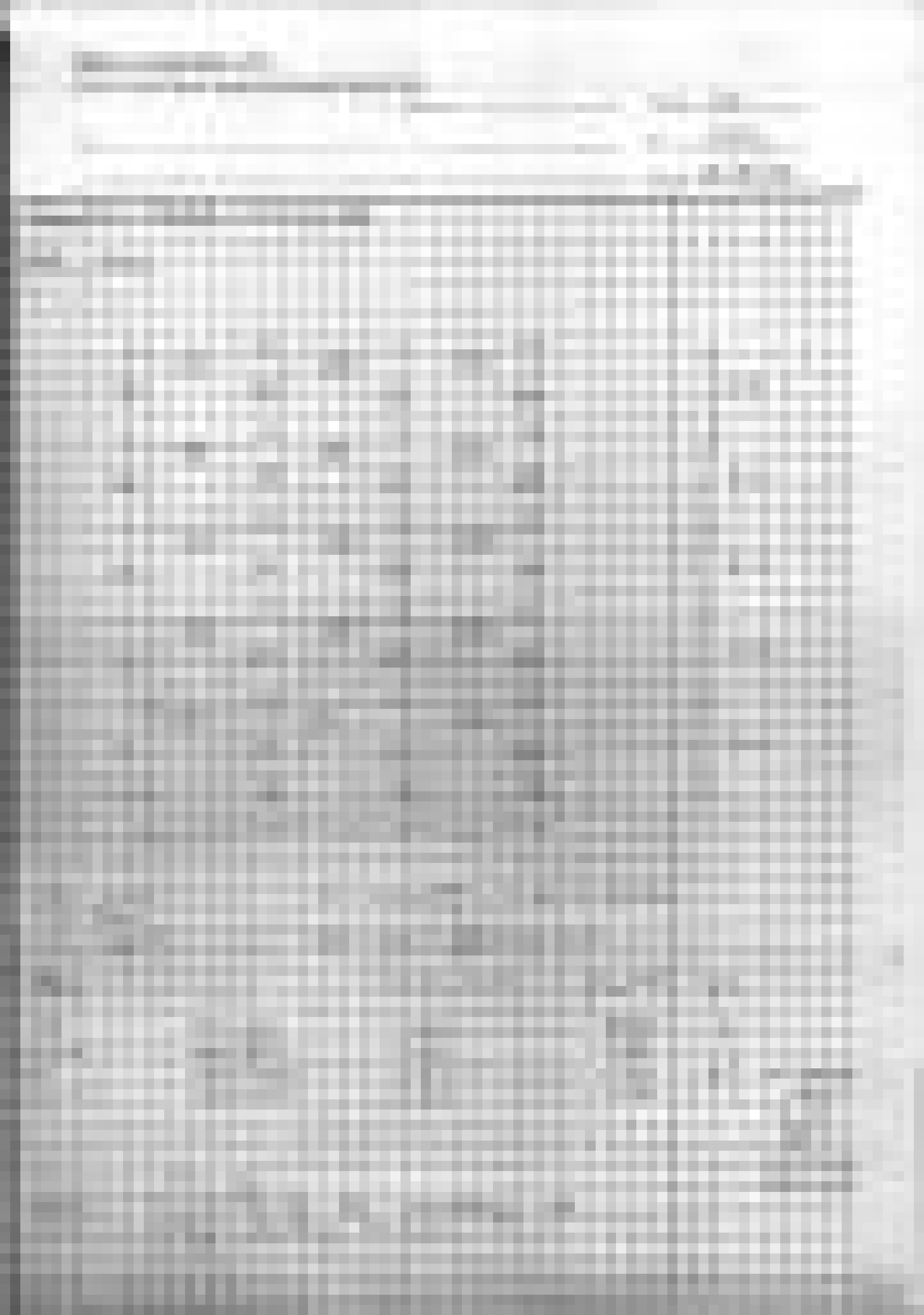
$E = 4700\sqrt{f'_c} = 2.35\ E+07\ kPa$

Max node difference = 6

Mbrs	x/s Area (m^2)	I_{xx} (m^4)	Type.	
1-5	350 x 800	0.28	.002	1	
6-20	800 x 500	0.40	.016	1	
21	500 x 500	0.25	.004	4?	← Look up book (p. 25 also)
22-35	800 x 500	0.40	.016	1	mbr pinned both ends

$A = A_g$

Assume $I_{cr} = .75\ I_g$ for consistency with existing building analysis



Coords

	x	y		x	y
1	0	0	13	9.6	0
2	0	2.6	14	9.6	2.6
3	0	5	15	9.6	5
4	0	9	16	9.6	9
5	0	12.4	17	9.6	12.4
6	0	15.8	18	9.6	15.8
7	4.3	0	19	15.9	0
8	4.3	2.6	20	15.9	2.6
9	4.3	5	21	15.9	5
10	4.3	9	22	15.9	9
11	4.3	12.4	23	15.9	12.4
12	4.3	15.8	24	15.9	15.8

Nodal Loads

Load Case	Joints				P-X (kN)
① E	2	8	14	20	8
	3	9	15	21	39
	4	10	16	22	65
	5	11	17	23	85
	6	12	18	24	60

SMITH LEUCHARS LTD

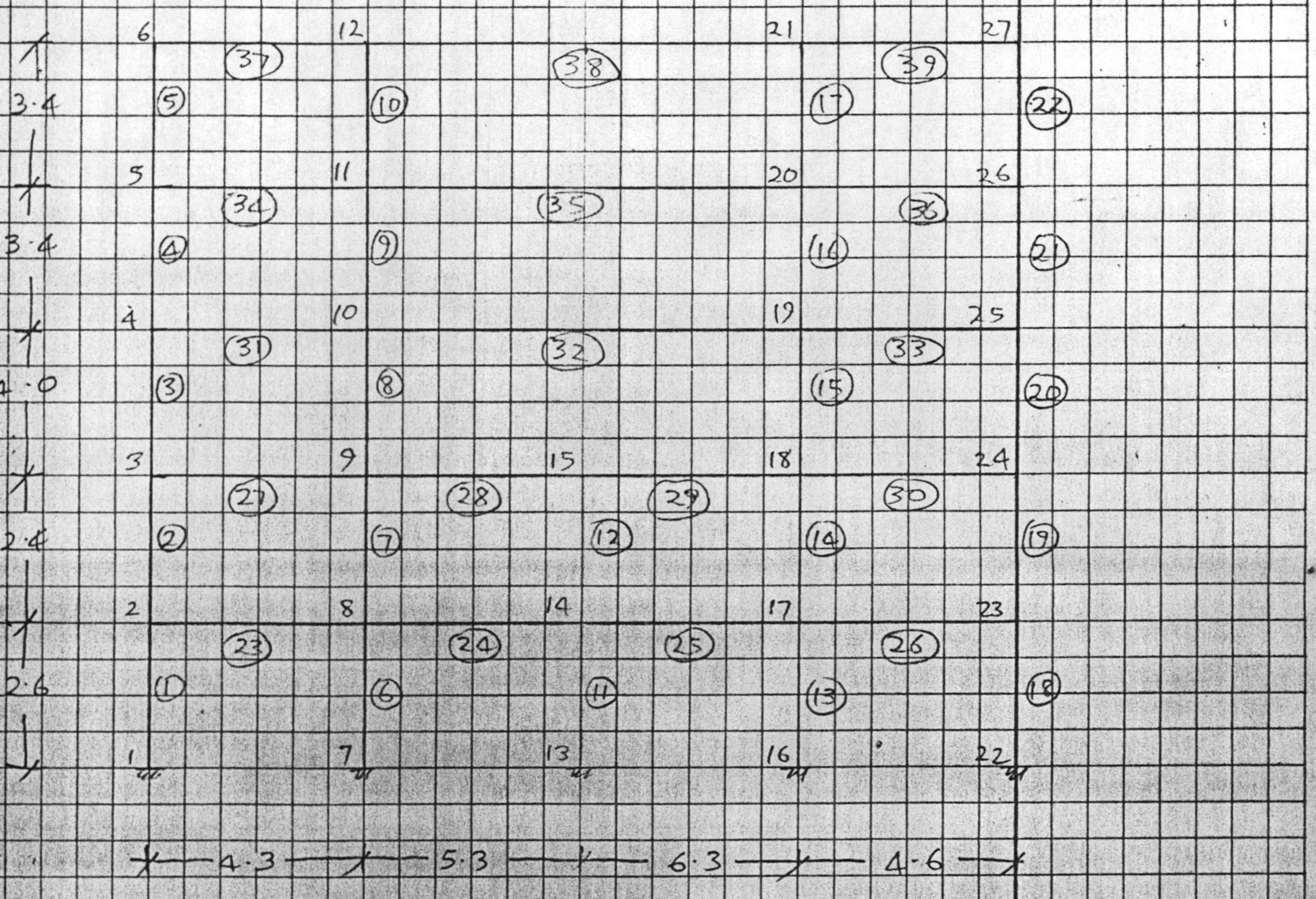
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 23

JOB _____ BY WJM

_____ DATE 28/8/86

West Frame



27 joints

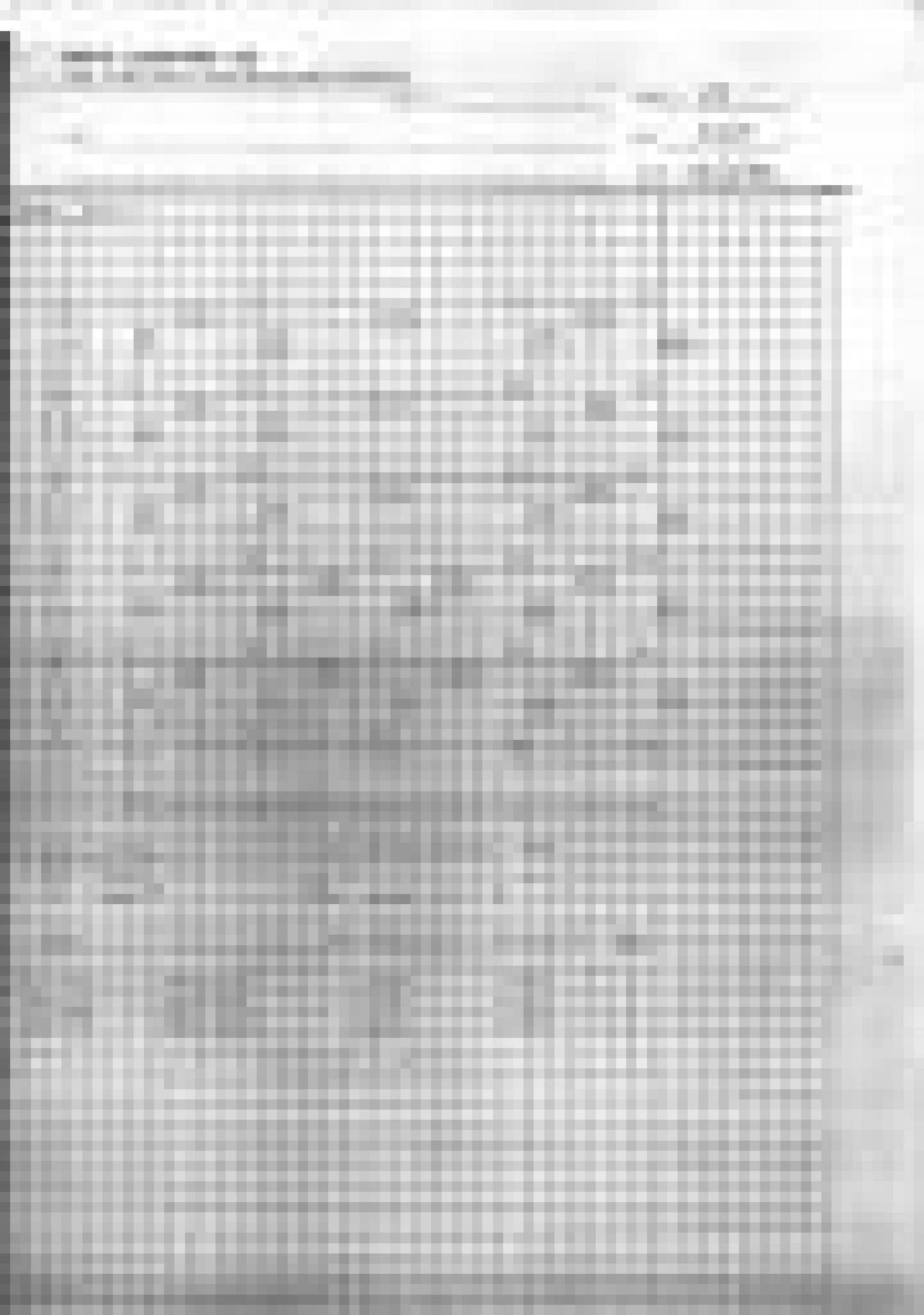
39 mbrs

5 supports

E = 2·35 E+07 kPa

Max node Δ = 9

Mbrs		X/S Area (m^2)	I_{xx} (m^4)	Type
1–17	800x500	0·40	·016	1
18–22	350 x 800	0·28	·002	1
23–39	800 x 500	0·40	·016	1



SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 24

JOB _____ BY WJM

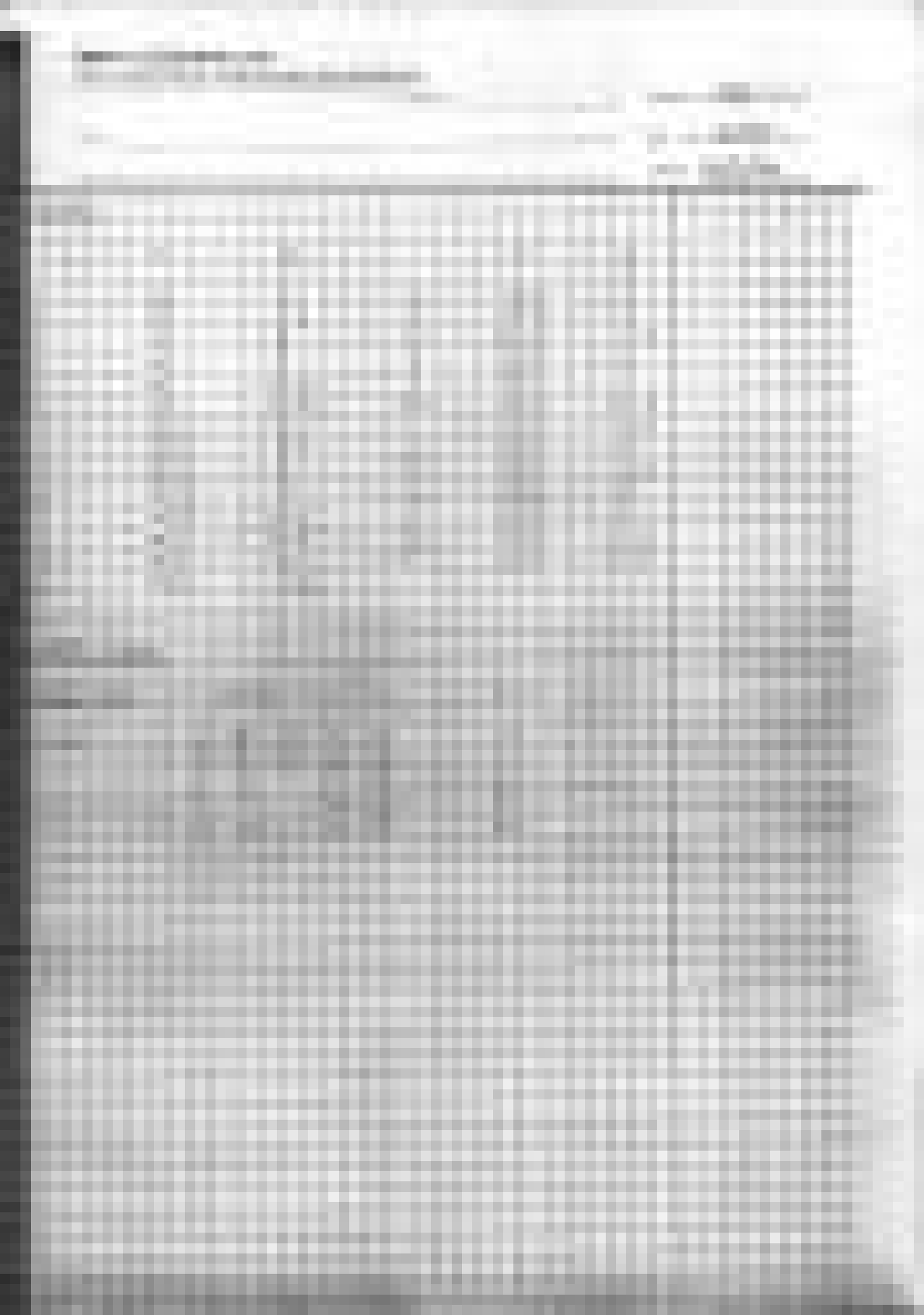
_____ DATE 28/8/86

Coords

	x	y		x	y
1	0	0	15	9.6	5
2	0	2.6	16	15.9	0
3	0	5	17	15.9	2.6
4	0	9	18	15.9	5
5	0	12.4	19	15.9	9
6	0	15.8	20	15.9	12.4
7	4.3	0	21	15.9	5.8
8	4.3	2.6	22	20.5	0
9	4.3	5	23	20.5	2.6
10	4.3	9	24	20.5	5
11	4.3	12.4	25	20.5	9
12	4.3	15.8	26	20.5	12.4
13	9.6	0	27	20.5	15.8
14	9.6	2.6			

Nodal Loads

Load Case	Joints					P-X
D E	2	8	14	17	23	7
	3	9	15	18	24	31
	4	10		19	25	65
	5	11		20	26	85
	6	12		21	27	60



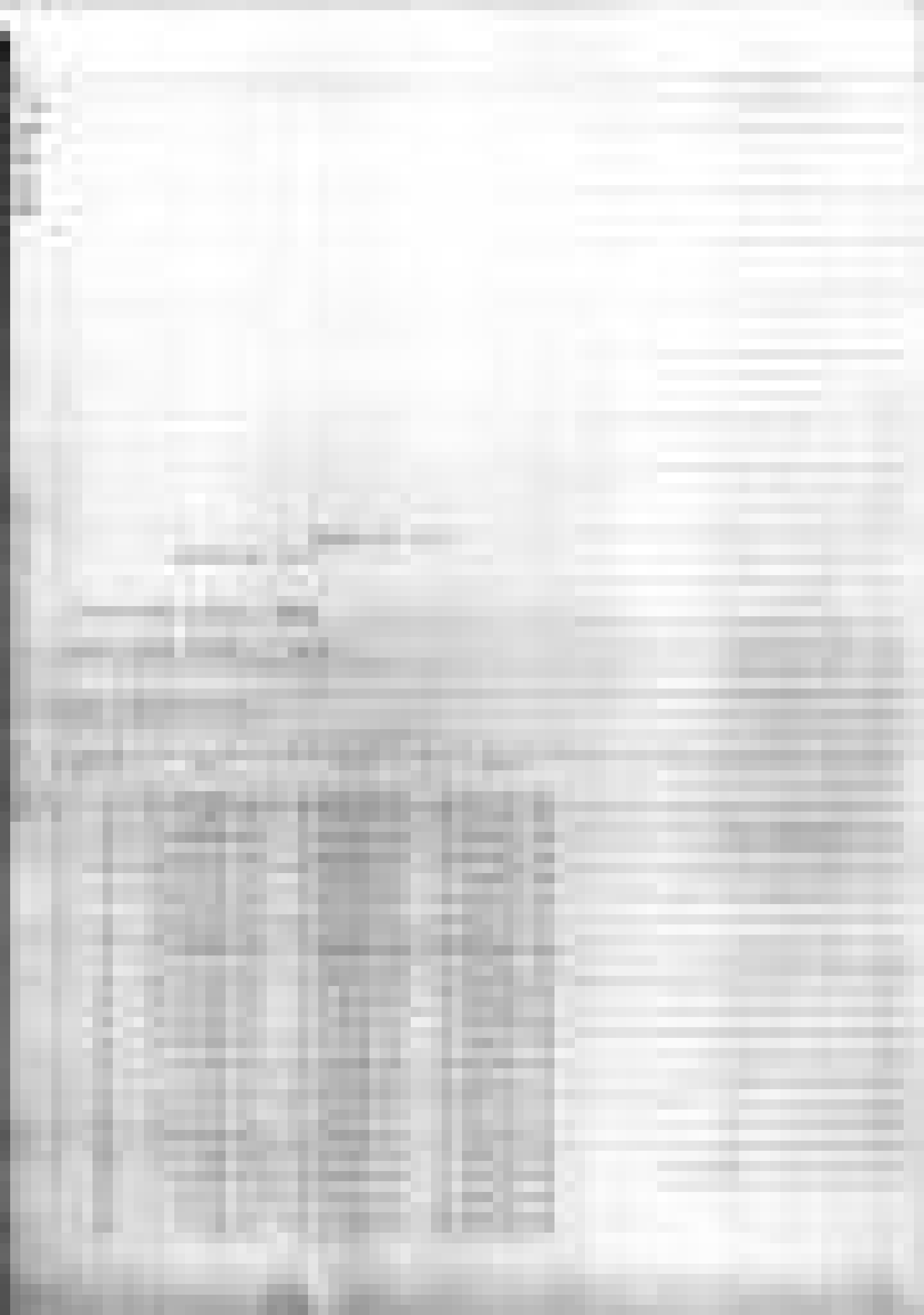
FRAME 80 V1.0

STRUCTURE TITLE : WMCE

LOAD CASE TITLE : 1★(E)

JOINT DISPLACEMENTS

JOINT	D-X	D-Y	R-Z
1	0.0000E+00	0.0000E+00	0.0000E+00
2	3.1128E-03	1.7016E-04	-2.1827E-03
3	7.3085E-03	3.2723E-04	-1.6493E-04
4	1.6336E-02	4.9024E-04	-2.4032E-04
5	2.1275E-02	5.5026E-04	-2.1605E-04
6	2.3707E-02	5.6529E-04	-1.2541E-04
7	0.0000E+00	0.0000E+00	0.0000E+00
8	3.0722E-03	8.1169E-05	-1.4313E-03
9	7.2833E-03	1.0523E-04	-1.2701E-03
10	1.6312E-02	1.2819E-04	-1.1739E-03
11	2.1252E-02	1.3795E-04	-6.8925E-04
12	2.3692E-02	1.4189E-04	-3.0992E-04
13	0.0000E+00	0.0000E+00	0.0000E+00
14	3.0334E-03	-4.3191E-05	-1.0963E-03
15	7.2439E-03	-6.7910E-05	-1.3198E-03
16	1.6296E-02	-9.3750E-05	-1.1381E-03
17	2.1241E-02	-1.0401E-04	-6.8679E-04
18	2.3687E-02	-1.0650E-04	-2.8149E-04
19	0.0000E+00	0.0000E+00	0.0000E+00
20	2.9719E-03	-1.5709E-04	-1.4011E-03
21	7.2624E-03	-2.6638E-04	-1.6753E-03
22	1.6287E-02	-3.7761E-04	-1.5313E-03
23	2.1252E-02	-4.1912E-04	-8.5023E-04
24	2.3703E-02	-4.3109E-04	-4.0376E-04



MEMBER FORCES

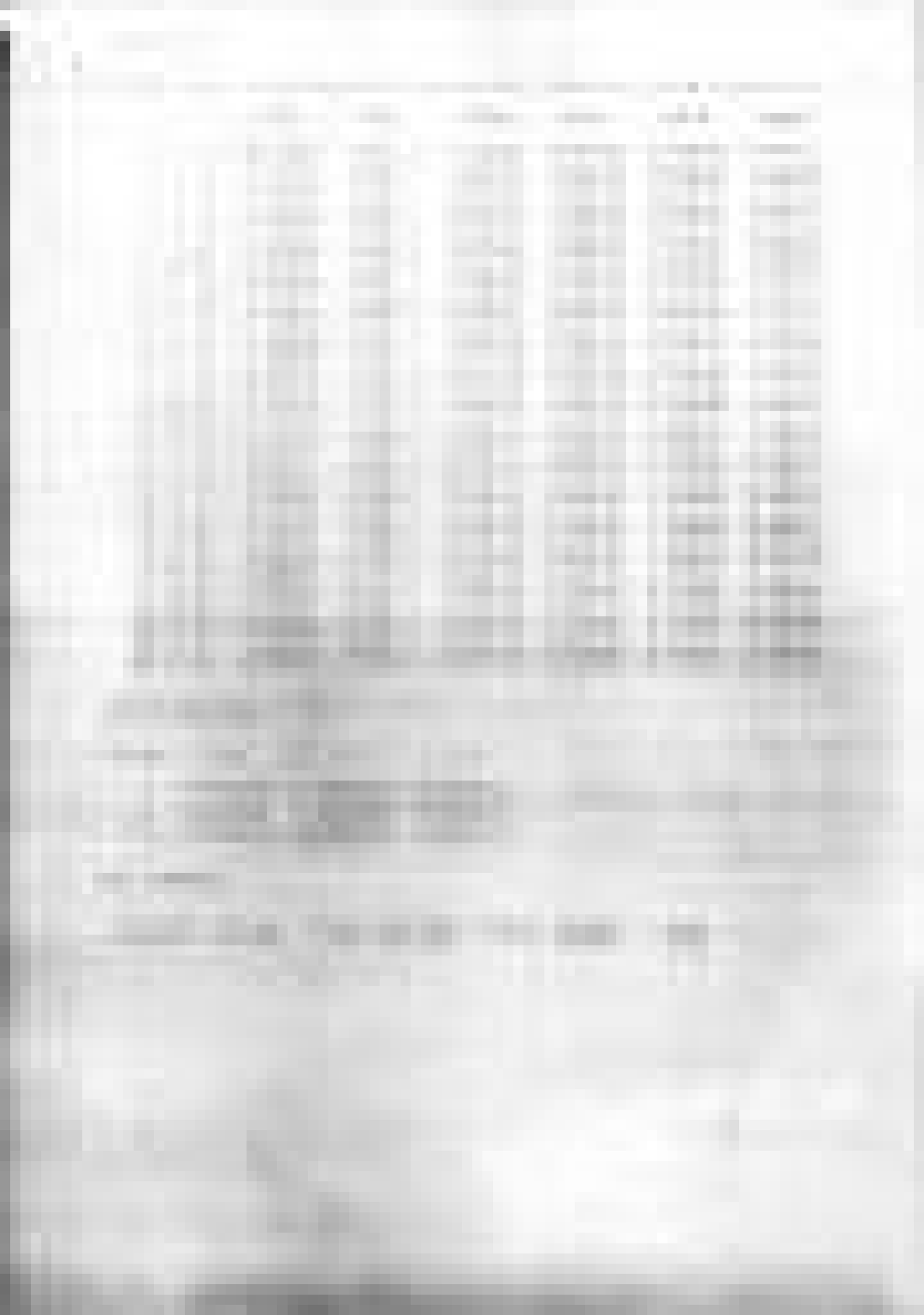
MMBR	J-J	<---------- J A ---------->			<---------- J B ---------->		
		AXIAL	SHEAR	MOMENT	AXIAL	SHEAR	MOMENT
1	1 2	-4.31E+02	8.83E+00	5.09E+01	4.31E+02	-8.83E+00	-2.80E+01
2	2 3	-4.31E+02	5.62E+01	2.80E+01	4.31E+02	-5.62E+01	1.07E+02
3	3 4	-2.68E+02	7.24E+01	1.46E+02	2.68E+02	-7.24E+01	1.44E+02
4	4 5	-1.16E+02	5.97E+01	1.01E+02	1.16E+02	-5.97E+01	1.02E+02
5	5 6	-2.91E+01	2.66E+01	4.39E+01	2.91E+01	-2.66E+01	4.64E+01
6	7 8	-3.93E+02	3.11E+02	6.11E+02	3.93E+02	-3.11E+02	1.97E+02
7	8 9	-9.42E+01	3.16E+02	3.54E+02	9.42E+01	-3.16E+02	4.05E+02
8	9 10	-5.40E+01	2.92E+02	5.75E+02	5.40E+01	-2.92E+02	5.93E+02
9	10 11	-2.70E+01	2.03E+02	2.92E+02	2.70E+01	-2.03E+02	3.99E+02
10	11 12	-1.09E+01	8.51E+01	1.03E+02	1.09E+01	-8.51E+01	1.87E+02
11	13 14	1.56E+02	4.13E+02	6.95E+02	-1.56E+02	-4.13E+02	3.78E+02
12	14 15	9.68E+01	4.28E+02	5.49E+02	-9.68E+01	-4.28E+02	4.79E+02
13	15 16	6.07E+01	2.92E+02	5.66E+02	-6.07E+01	-2.92E+02	6.00E+02
14	16 17	2.84E+01	2.12E+02	3.10E+02	-2.84E+01	-2.12E+02	4.10E+02
15	17 18	6.88E+00	9.18E+01	1.11E+02	-6.88E+00	-9.18E+01	2.01E+02
16	19 20	5.68E+02	2.95E+02	5.87E+02	-5.68E+02	-2.95E+02	1.81E+02
17	20 21	4.28E+02	1.95E+02	2.78E+02	-4.28E+02	-1.95E+02	1.92E+02
18	21 22	2.61E+02	1.84E+02	3.55E+02	-2.61E+02	-1.84E+02	3.82E+02
19	22 23	1.15E+02	1.05E+02	1.04E+02	-1.15E+02	-1.05E+02	2.54E+02
20	23 24	3.31E+01	3.66E+01	1.28E+01	-3.31E+01	-3.66E+01	1.12E+02
21	2 8	5.54E+01	0.00E+00	0.00E+00	-5.54E+01	0.00E+00	0.00E+00
22	8 14	6.88E+01	-1.99E+02	-5.52E+02	-6.88E+01	1.99E+02	-5.04E+02
23	14 20	9.19E+01	-1.40E+02	-4.22E+02	-9.19E+01	1.40E+02	-4.59E+02
24	3 9	5.52E+01	-1.62E+02	-2.53E+02	-5.52E+01	1.62E+02	-4.46E+02
25	9 15	6.97E+01	-2.03E+02	-5.34E+02	-6.97E+01	2.03E+02	-5.41E+02
26	15 21	-2.76E+01	-1.67E+02	-5.04E+02	2.76E+01	1.67E+02	-5.46E+02
27	4 10	5.23E+01	-1.52E+02	-2.45E+02	-5.23E+01	1.52E+02	-4.08E+02
28	10 16	2.88E+01	-1.79E+02	-4.77E+02	-2.88E+01	1.79E+02	-4.72E+02
29	16 22	1.38E+01	-1.47E+02	-4.38E+02	-1.38E+01	1.47E+02	-4.85E+02
30	5 11	5.18E+01	-8.71E+01	-1.46E+02	-5.18E+01	8.71E+01	-2.29E+02
31	11 17	1.85E+01	-1.03E+02	-2.74E+02	-1.85E+01	1.03E+02	-2.73E+02
32	17 23	-1.63E+01	-8.17E+01	-2.48E+02	1.63E+01	8.17E+01	-2.67E+02
33	6 12	3.34E+01	-2.91E+01	-4.64E+01	-3.34E+01	2.91E+01	-7.87E+01
34	12 18	8.36E+00	-4.00E+01	-1.08E+02	-8.36E+00	4.00E+01	-1.04E+02
35	18 24	-2.34E+01	-3.31E+01	-9.69E+01	2.34E+01	3.31E+01	-1.12E+02

SUPPORT REACTIONS

JOINT	R-X	R-Y	R-Z
1	-8.8320E+00	-4.3064E+02	5.0939E+01
7	-3.1101E+02	-2.9346E+02	6.1131E+02
13	-4.1285E+02	1.5615E+02	6.9525E+02
19	-2.9534E+02	5.6795E+02	5.8656E+02

LOAD SUMMATION

HORIZONTAL	APPLIED	1028.00	REACTION -1028.04	BALANCE	-0.04
VERTICAL	APPLIED	0.00	REACTION 0.00	BALANCE	0.00



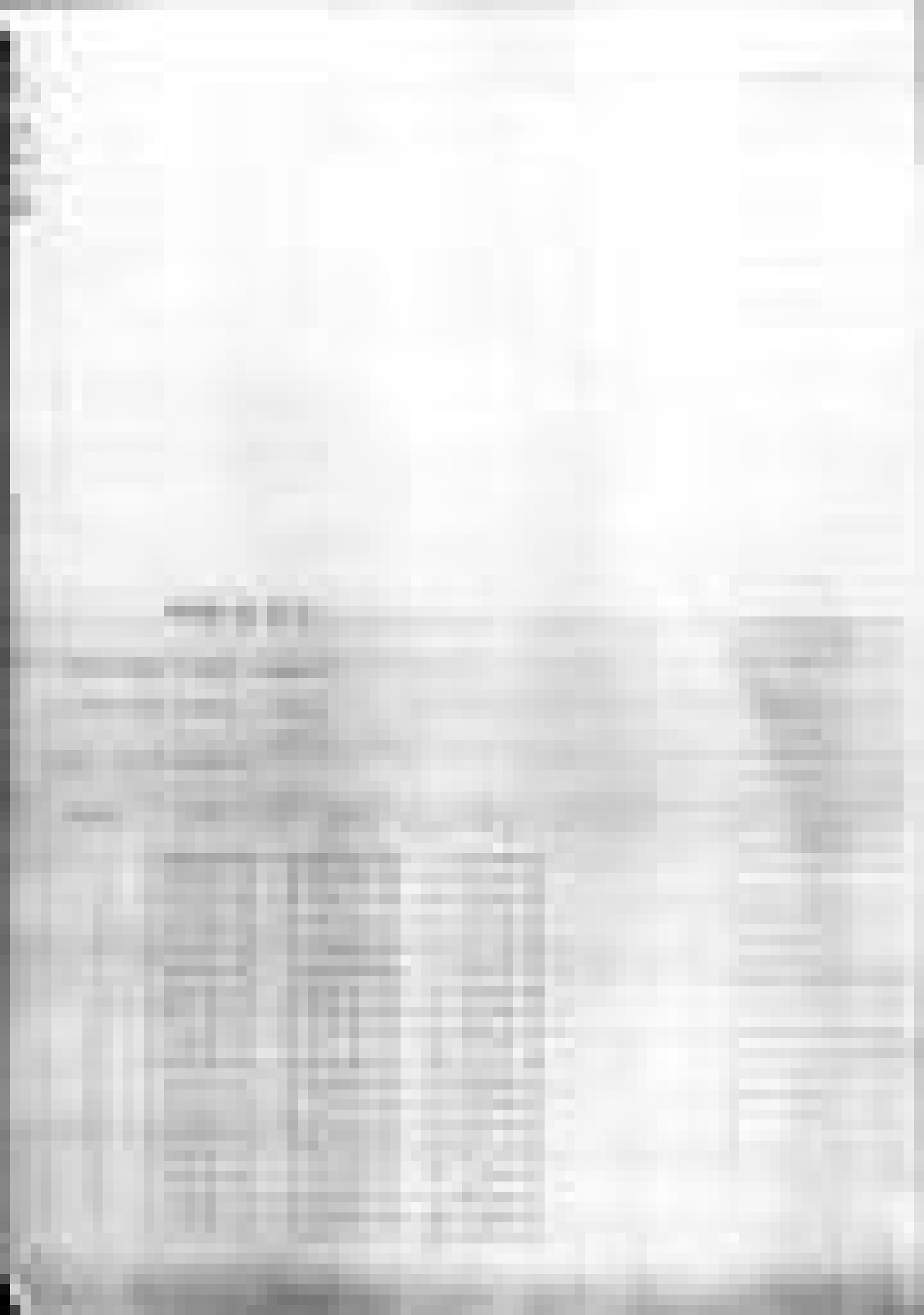
FRAME 80 V1.0

STRUCTURE TITLE : WMCW

LOAD CASE TITLE : 1*(E)

JOINT DISPLACEMENTS

JOINT	D-X	D-Y	R-Z
1	0.0000E+00	0.0000E+00	0.0000E+00
2	1.8584E-03	2.4133E-04	-8.2041E-04
3	4.7057E-03	4.2427E-04	-1.2624E-03
4	1.3342E-02	6.2826E-04	-1.4783E-03
5	1.8733E-02	7.0151E-04	-9.5317E-04
6	2.1686E-02	7.1990E-04	-5.5511E-04
7	0.0000E+00	0.0000E+00	0.0000E+00
8	1.8962E-03	-1.4912E-04	-6.3944E-04
9	4.6417E-03	-2.7704E-04	-1.0074E-03
10	1.3348E-02	-4.4065E-04	-1.2880E-03
11	1.8740E-02	-4.9672E-04	-8.4734E-04
12	2.1679E-02	-5.0914E-04	-4.3316E-04
13	0.0000E+00	0.0000E+00	0.0000E+00
14	1.9514E-03	-1.7834E-05	-7.7804E-04
15	4.5234E-03	-2.6011E-05	-3.9981E-04
16	0.0000E+00	0.0000E+00	0.0000E+00
17	1.9207E-03	5.9976E-05	-6.9919E-04
18	4.6153E-03	1.1464E-04	-1.1143E-03
19	1.3393E-02	1.9806E-04	-1.4317E-03
20	1.8795E-02	2.1398E-04	-8.7744E-04
21	2.1694E-02	2.1892E-04	-4.2630E-04



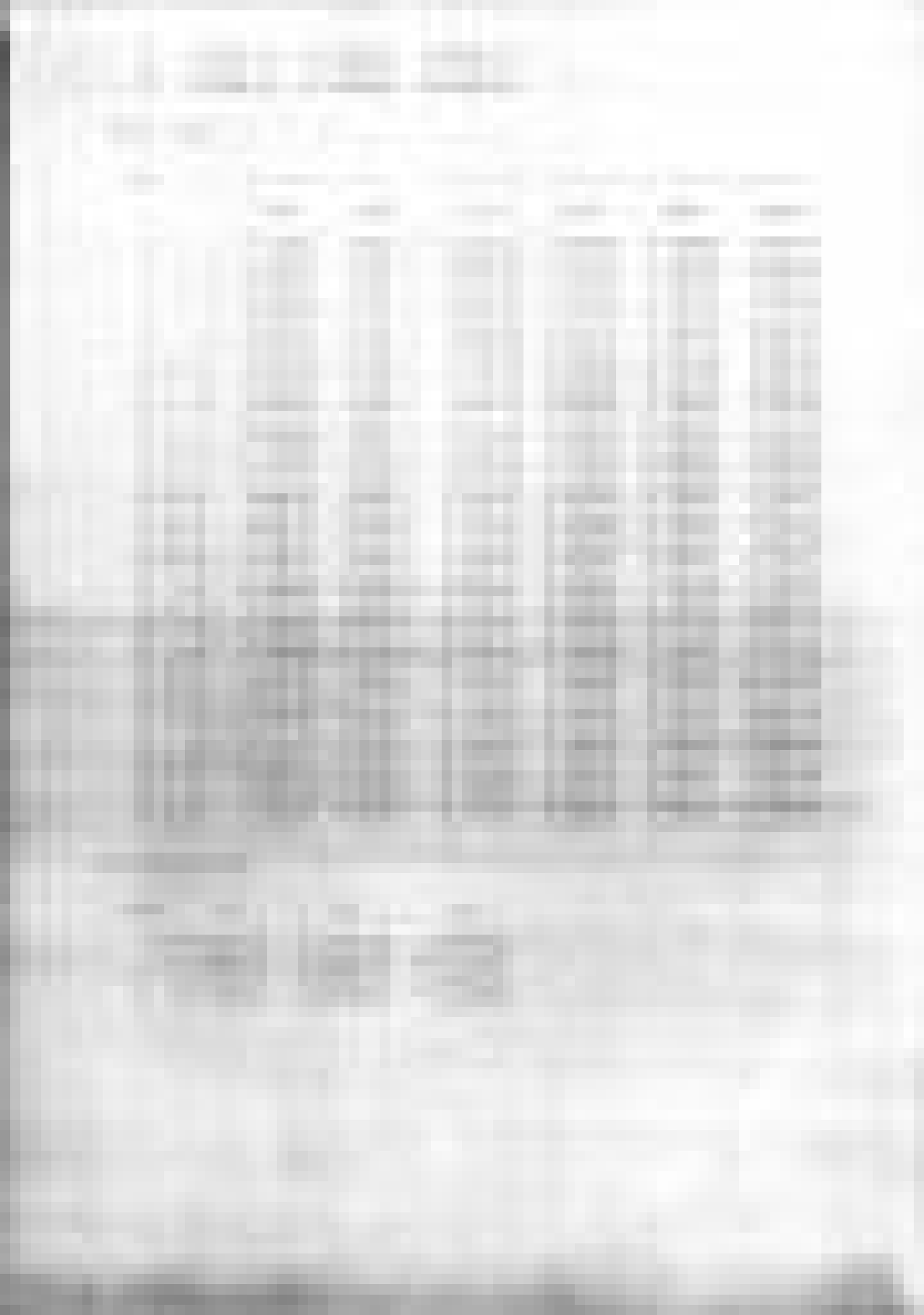
24	1.6230E-03	-2.2639E-04	-8.0322E-04
25	1.3423E-02	-4.9952E-04	-2.5800E-04
26	1.8819E-02	-5.6108E-04	-2.9392E-04
27	2.1709E-02	-5.7668E-04	-2.0278E-04

MEMBER FORCES

MMBR	J-J	< J A			J B >		
		AXIAL	SHEAR	MOMENT	AXIAL	SHEAR	MOMENT
1	1 2	-8.72E+02	2.03E+02	3.83E+02	8.72E+02	-2.03E+02	1.46E+02
2	2 3	-7.17E+02	1.14E+02	2.06E+02	7.17E+02	-1.14E+02	6.70E+01
3	3 4	-4.79E+02	2.22E+02	4.65E+02	4.79E+02	-2.22E+02	4.25E+02
4	4 5	-2.03E+02	1.44E+02	1.87E+02	2.03E+02	-1.44E+02	3.03E+02
5	5 6	-5.08E+01	4.47E+01	3.19E+01	5.08E+01	-4.47E+01	1.20E+02
6	7 8	5.39E+02	2.73E+02	4.48E+02	-5.39E+02	-2.73E+02	2.63E+02
7	8 9	5.01E+02	2.51E+02	3.59E+02	-5.01E+02	-2.51E+02	2.44E+02
8	9 10	3.84E+02	2.90E+02	6.07E+02	-3.84E+02	-2.90E+02	5.54E+02
9	10 11	1.55E+02	2.02E+02	2.95E+02	-1.55E+02	-2.02E+02	3.93E+02
10	11 12	3.43E+01	8.75E+01	1.03E+02	-3.43E+01	-8.75E+01	1.95E+02
11	13 14	6.45E+01	2.41E+02	4.26E+02	-6.45E+01	-2.41E+02	2.01E+02
12	14 15	3.20E+01	3.78E+02	3.94E+02	-3.20E+01	-3.78E+02	5.13E+02
13	16 17	-2.17E+02	2.60E+02	4.39E+02	2.17E+02	-2.60E+02	2.37E+02
14	17 18	-2.14E+02	1.69E+02	2.68E+02	2.14E+02	-1.69E+02	1.38E+02
15	19 19	-1.73E+02	2.60E+02	5.49E+02	1.73E+02	-2.60E+02	4.90E+02
16	19 20	-7.17E+01	1.69E+02	2.27E+02	7.17E+01	-1.69E+02	3.49E+02
17	20 21	-1.37E+01	7.85E+01	8.35E+01	1.37E+01	-7.85E+01	1.63E+02
18	22 23	4.86E+02	5.24E+01	7.23E+01	-4.86E+02	-5.24E+01	6.38E+01
19	23 24	3.98E+02	8.31E+01	1.01E+02	-3.98E+02	-8.31E+01	9.84E+01
20	24 25	2.67E+02	6.77E+01	1.35E+02	-2.67E+02	-6.77E+01	1.36E+02
21	25 26	1.19E+02	6.40E+01	1.09E+02	-1.19E+02	-6.40E+01	1.08E+02
22	26 27	3.02E+01	2.94E+01	4.86E+01	-3.02E+01	-2.94E+01	5.12E+01
23	2 8	-8.27E+01	-1.56E+02	-3.51E+02	8.27E+01	1.56E+02	-3.19E+02
24	8 14	-9.80E+01	-1.18E+02	-3.02E+02	9.80E+01	1.18E+02	-3.22E+02
25	14 17	4.58E+01	-8.54E+01	-2.74E+02	-4.58E+01	8.54E+01	-2.64E+02
26	17 23	-3.77E+01	-8.81E+01	-2.40E+02	3.77E+01	8.81E+01	-1.65E+02
27	3 9	1.40E+02	-2.37E+02	-5.32E+02	-1.40E+02	2.37E+02	-4.88E+02
28	9 15	2.10E+02	-1.21E+02	-3.63E+02	-2.10E+02	1.21E+02	-2.77E+02
29	15 18	-1.37E+02	-8.86E+01	-2.36E+02	1.37E+02	8.86E+01	-3.22E+02
30	18 24	-1.56E+01	-1.30E+02	-3.66E+02	1.56E+01	1.30E+02	-2.33E+02
31	4 10	-1.31E+01	-2.77E+02	-6.12E+02	1.31E+01	2.77E+02	-5.79E+02
32	10 19	-3.60E+01	-4.74E+01	-2.70E+02	3.60E+01	4.74E+01	-2.80E+02
33	19 25	-6.13E+01	-1.48E+02	-4.37E+02	6.13E+01	1.48E+02	-2.45E+02
34	5 11	-1.47E+01	-1.52E+02	-3.35E+02	1.47E+01	1.52E+02	-3.17E+02
35	11 20	-4.44E+01	-3.10E+01	-1.79E+02	4.44E+01	3.10E+01	-1.81E+02
36	20 26	-5.04E+01	-8.90E+01	-2.52E+02	5.04E+01	8.90E+01	-1.57E+02
37	6 12	1.53E+01	-5.08E+01	-1.20E+02	-1.53E+01	5.08E+01	-9.86E+01
38	12 21	-1.22E+01	-1.65E+01	-9.60E+01	1.22E+01	1.65E+01	-9.56E+01
39	21 27	-3.06E+01	-3.02E+01	-8.77E+01	3.06E+01	3.02E+01	-5.12E+01

SUPPORT REACTIONS

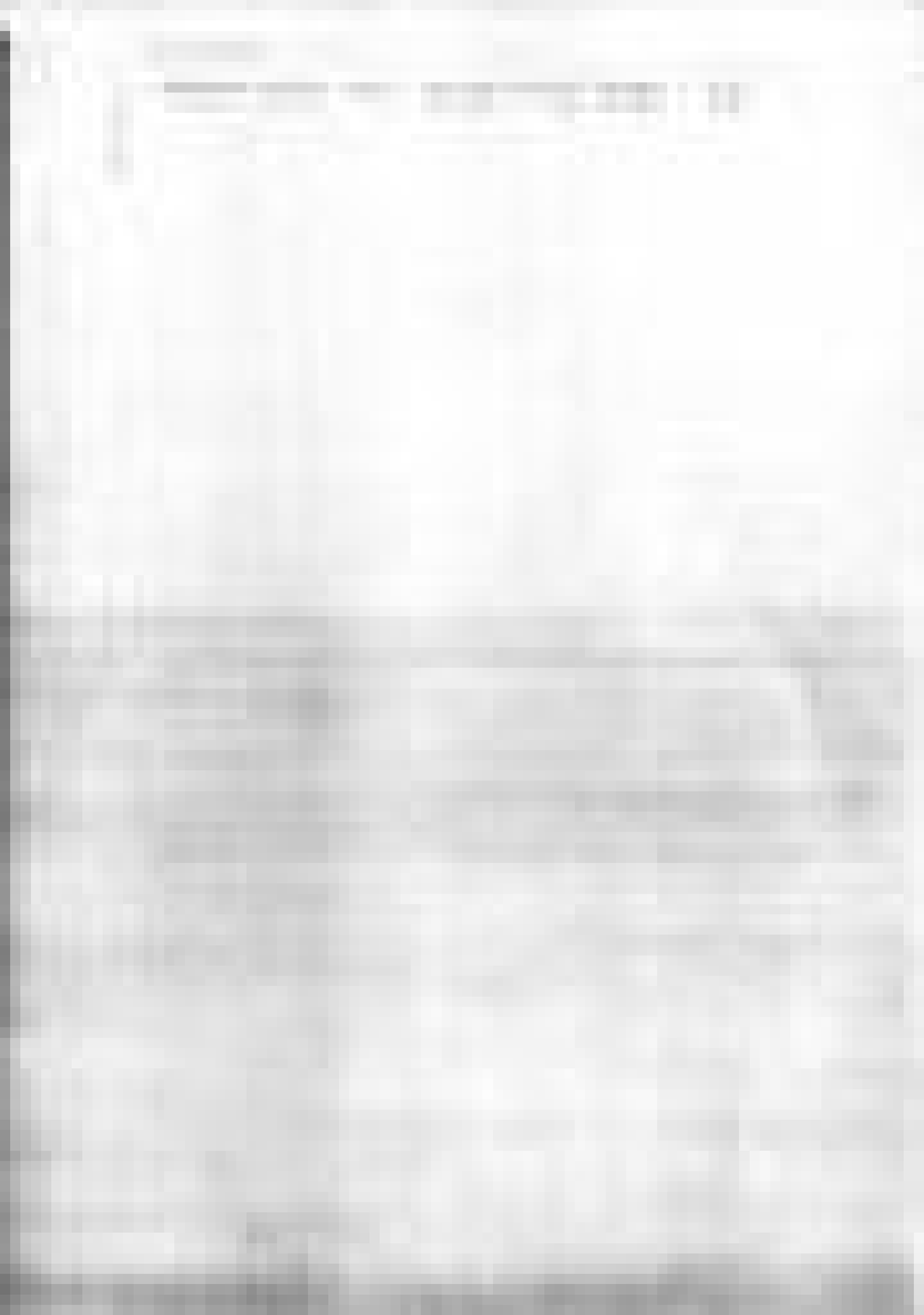
JOINT	R-X	R-Y	R-Z
1	-2.0327E+02	-8.7249E+02	3.8290E+02
7	-2.7338E+02	5.3914E+02	4.4787E+02
13	-3.4131E+02	6.4478E+01	4.2622E+02
16	-2.5974E+02	-2.1683E+02	4.3677E+02
22	-5.2360E+01	4.8571E+02	7.2343E+01



LOAD SUMMATION

	HORIZONTAL	APPLIED	1030.00	REACTION	-1030.06	BALANCE	-0.06
	VERTICAL	APPLIED	0.00	REACTION	0.00	BALANCE	0.00

AE184



SMITH LEUCHARS LTD

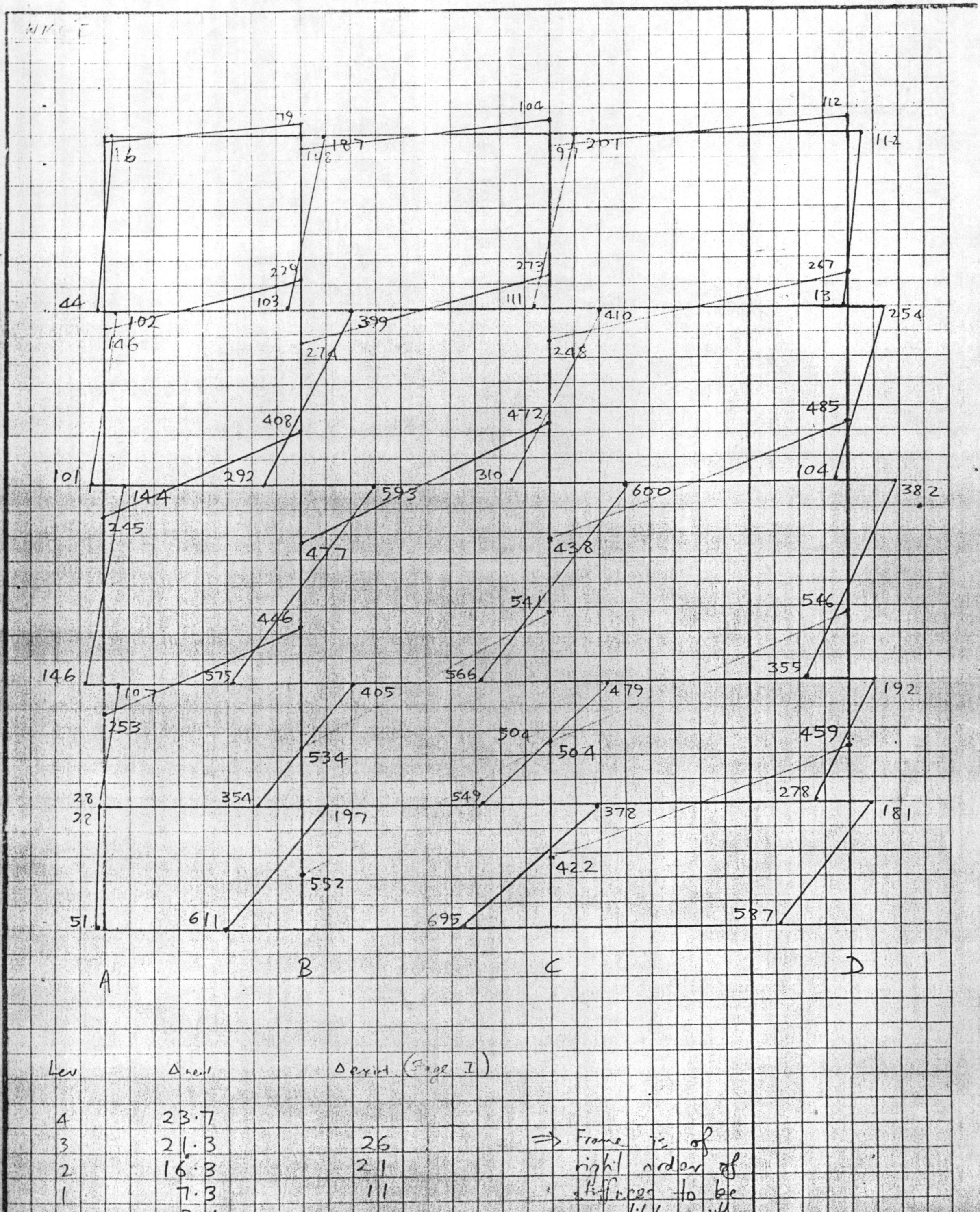
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 30

JOB _____ BY WJM

_____ DATE 1/10/86

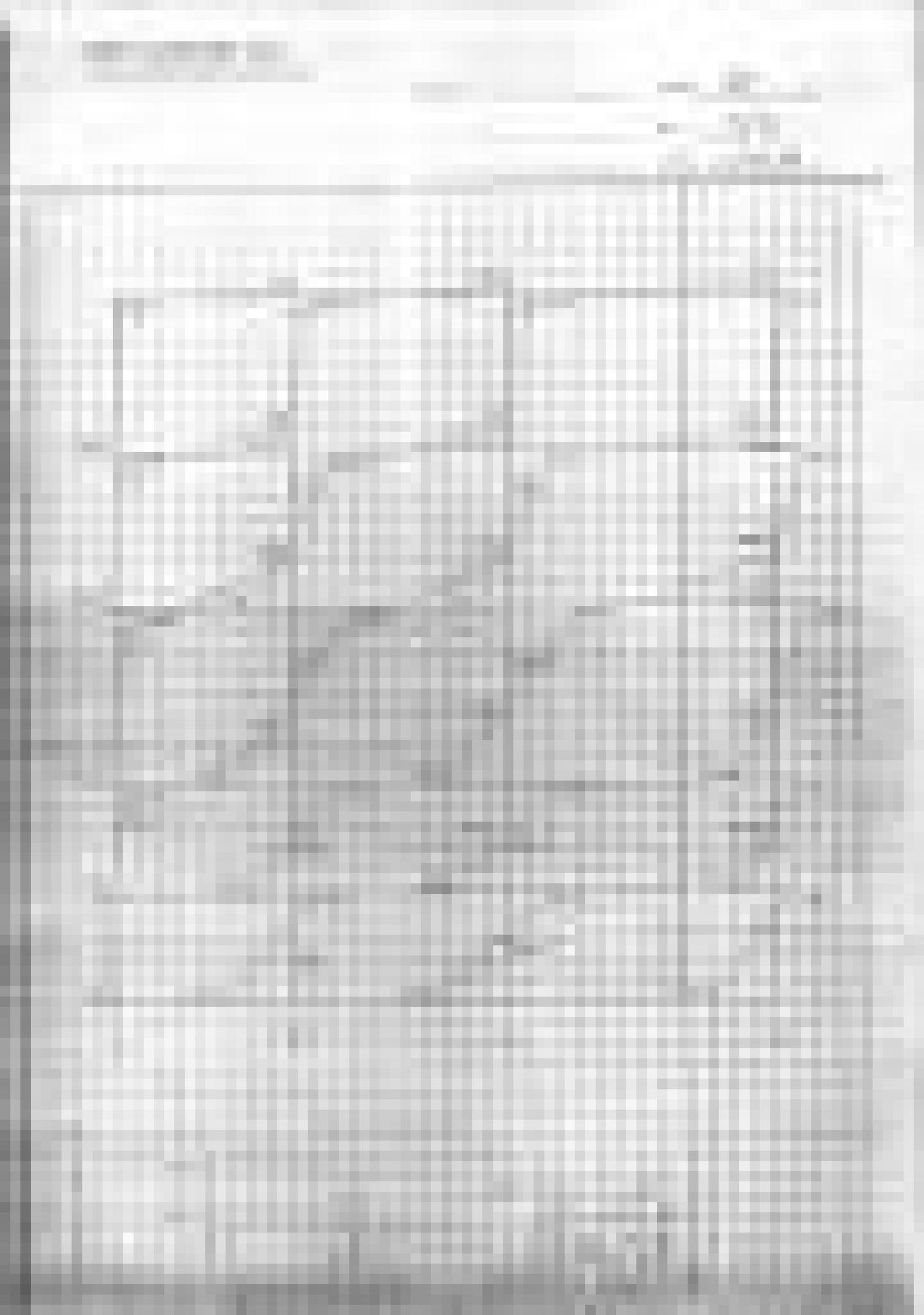
WIND



A B C D

Lev	Δ new	Δ exist. (Stage I)
4	23·7	
3	21·3	26
2	16·3	21
1	7·3	11
M	3·1	—

⇒ Frame is of right order of stiffness to be compatible with existing stage 1 bldg



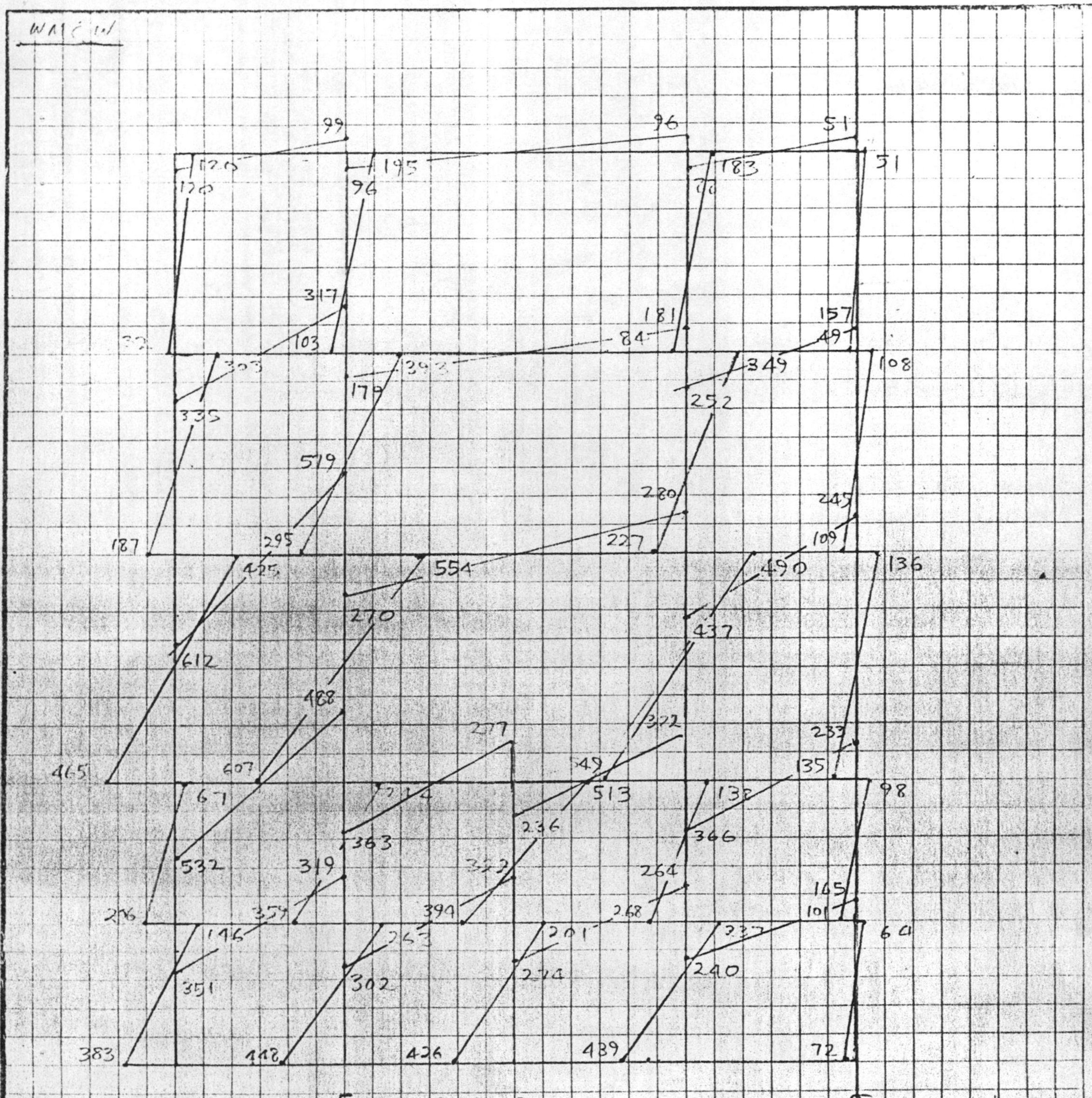
SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 31

JOB _____ BY WJM

_____ DATE 1/10/86

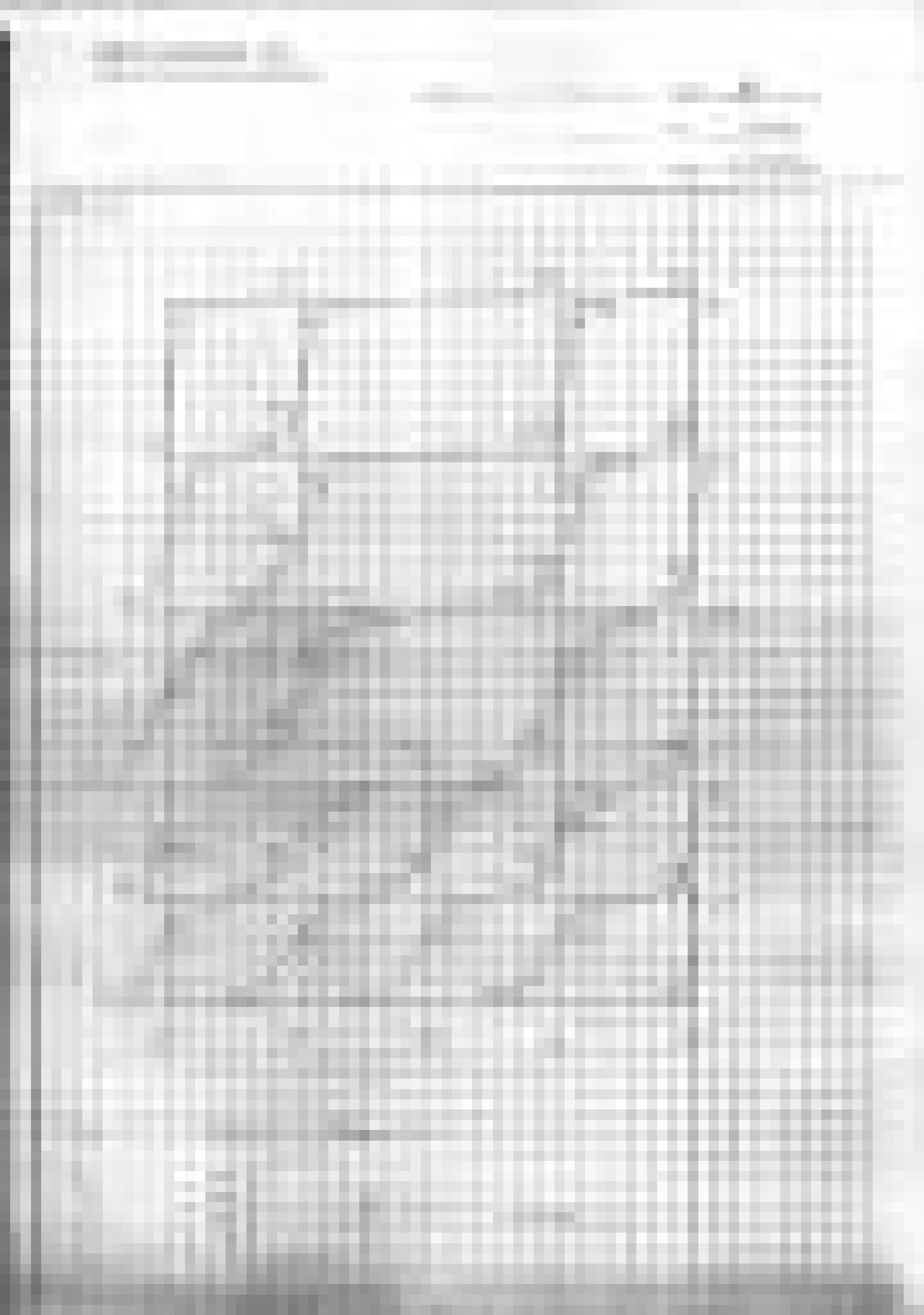
WALL (1)



E F G H I

Low	Δ low	Δ (3 legs)
4	21.7	
3	18.7	26
2	13.3	21
1	4.7	11
PA	1.9	

⇒ OK



SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. _____ PAGE 32

JOB _____ BY WJM

_____ DATE 1/10/86

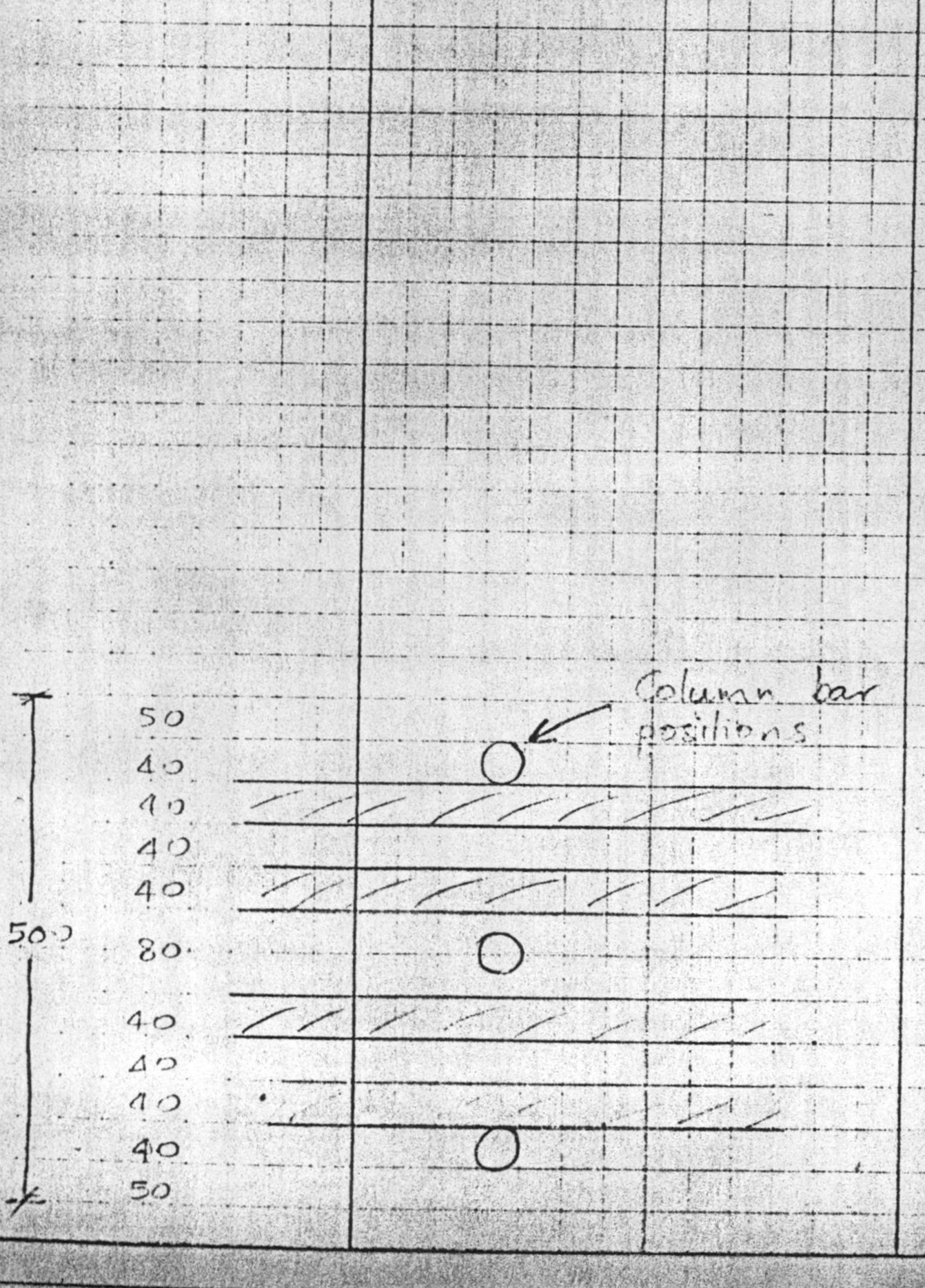
Beam Section 800 x 500

ρ_{min} = .0037

f'_c = 25 MPa

ρ_{max} = .75 ρ_b = .0218

Bars	A_s (mm^2)	d (mm)	ρ	R_u	M_u (kNm)	M_o (kNm)
3HD24	1357	730	.0037	1.34	321	
2HD24 + 2HD20	1533	730	.0042	1.50	360	
4HD24	1810	730	.0050	1.80	432	
4HD28	2463	730	.0067	2.38	571	
4HD32	3217	730	.0088	3.12	748	



SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No _____ PAGE _____

JOB _____ BY _____

_____ DATE _____

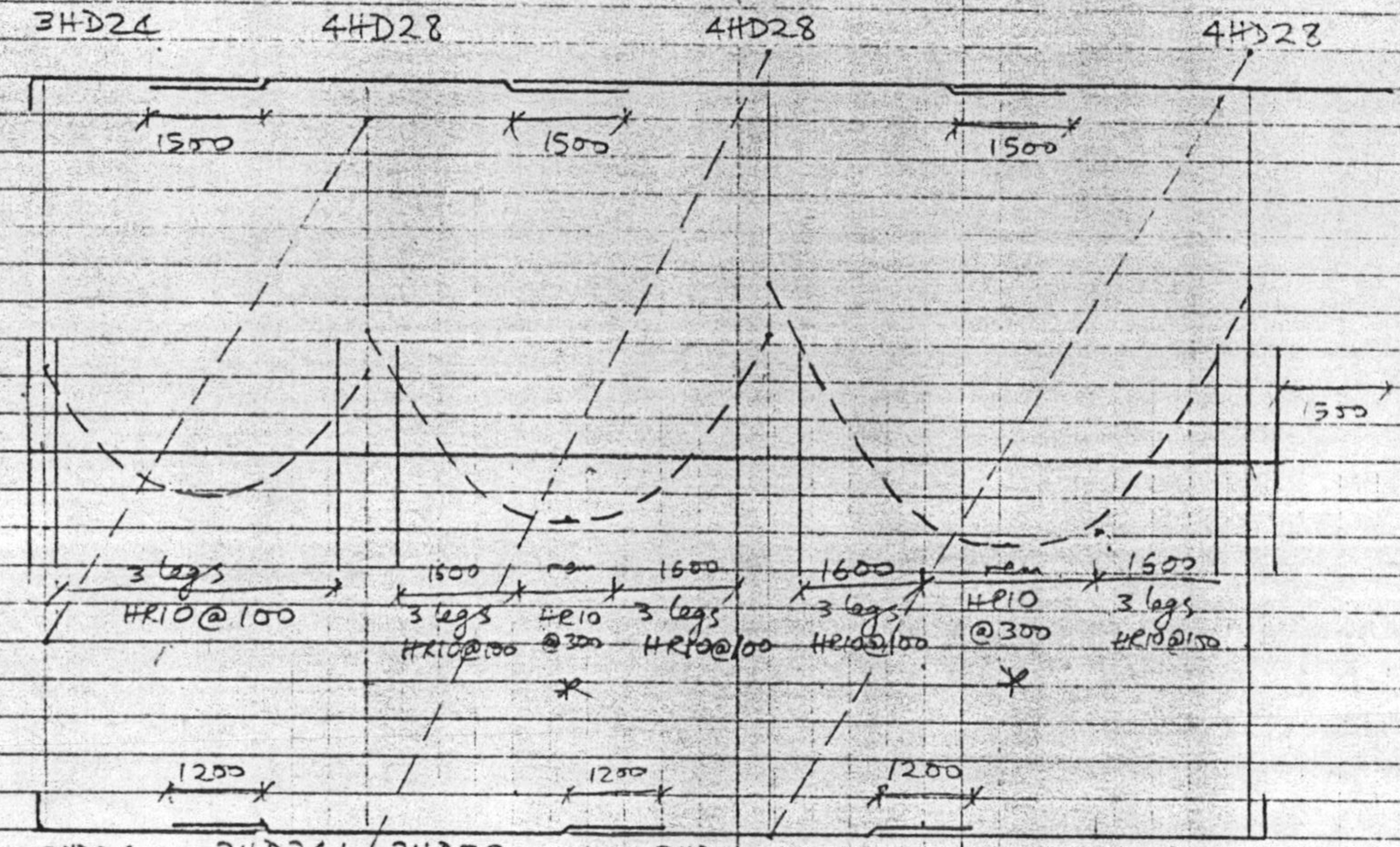
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No _____ PAGE 33.

BY _____

DATE _____

East Face -800x500 beams — all levels same except for pinned beams



D+1.3Le	80	60	60	100	90	170	140	120	140	
E(±)	220		370	450		460	420		480	
D+1.3Le+E	-300		+310	-550		+360	-560		+340	
D+1.3Le-E	+140		-430	+350		-560	+280		-620	
D+1.3Le-E redn.	+210		-360	+350		-560	+330		-570	
Design M_u^-	-300		-550			-560			-570	
Design M_u^+	+210		+350			+360			+340	
Seismic Cse		163			203			167		
V_u 1.4D+1.4Le	219		219	260		260	303		303	
	151		151	179		191	227		227	

* Transverse Reo Note

If transverse reo region @ midspan becomes less than 1000, extend end region transverse reo. for full length of beam

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB NO _____ PAGE _____

JOB _____ BY _____

_____ DATE _____

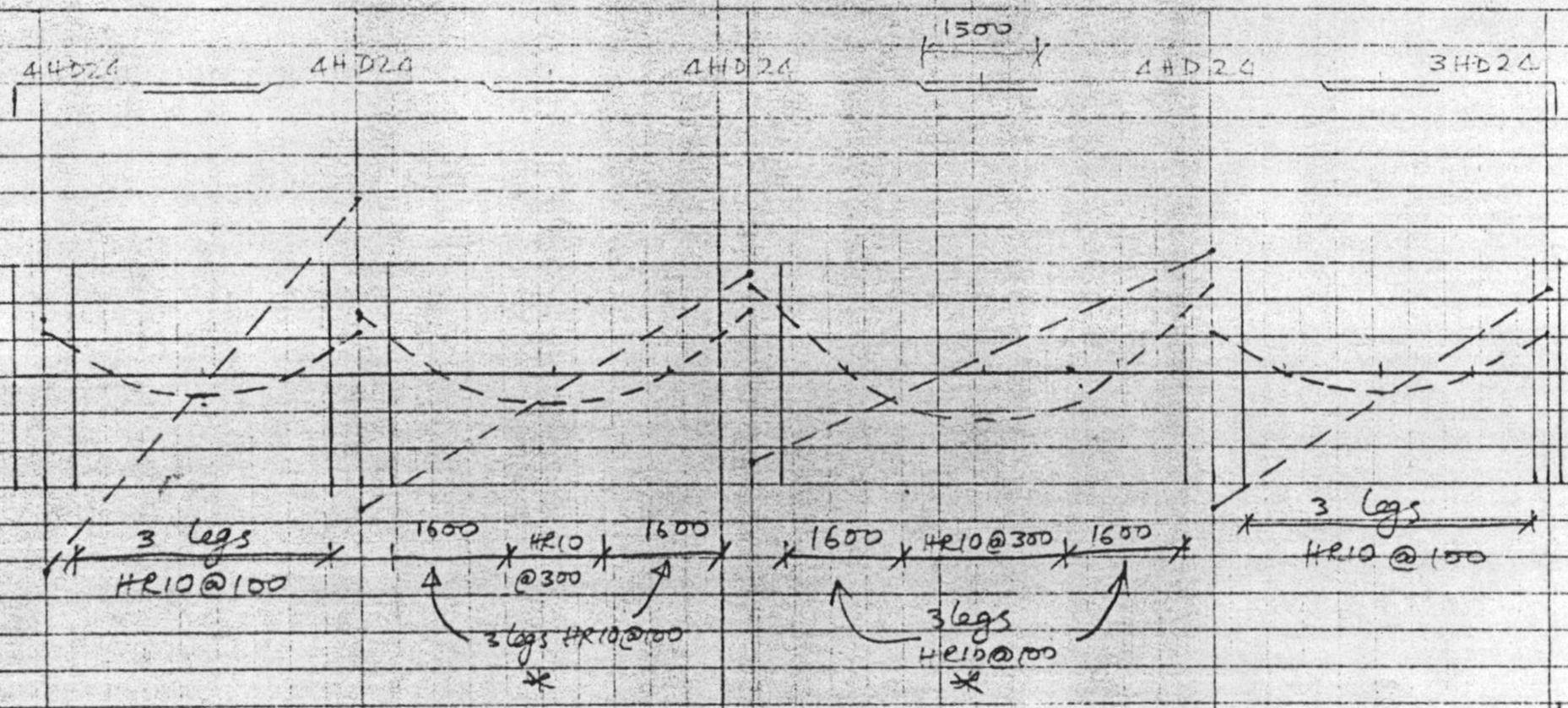
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB NO _____ PAGE 34

JOB _____ BY WJK

_____ DATE 2/10/86

West Frame 2 – Levels 1A, 1



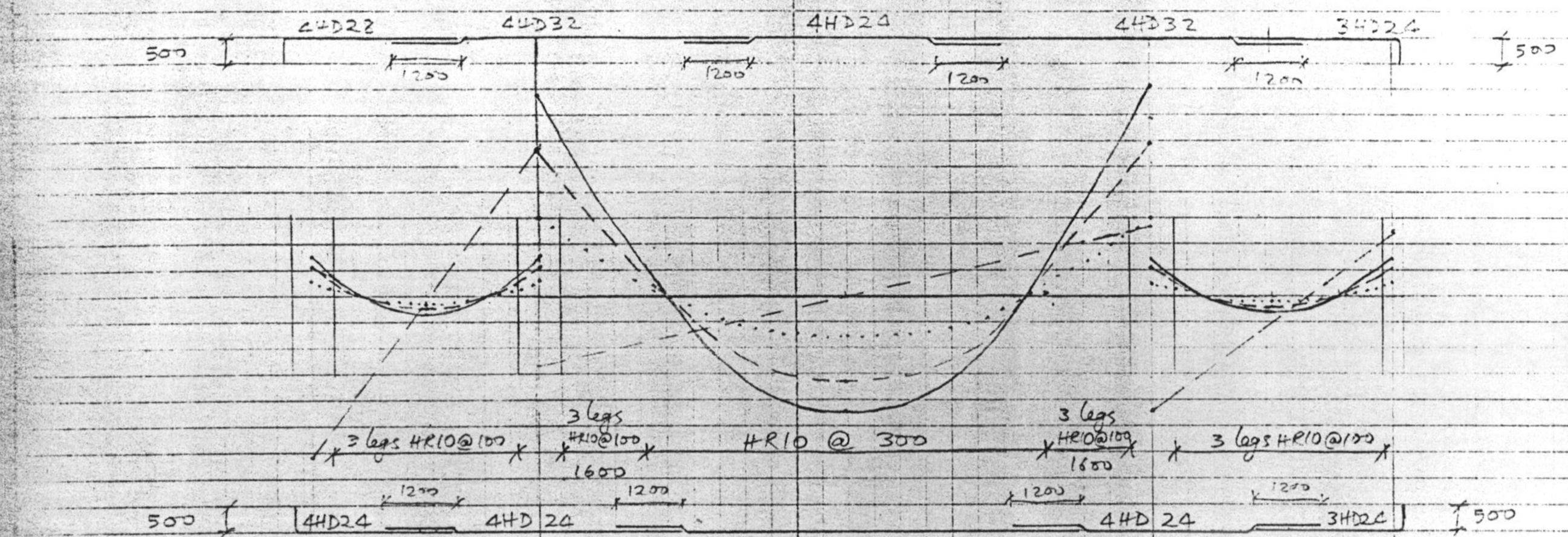
Transverse Reo

* Delete middle zone if becomes less than 1000 long

D+1.3L_R	80	60	80	100	90	100	170	120	170	70	50	90		
E(I)	430		380	310		220	200		300	310		200		
D+1.3L_R+E	-510		+300	-410		+120	-370		+130	-380		+110		
D+1.3L_R-E	+350		-460	+210		-320	+30		-470	+240		-290		
D+1.3L_R+E redist	-430		+380	-410		+120	-370		+130	-380		+110		
D+1.3L_R-E redist	+380		-430	+210		-320	+70		-430	+240		-290		
		237			121			120			130			
V_u 1.2D+1.0L_R	219		219	250		250	303		303	182		188		
D+1.3L_R	15		61	19		171	222		222	139		139		

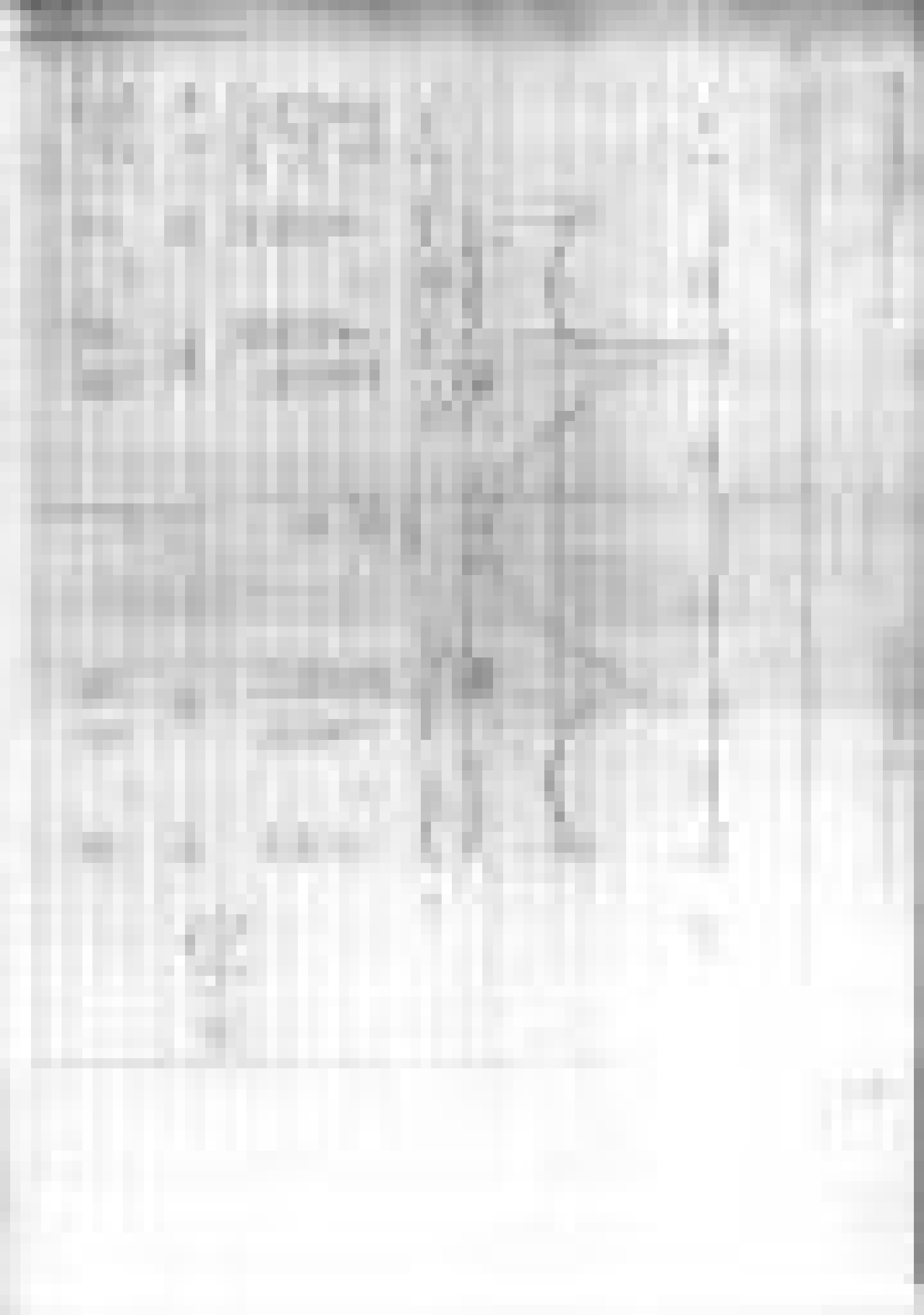
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

West Frame – Level 2 2-C



1·4D+1·7Le			620		450		650		
D+1·3Le	50	50	50	450	330	490	50	50	90
·9D	20		30	230		240	30		40
E	500		460	250		250	380		210
D+1·3Le+E	-550		+390	-700	330	-240	-430		+120
D+1·3Le-E	+450		-510	+200	330	-740	+330		-300
·9D+E	-530		+430	-480		+10	-410		+170
·9D-E	+470		-490	+20		-490	+350		-250
D+1·3Le-E redist	+430		-530						
·9D-E redist	+430		-530						
Design M_u	-550		-700			-740		-300	
	+430		+430		+450	+350		+170	
Seismic SF	277				47	148			
V_u 1·4D+1·7Le	219		219	359		359	188	188	
D+1·3Le	161		161	262		262	139	139	
Vu max	438		438	359		359	287	287	

Design done with no redistribution to reduce possibility of midspan hinge



SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 36

JOB _____ BY WJM

DATE 2/10/86

Transverse Reo

PH Region $s_{max} = d/4 = 182$ $6d_b = 6 \times 25 = 150$

$A_{sc} = 1.5 \times 804 \times 380 \times 150 / 16 \times 380 \times 100 = 113 \text{ mm}^2$

⇒ HR12 @ 150 or (3 legs)
or HR10 @ 100 (3 legs)

Mid region assume $v_c/2$

$v_i = 438 \times 10^3 / .85 \times 500 \times 730 = 1.41$ MPa

$\rho_w = .0050$ $v_c = .6$ $v_c/2 = .3$ $v_s = 1.01$

$A_v = v_s b_w s / f_y = 1.01 \times 500 \times 150 / 380 = 199$

(⇒ 2 legs HR10 @ 150 OK)

Outside PH region $s_{max} = 730/2 = 365$

Middle spans only

$v_i = 191 \times 10^3 / .85 \times 500 \times 730 = .62$

$v_s = .62 - .6 = .02$

$A_{v\,min} = .35 b_w s / f_y$

$= .35 \times 500 \times 300 / 380 = 138$

⇒ HR10 @ 300 OK.

Transverse Reo

PH Regions
1400 from face
3 legs HR10 @ 100

Rem.
HR10 @ 300

Gravity Beams:

Beams MB1, 4 - MB4

M_u = 165 kNm V_u = 230 kN

Try 500 x 500.

ϕ_c = 265 x 10⁶ / .9 x 500 x 430² = 3.18 ρ = .009

A_s = 1935 mm²

⇒ 4HD28

v_i = 230 x 10³ / .85 x 500 x 430 = 1.26 MPa

f_w = .011 v_c = .92 v_s = .34

$A_{v min}$ = .35 $b_w s / f_y$ s_{max} = d/2 = 215.

= .35 x 500 x 200 / 380 = 92 mm²

⇒ HR10 @ 200 OK

Pinned End Infill

Try 300 x 500 connection

v_i = 230 x 10³ / .85 x 500 x 230 = 2.35

.2 f'_c = 5 MPa ⇒ ok

$A_{vf} = V_u - P_u / \phi \mu f_y$ = 230 x 10³ / .85 x .7 x 380 = 1017 mm²

⇒ 6HD16. (3T & B)

End clips to take reaction

A_r = 230 x 10³ / .9 x 380 = 673 mm²

⇒ 673 / 157 = 4.3

673 / 226 = 3.0 673 / 339 = 2.0

Shear

f_w = .0052 v_c = .61 v_s = 1.74

$A_v = v_s b_w s / f_y$ = 1.74 x 500 x 50 / 380 = 114 mm²

⇒ HR10 @ 50 OK

SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 38

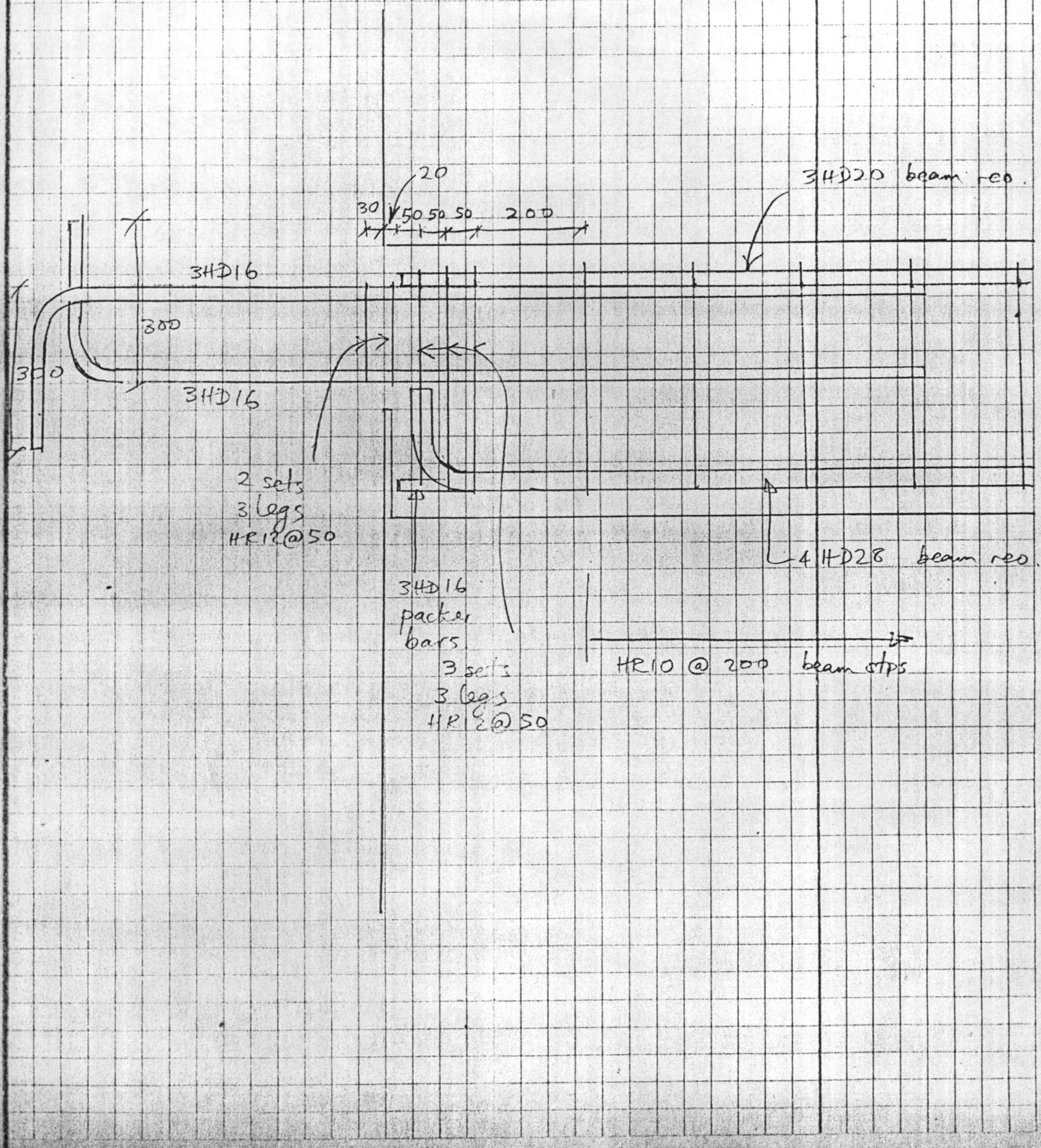
JOB _____ BY WJM

DATE 3/10/86

Gravity Beams — 500 x 500 East Frame + North end + South end (refer pinned end beams shown on frame p. 32) Level M levels M-4

3HD20 T
4HD28 B
HR10 @ 200

Typical End Detail



SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB NO. _____ PAGE 39

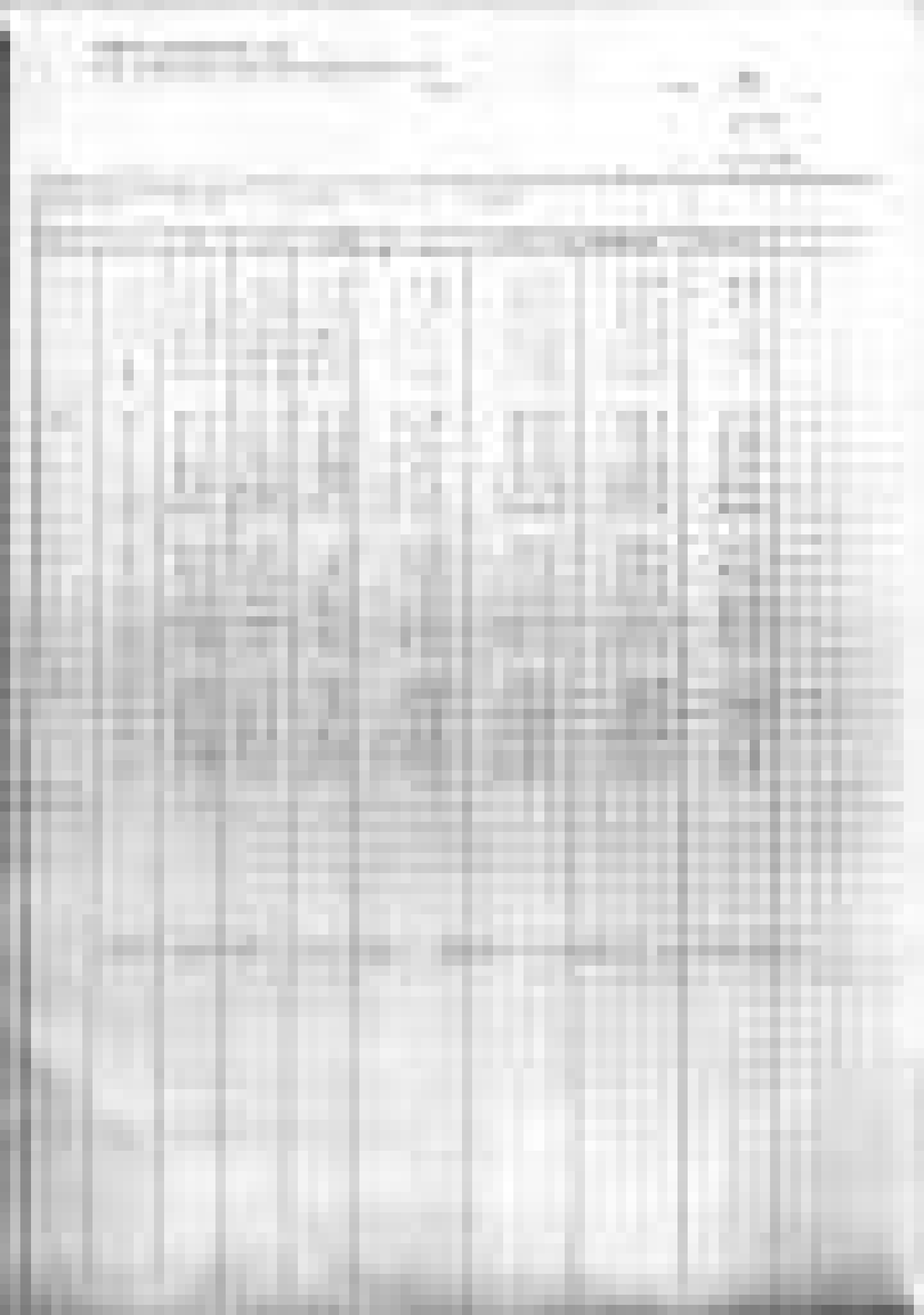
BY WJM

DATE 2/10/86

COLUMN AXIAL LOADS - EAST FRAME

COL	LEV	D	LL	E (±)	D + LL	1.4D + 1.7LL	D+1.3LL+E*	.9D+E*		
A	4	93	52	29	145	219	190	55		
	3	186	104	116	290	437	437	51		
	2	279	156	268	435	656	750	−17		
	1	372	208	431	580	874	1073	−96		
	M	471	262	431	733	1105	1243	−7		
B	4	207	111	11	318	479	362	175		
	3	414	222	27	636	957	730	346		
	2	621	333	54	954	1436	1108	505		
	1	828	444	94	1272	1914	1499	651		
	M	1041	557	293	1598	2404	2058	644		
C	4	250	125	7	375	563	420	218		
	3	500	250	28	750	1125	853	422		
	2	750	375	61	1125	1688	1299	614		
	1	1000	500	97	1500	2250	1747	803		
	M	1250	625	156	1875	2813	2219	969		
D	4	235	120	33	355	533	424	179		
	3	470	240	115	710	1066	897	308		
	2	705	360	261	1065	1599	1434	374		
	1	940	480	428	1420	2132	1992	418		
	M	1175	600	568	1775	2665	2523	490		

Have ignored LL red= factor (cumulative) ⇒ conservative



SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No

PAGE 40

JOB

BY WJM

DATE 2/10/86

COLUMN AXIAL LOADS - WEST FRAME

COL	LEV	D	Lr	E°	D + Lr	1.4D + 1.7Lr	D+1.3Lr+E°	.9D + E°
E	4	93	52	51	145	219	212	33
	3	186	104	203	290	437	524	-36
	2	279	156	479	435	656	961	-228
	1	372	208	717	580	874	1359	-382
	M	465	260	872	725	1093	1675	-454
F	4	267	120	34	387	578	457	206
	3	534	240	155	774	1156	1001	326
	2	773	358	384	1131	1691	1622	312
	1	980	469	501	1449	2169	2091	381
	M	1187	580	539	1767	2648	2480	529
G	1	202	113	32	315	475	381	150
	M	250	238	65	488	755	624	160
H	4	243	122	14	365	548	416	205
	3	486	244	72	730	1095	875	365
	2	703	367	173	1070	1608	1353	460
	1	851	463	214	1314	1979	1667	552
	M	1056	583	217	1639	2470	2031	733
I	4	69	54	30	123	188	169	32
	3	138	108	119	246	377	397	5
	2	207	162	267	369	565	685	-81
	1	276	216	398	492	754	955	-150
	M	345	270	486	615	942	1182	-176

Cols

6.6 Max axial = $.85\phi P_o$
$= .85\phi [.85 f'_c (A_g - A_{st}) + f_y A_{st}]$
$= .85 \times .7 [.85 \times 25 (500 \times 800 - 3968) + 380 \times 3968]$
$= 5904$ kN.

6.5 Max axial = $.7\phi f'_c A_g = 4900$ kN
or $.7\phi P_o = .7\phi [.85 f'_c (A_g - A_{st}) + f_y A_{st}]$
$= 4861$ kN

Max. $P_u = 2813$ kN $\Rightarrow$ OK

6 > 0.7

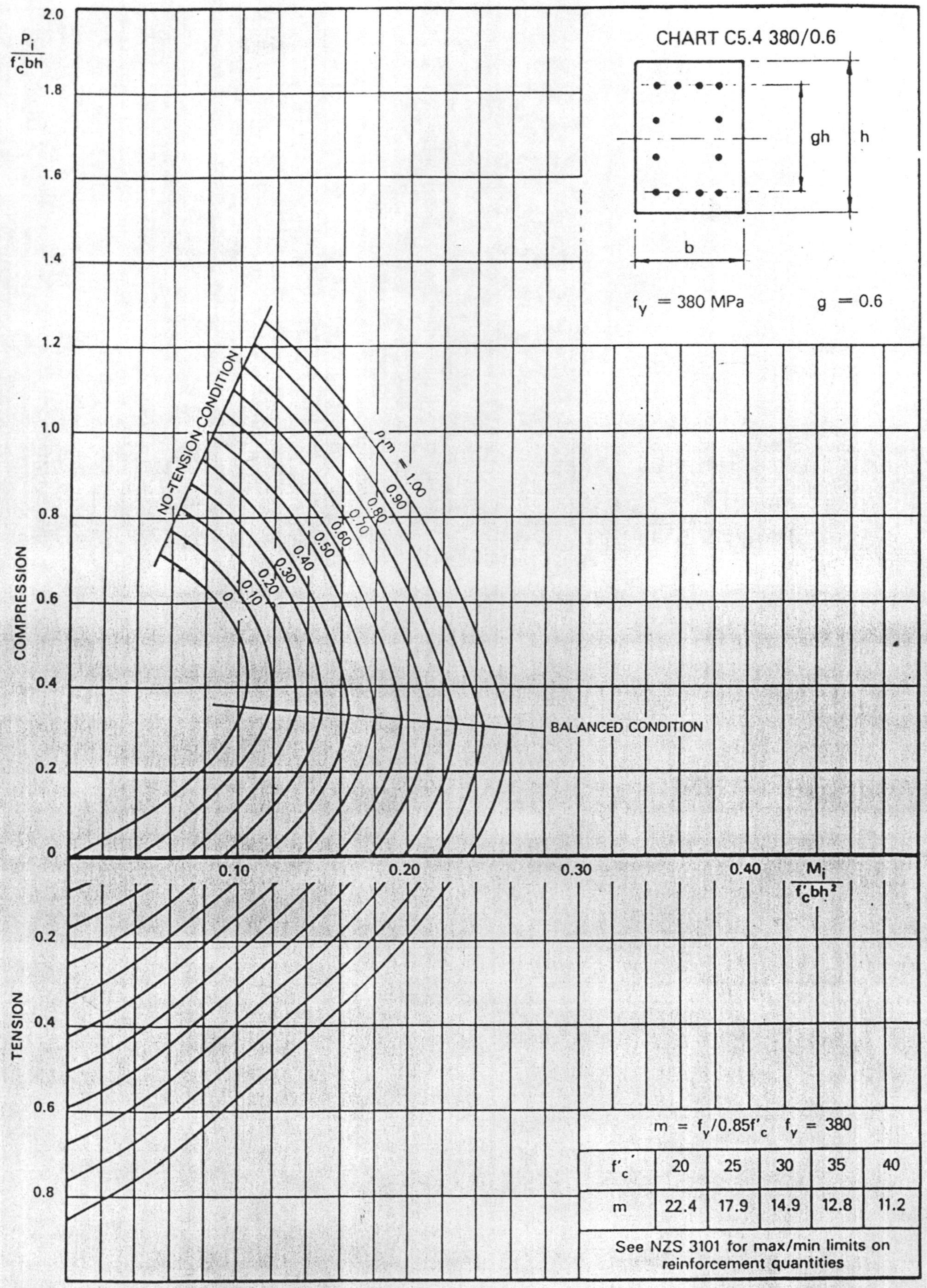
$\phi = .8$

$\phi = .6$

6H32 + 4HD20 $A_s = 3971$ $\rho_t = .0099$ $\rho_t m = .177$ $(f'_c = 25)$ 800 x 500

10H32 $A_s = 3142$ $\rho_t = .0112$ $\rho_t m = .203$ $(f'_c = 15)$ 350 x 800

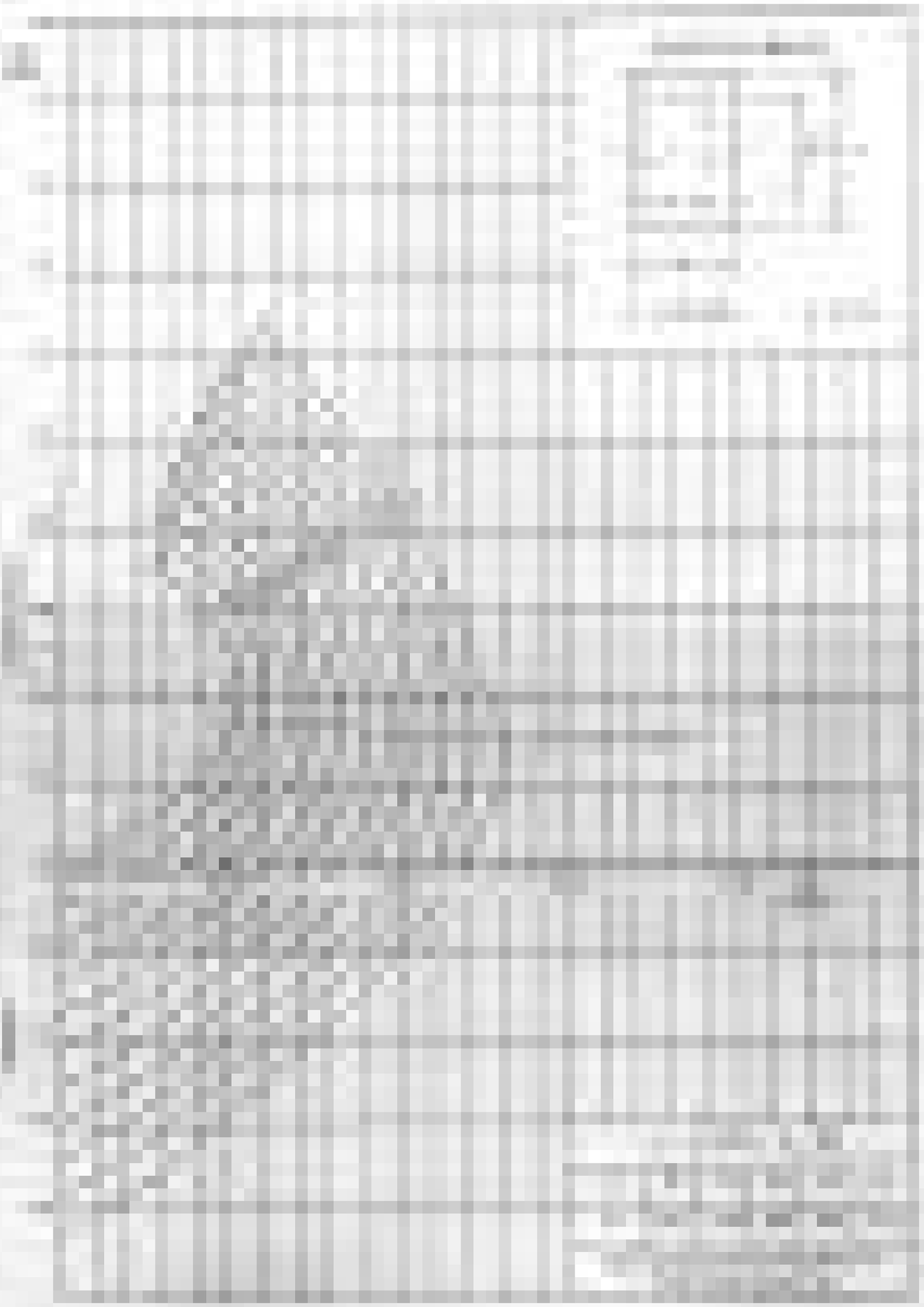
C5.4 COLUMN DESIGN CHART



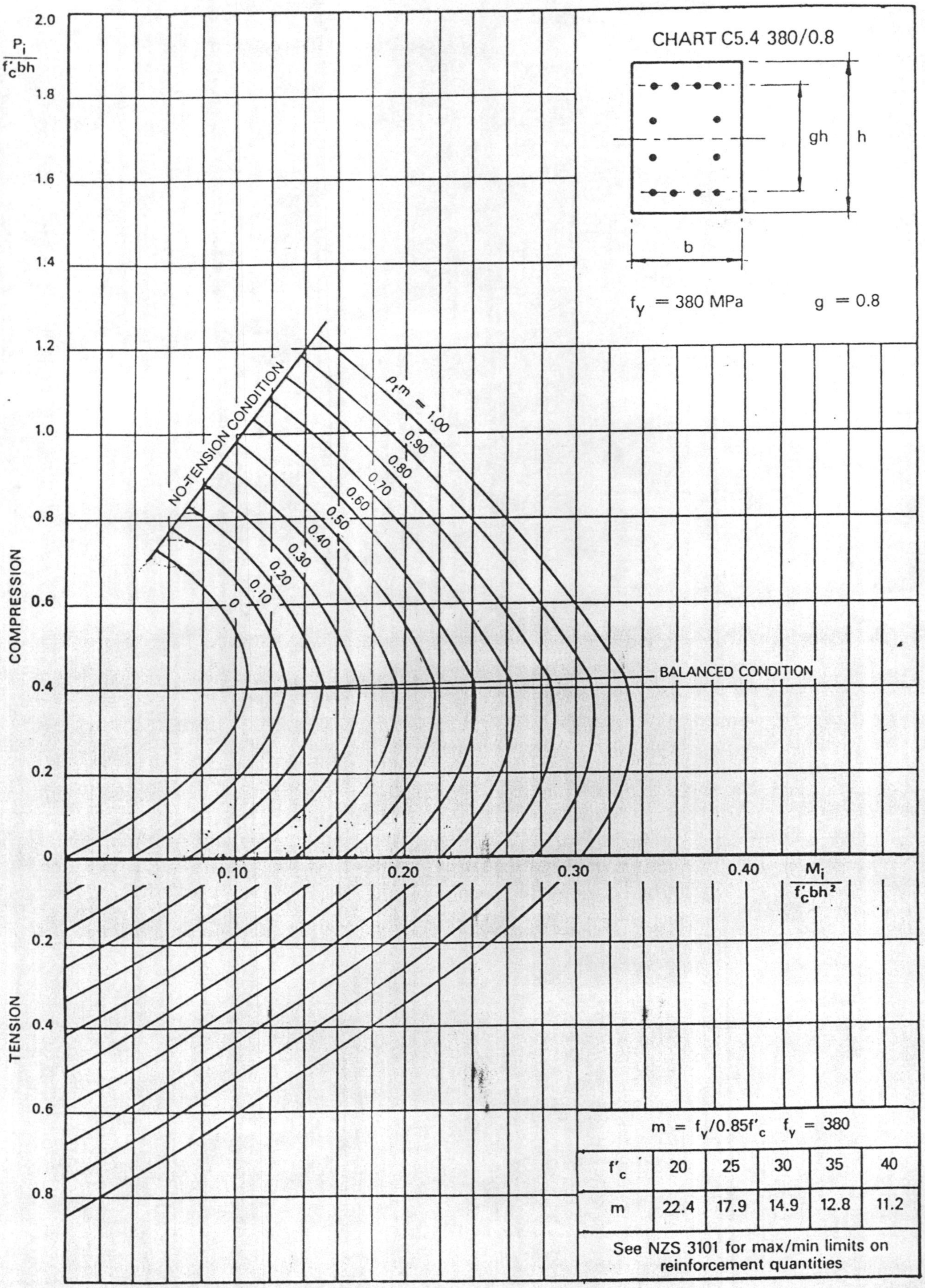
$m = f_y/0.85f'_c$ f_y = 380

f'_c	20	25	30	35	40
m	22.4	17.9	14.9	12.8	11.2

See NZS 3101 for max/min limits on reinforcement quantities



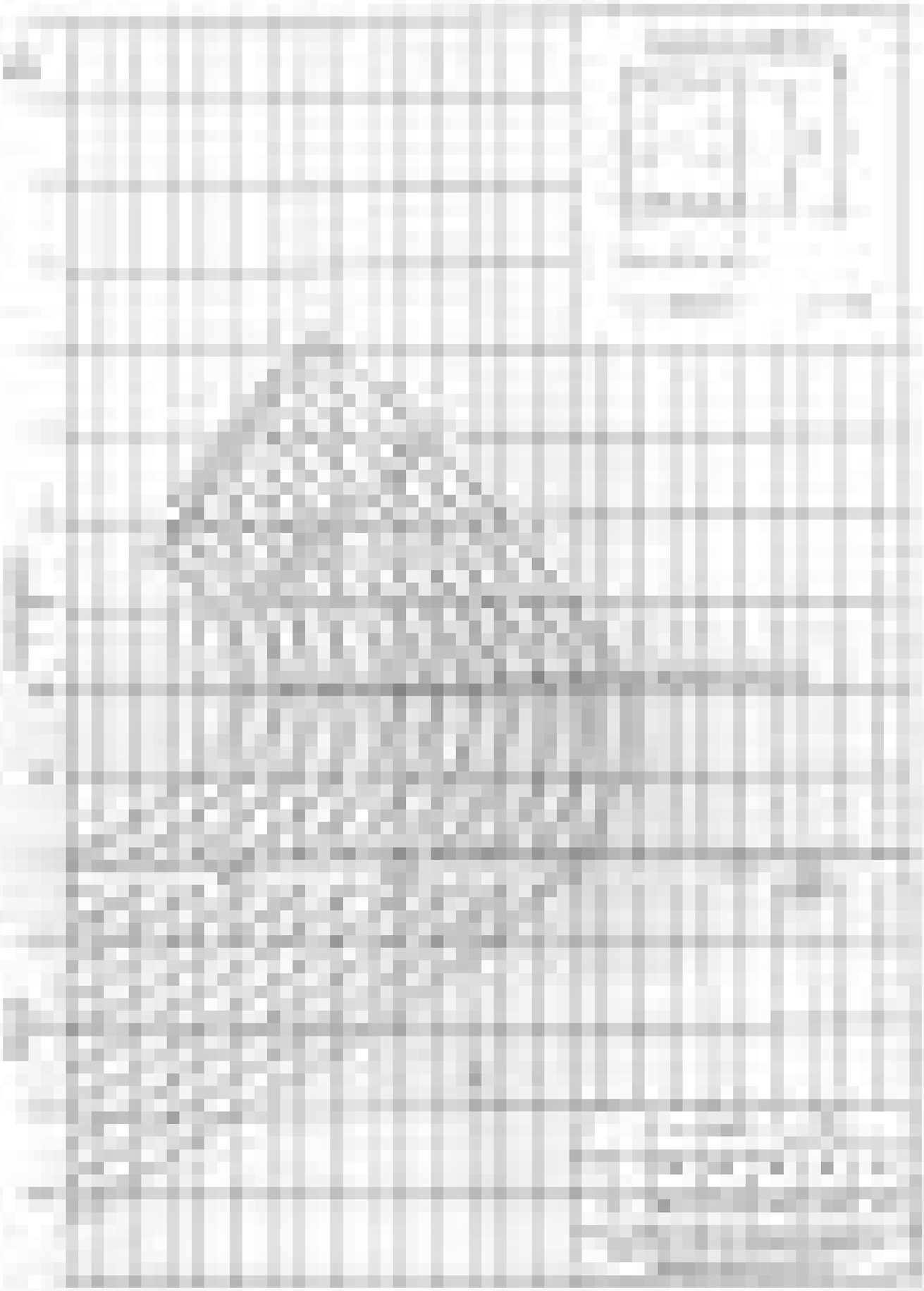
C5.4 COLUMN DESIGN CHART



$m = f_y / 0.85 f'_c$ f_y = 380

f'_c	20	25	30	35	40
m	22.4	17.9	14.9	12.8	11.2

See NZS 3101 for max/min limits on reinforcement quantities



SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 44

JOB _____ BY WJM

_____ DATE 2/10/86

COLUMNS - EAST FRAME

LEV.	P_u max	P_u min	M_u	$P_u/f'_c bh$		$M_u/f'_c bh^2$	ρ_{tm}	ρ_t	A_s	BARS	f'_c
				max	min	$\phi = .9$					
COL A		350 x 800									
4	190	55	46		.01	.021	<.20		min	10HD20	25
3	437	51	102		.01	.046				"	"
2	750	-17	146		—	.066				"	"
1	1073	-96	107		— .02	.049				"	"
M	1243	- 7	51	.25	—	.023				"	"
COL B		800 x 500									
4	362	175	187		.02	.026	<.177			6HD24+4HD20	25
3	730	346	399		.04	.055				"	"
2	1108	505	593		.06	.082				"	"
1	1499	651	405		.02	.056				"	"
M	2058	644	611	.29	.02	.085				"	"
COL C		800 x 500									
4	420	218	201		.03	.028	<.177			6HD24+4HD20	25
3	853	422	410		.05	.057				"	"
2	1299	614	600		.09	.083				"	"
1	1747	803	549		.11	.076				"	"
M	2219	969	695	.32	.14	.097				"	"
COL D		800 x 500									
4	424	179	112		.02	.016	<.177			6HD24+4HD20	25
3	897	308	254		.04	.035				"	"
2	1434	374	382		.05	.053				"	"
1	1992	418	278		.05	.039				"	"
M	2523	490	587	.36	.06	.082				"	"

↑

M_u values $\phi = .7 - .9$

or ①

↓

Conservative.

SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 45

JOB _____ BY WJM

_____ DATE 2/10/86

COLUMNS - WEST FRAME

LEV	P_u max MINUS	P_u min SAG +	M_u	$P_i/f'_c bh$ max	$P_i/f'_c bh$ min	$M_i/f'_c bh^2$	ρ_{LM}	ρ_t	A_s	BARS	f'_c
COL E		800x	500								
4	212	33	120		—	.017	<.177			6HD24+4HD20	25
3	524	-36	303		—	.042				"	"
2	961	-228	465		-.03	.065	.20	.0112	4480	6HD28+4HD20	"
1	1359	-378	206		-.04	.029				"	"
M	1675	-454	383	.24	-.05	.053	.20			"	"
COL F		800x	500								
4	457	206	195		.02	.027	<.177			6HD24+4HD20	25
3	1001	326	393		.04	.055				"	"
2	1622	312	607		.04	.084	.20			6HD28+4HD20	"
1	2091	381	359		.05	.050				6HD24+4HD20	"
M	2480	529	448	.35	.07	.062				"	"
COL G		800x	500								
1	381	150	513		.02	.071	<.177			6HD24+4HD20	25
M	624	160	426	.08	.02	.059				"	"
COL H		800x	500								
4	416	205	183		.02	.025	<.177			6HD24+4HD20	25
3	1875	365	349		.04	.048				"	"
2	1353	460	513		.06	.071				"	"
1	1667	552	268		.07	.037				"	"
M	2031	733	439	.29	.10	.061				"	"
COL I		350x	800								
4	169	32	51		—	.023	<.200			10HD20	25
3	397	5	109		—	.049				"	"
2	685	-81	136		-.01	.062				"	"
1	955	-150	101		-.02	.046				"	"
M	1182	-176	72	.24	-.03	.033				"	"

ϕ = .7 -> .9 ϕ = .9

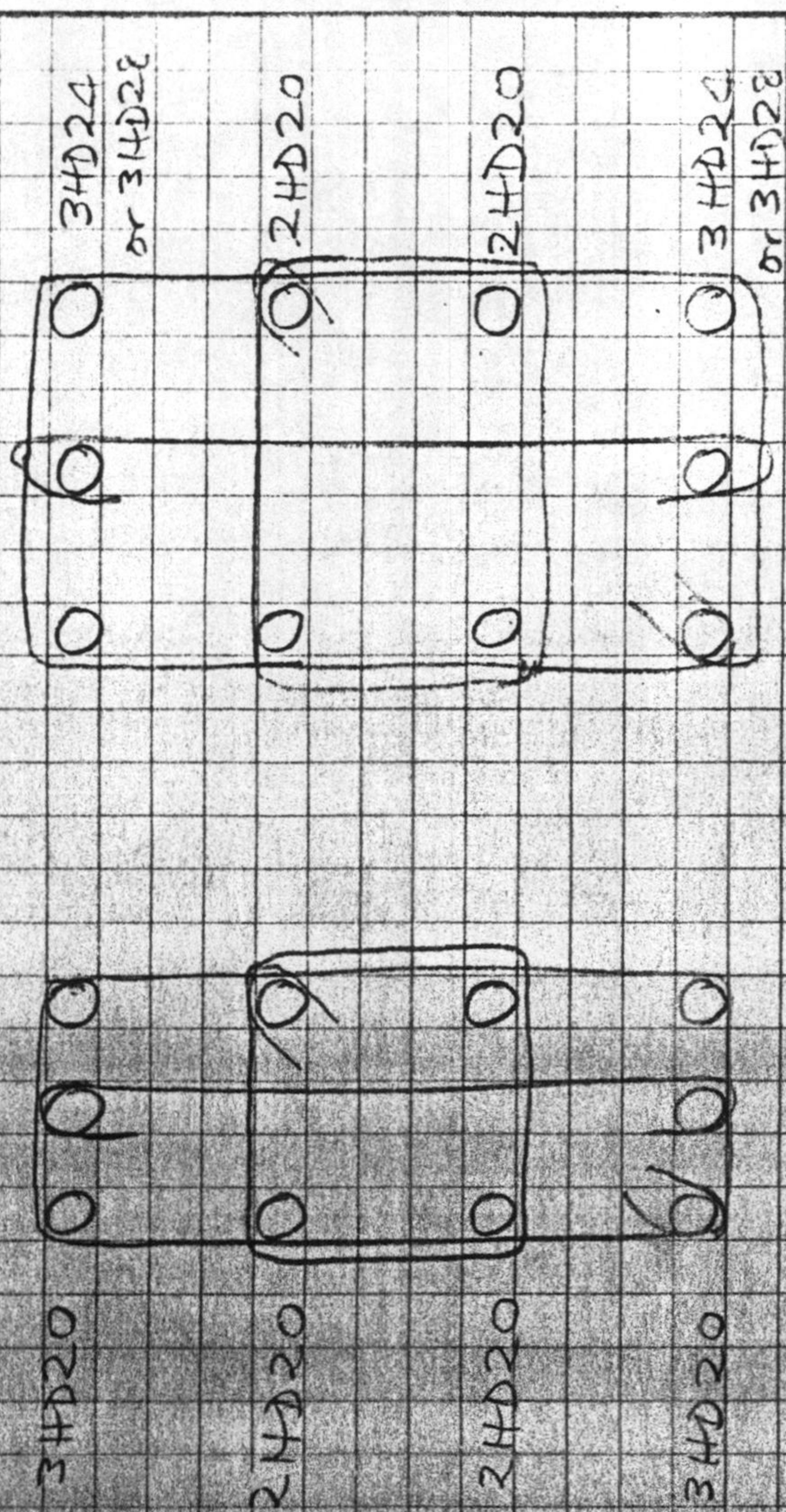
SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 46

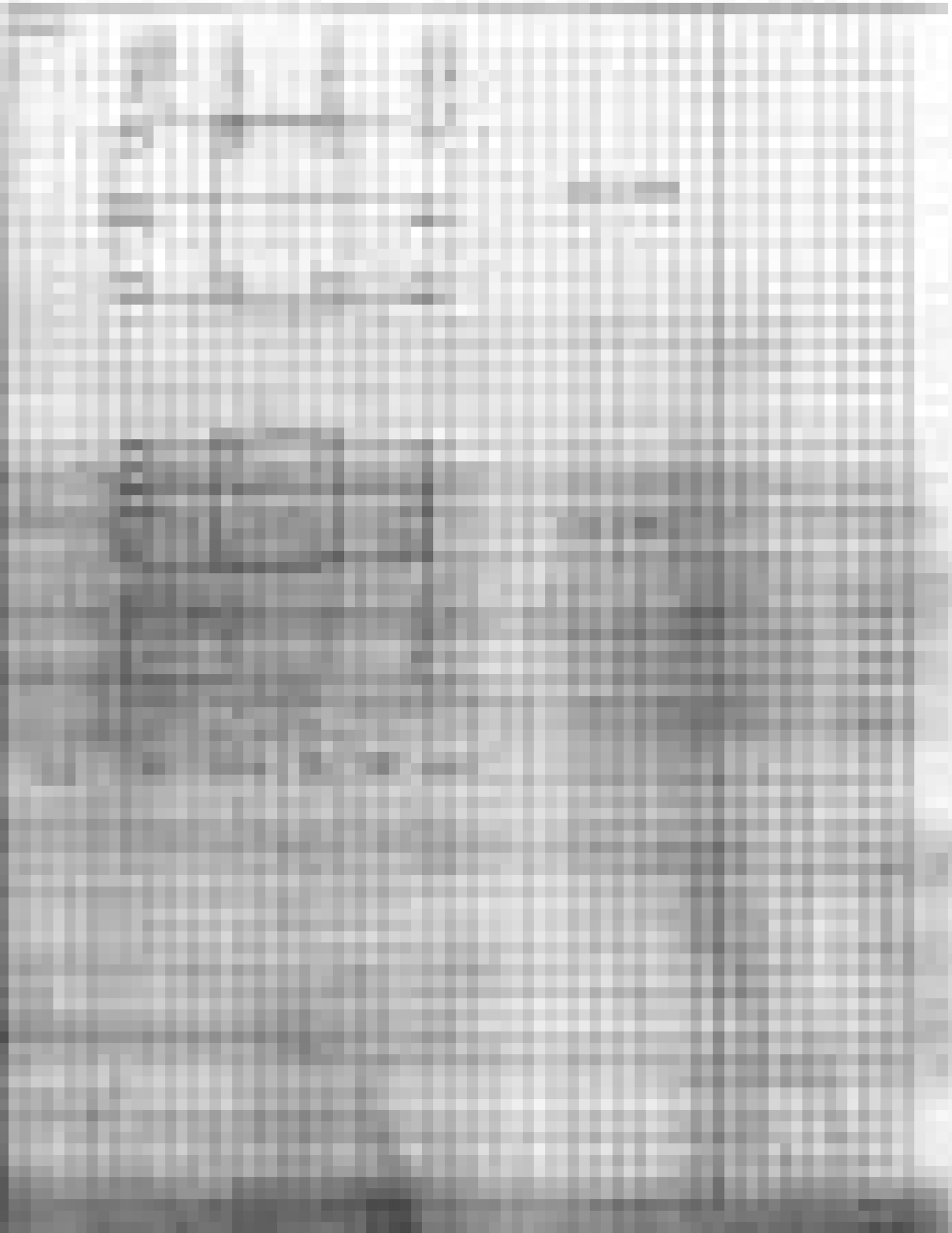
JOB _____ BY WJM

_____ DATE 2/10/86

66



Note i) 50 cover to all bars

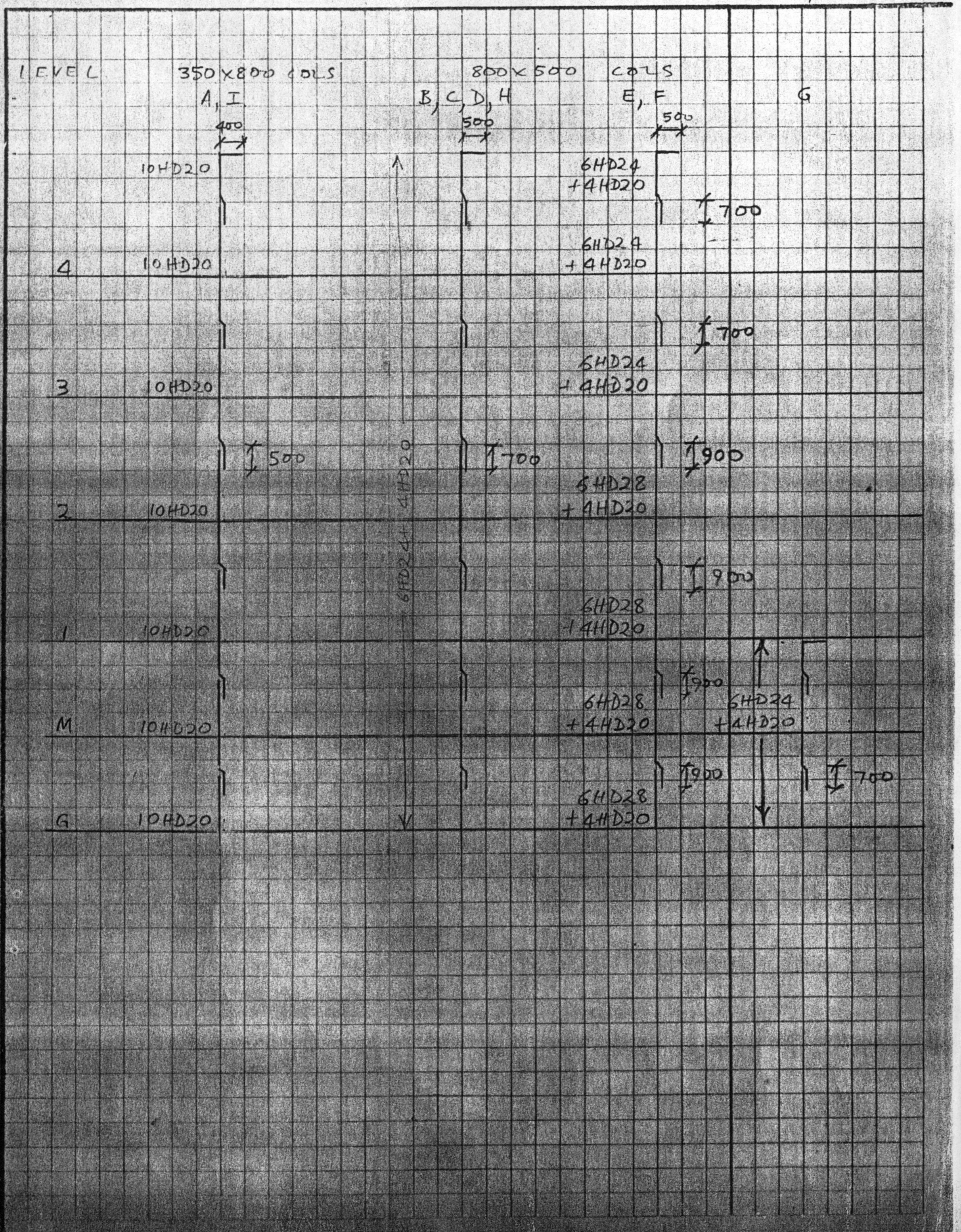


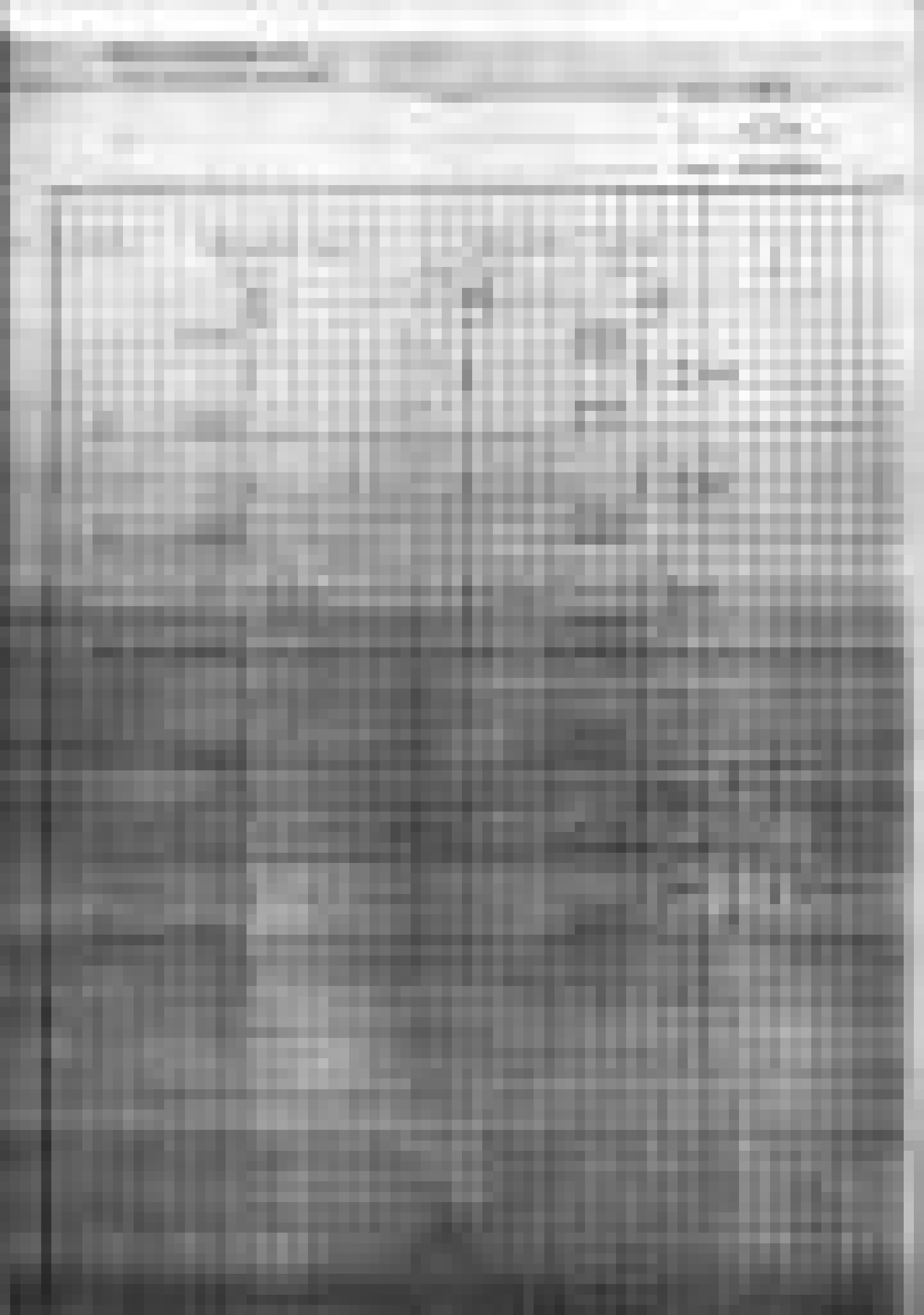
SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 47

JOB _____ BY WJM

_____ DATE 2/10/86





Transverse Beam

Confinement Req. Ltd Ductility End Regions

$$i.\ \frac{M_e^* \cdot 1.3 P_h h}{\cdot 4 \phi f_c A_g^* h} = \frac{695\times10^6 + .3 \times 2219\times10^3 \times 200}{.6\times.9\times25\times.2\times800\times500\times800}$$

$$= 1.42$$

$$\gamma = \frac{587\times10^6 + .3\times2523\times10^3\times800}{.6\times.9\times25\times.2\times800\times500\times800} = 1.38$$

$$R_c = \frac{\gamma_1}{1+P^{yr}m} - 1 = \frac{1.42}{\left(1+\frac{1848}{500\times.2\times800}\times\frac{380}{.85\times25}\right)} - 1$$

$$= .005$$

$$A_{sh} = P_c\,(.025\, s_h\, h f'_c / f_{yh}) = .005(.02\times150\times800\times25/380)$$
$$= 0.8\ mm^2$$

$\Rightarrow$ nil

$S_{max} = 10 \cdot 20 \cdot 1m$

$V_{a\ max} = 447\ kN$

$v_i = 447\times10^3/.85\times500\times680 = 1.55$

$v_c = .9\sqrt{P_c/A_g} = 1\sqrt{969\times10^3/500\times800} = .62$

$v_s = .93$ $s_{max} = 680/4 = 170$

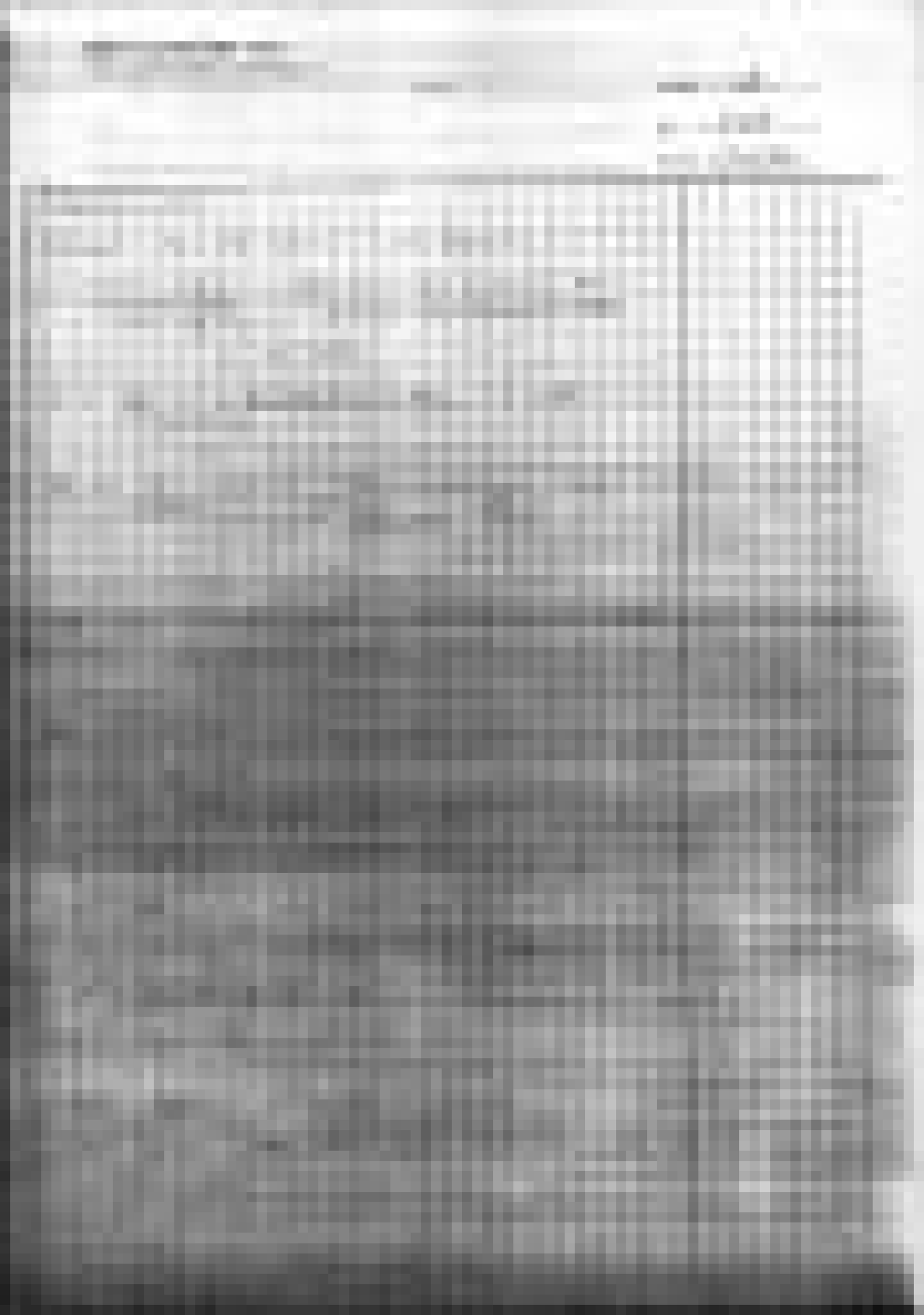
$A_v = v_s b_w s/f_y = .93\times500\times150/380 = 184\ mm^2$

$\Rightarrow$ 3 legs HR10 @ 150 OK

6.4 $S_{max} = 500$, $16\times20 = 320, 480$

$\Rightarrow$ End Regions HR 10 sets @ 150 OK.

End Regions 800 from face



Outside ER

v_c 7.3.2

$\rho_w = 3\times616 + 2\times314 / 500\times680 = .0073$

$v_6 = .72$

$\left(1 + \frac{3\rho_w}{4f'_c}\right)$ $v_6 = \left(1 + \frac{3\times969\times10^{-3}}{500\times880\times25}\right) .72 = .93$

$v_s = 1.55 - .93 = .62$

$A_v = v_s b_w s / f_y$

$\Rightarrow s_{max} = 236\times380 / .62\times500 = 289$

$\Rightarrow$ HR10 s@s @ 250

Joint P_{uc}

Design M_c beam $-560 + 390$

$T_{up} = 560 / .73 = 767$ kN

$T_{bot} = 330 / .73 = 452$ kN

$V_{col} = 2\left(\frac{l_1}{l_1} M_1 + \frac{l_2}{l_2} M_2\right) / (l_c - l_b)$

$V_{col} = 2\left(\frac{5.3}{4.5}\times330 + \frac{6.3}{5.5}\times560\right) / 6.6 = 312$ kN

$V_{jh} = 767 - 452 - 312 = 907$ kN

$V_{ju} = V_{jh} \frac{h_b}{h_c} = 907$ kN

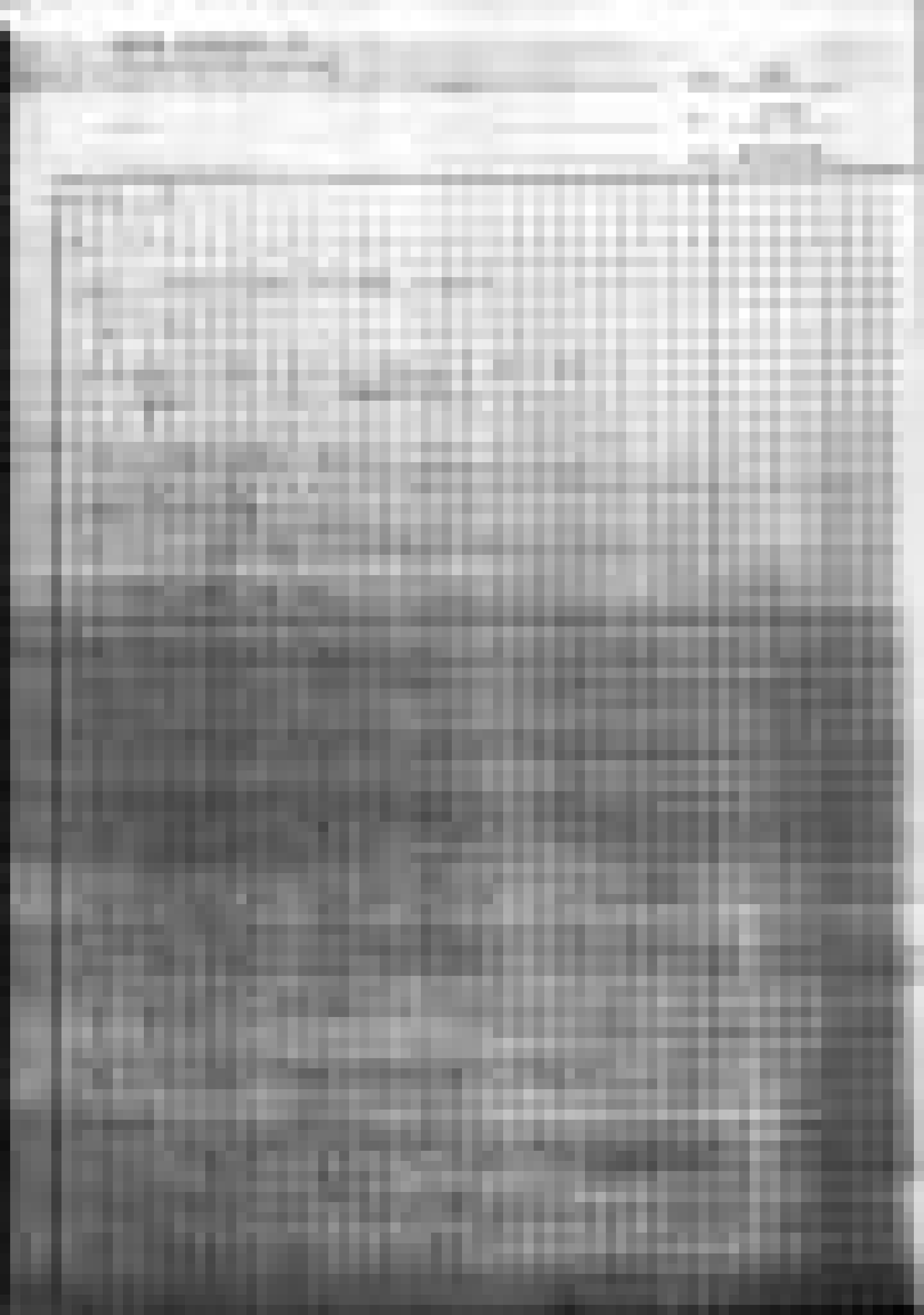
$v_{jh} = V_{jh} / b_j h_c = 907\times10^3 / 500\times800 = 2.27$ MPa

$1.5\sqrt{f'_c} = 7.5 \Rightarrow$ OK

$V_{sh} = .5 v_{jh} \left(1 + \frac{\rho_w f_y}{.4 f'_c}\right) = .5\times907 \left(1 + \frac{614\times10^3}{.4\times500\times800\times25}\right)$

$= 523$ kN

$V_{sh} = 907 / .85 - 523 = 544$ kN



SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 50

JOB _____ BY WJM

_____ DATE 3/10/86

$A_{jh} = V_{sh}/f_y = 544\times10^3/380 = 1432\ mm^2$

Clear space = 620 $\quad$ 1432/236 = 6

→ HR10 sets @ 100 $\quad$ ($A_s = 1652\ mm^2$)

$V_{cv} = \frac{A_s}{A_{sf}} V_{jv}\left(.6 + \frac{G_j P_u}{A_g f'_c}\right) = 1 \times 907\left(.6 + \frac{614\times10^3}{500\times800\times25}\right)$

$= 600\ kN$

$V_{sv} = 907/.85 - 600 = 467\ kN$

$A_{jv} = V_{sv}/f_y = 1229$

A_{jv} provided = $4\times314 = 1256 \Rightarrow$ OK

350 × 800

Max $V_u = 77\ kN$

$V_c = 77\times10^3/.85\times800\times290 = .39\ MPa$

$.07 f'_c = 1.75 \Rightarrow$ Dr. from $d/2 = 145$.

→ HR10@100.

Outside THR HR10@150

Note – All cols.

800 × 500 C&G

Transverse Reo

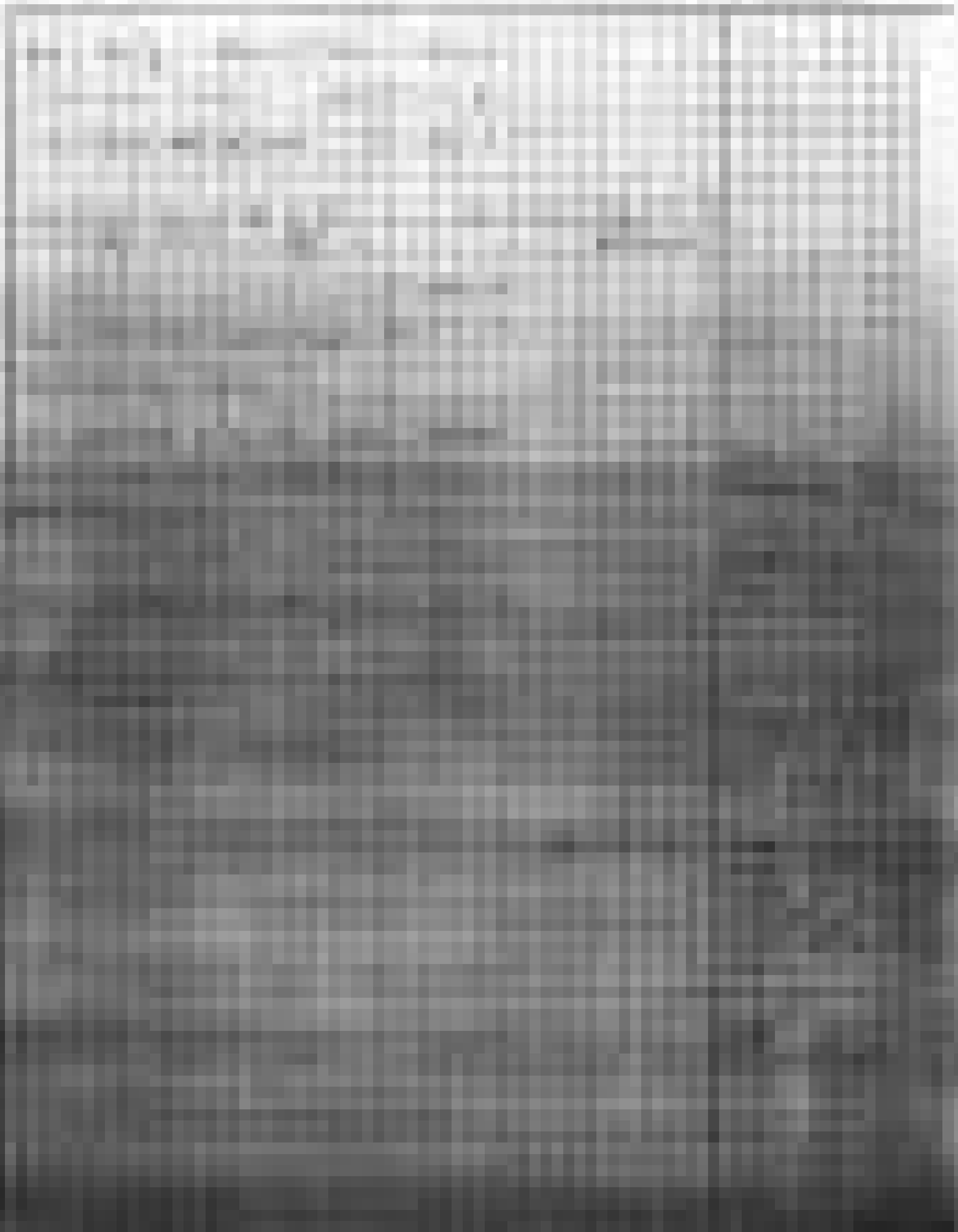
HR10 @ 100 joint
HR10 @ 150 for 800 from face
HR10 @ 250 rem

350 × 800 C&G

HR10@100 joint
HR10@100 for 800 from face
HR10@150 rem.

Middle zone (rem.)
Levels 2–4 only.
Levels 6–2
one zone for full height between beam faces

Refer P.
for stirrup sets

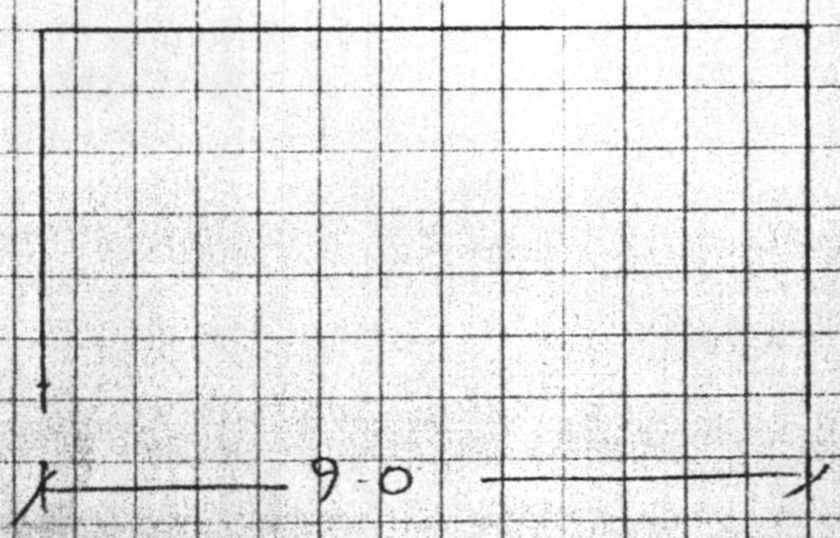


Level 4 Frame 2

500 x 800

500 x 350

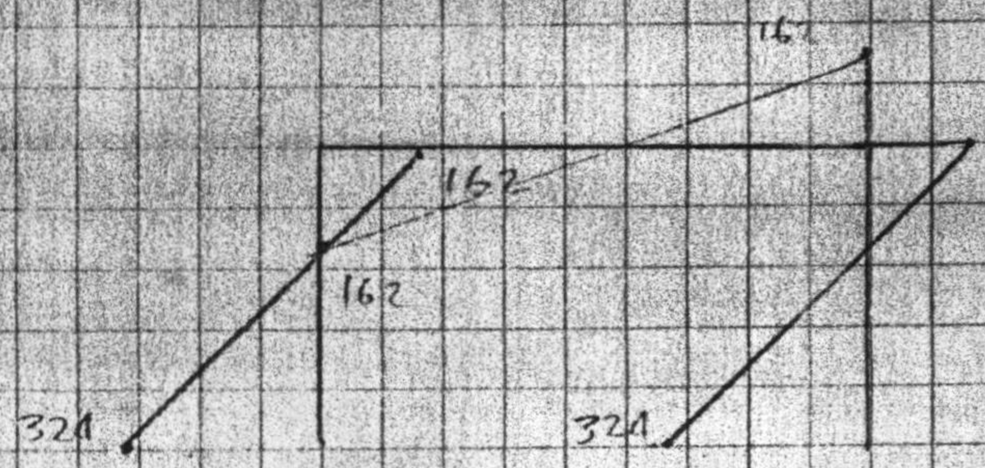
350 x 500



Try conservatively frame takes V/2 + torsion

$F = (476/2) + 48 = 286$ kN

Mom = centre pt of contraflexure @ 2/3 ht.



$K = M/f_{cu} b d^2 = 324 \times 10^6 / .9 \times 25 \times 500 \times 500^2 = .072$

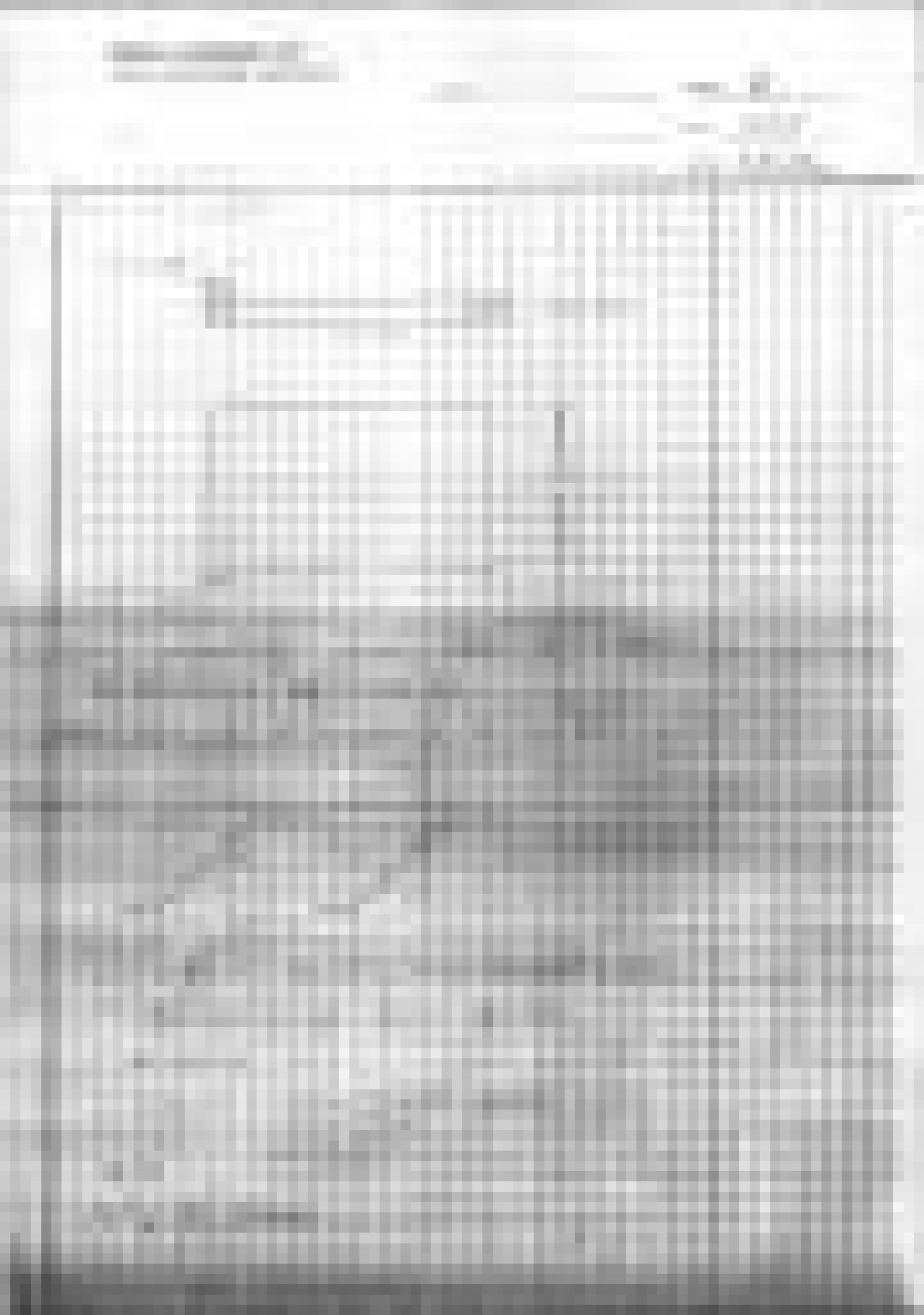
$l_{sm} = .20$ $p_t = .012$ $A_s = 4480$

$\Rightarrow$ 10 H D 24 (6 no.)

$K = M/f_{cu} b d^2 = 324 \times 10^6 / .9 \times 25 \times 350 \times 500^2 = .165$

$\Rightarrow$ NG

$\Rightarrow$ Try 2 frames



Distribute drop at ends according to col. stiffness:

$f = H/AE\,[(H/l)^2 + 3]$

500 x 800 $f = 3.4/.5 \times .8 \times 23500\,[(3.4/.5)^2 + 3] \times 10^3 = 17.81$

500 x 350 $f = 40.71$

$S = 1/f$ 500x800 $S = .056 \times 3 = .168$

500x350 $.025$

$.193$

Shear 500 x 800 $V = [.168/.193 \times 286]/3 = 83$ kN

500 x 350 $V = .025/.193 \times 286 = 37$ kN

500 x 800 $M = 188$ kNm

$M_u/f'_c bd^2 = .042 \Rightarrow$ Min steel OK

500 x 350 $M = 84$ kNm

$M_u/f'_c bd^2 = .023 \Rightarrow$ Min steel OK

$A_{s\,min}$ = 8 HD16 but 2 are HD20's below

$\Rightarrow$ 8 HD20

Beam 1 at 500x500

$M_E = 94$ kNm

$W_D = 24 \times .8 \times .4 + 5 \times 1 + 1 \times 3 = 15.7$ kN/m

$W_L = 3 \times 4 = 12$ kN/m

$W_u = 1.4 \times 15.7 + 1.7 \times 12 = 42.4$ kN/m

$M_u = 42.4 \times 9^2/12 = 286$ kNm

Col. A

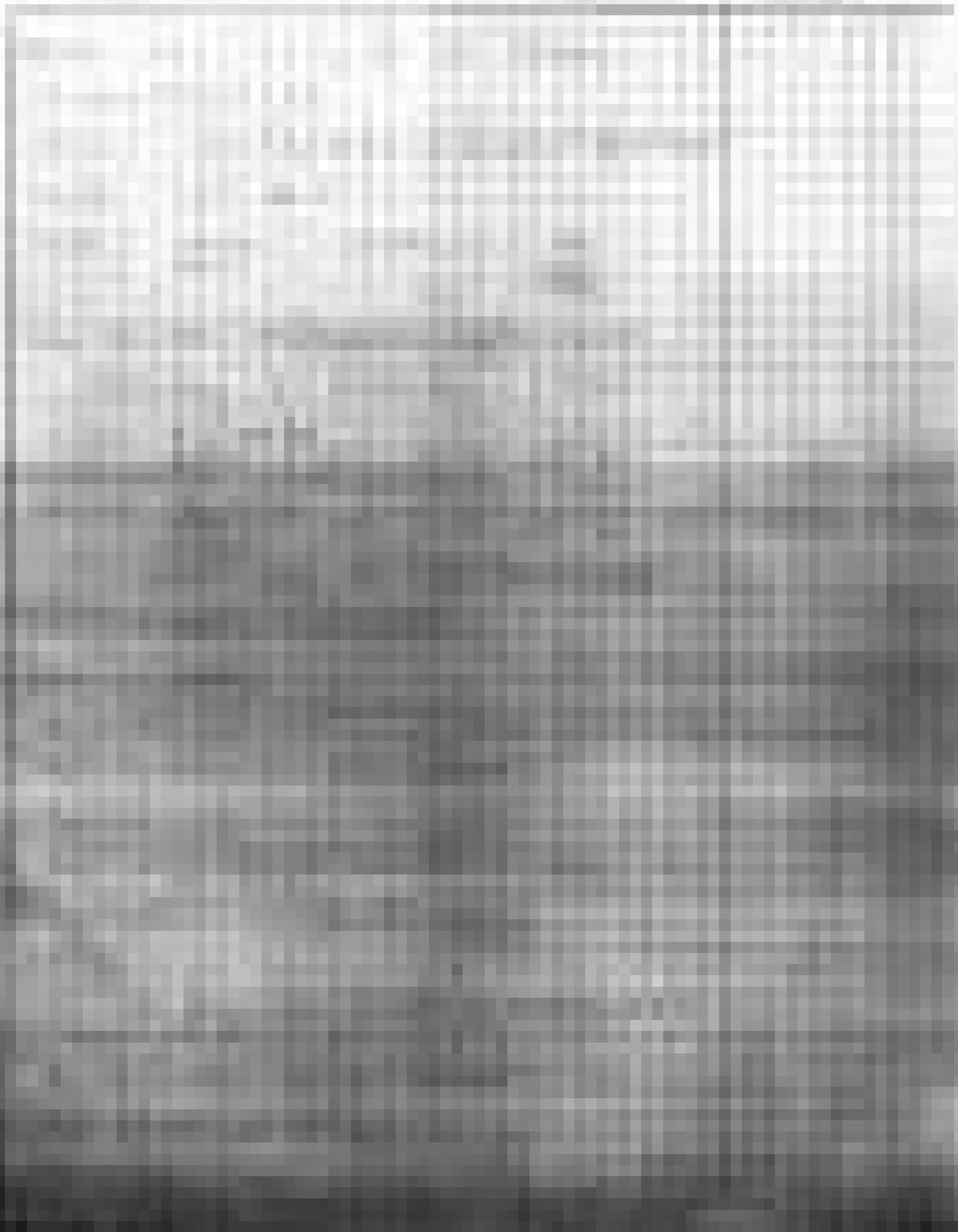
$P_u = 1.4 \times 24 \times .8 \times .4 \times 5 + 1.4 \times 60 + 1.4 \times 5 \times 5 \times .8 = 166$ kN

$W_u = 1.4 \times 24 \times .8 \times .5 = 13.4$ kN/m

$M_u = 13.4 \times 2^2/2 + 166 \times .2 = 359$ kNm

2+1 24+8 $M_u = 305$ kNm

$\Rightarrow$ 4 HD24 T & B



Shear:

V_u = 166 + 13.4 x 2 = 193 kN or 47.4 x 9/2 = 19 kN

v_u = 193 000 / .85 x 500 x 730 = .62

p_w = .0050 v_c = .60

$A_{v\,min}$ = .35 $b_w s / f_y$

s_{max} = 157 x 380 / .35 x 500 = 341

→ 3 legs HR10 @ 100 for 1620 from face

HR10 @ 300 rem.

Edge Beam — Try 600 x 300

w_{DL} = 1.4 x 21 x .8 x .4 + 1.4 x 5 x .8 + 1.4 x 10.3 = 30.8

M_u = 30.8 x 2^2/2 = 62 kNm

or 30.8 x 5^2/8 = 96 kNm

R_u = 96 x 10^6 / .9 x 300 x 530^2 = 1.27 ρ = .0035

A_s = .0035 x 300 x 530 = 588 mm^2

⇒ 2H20 T & B

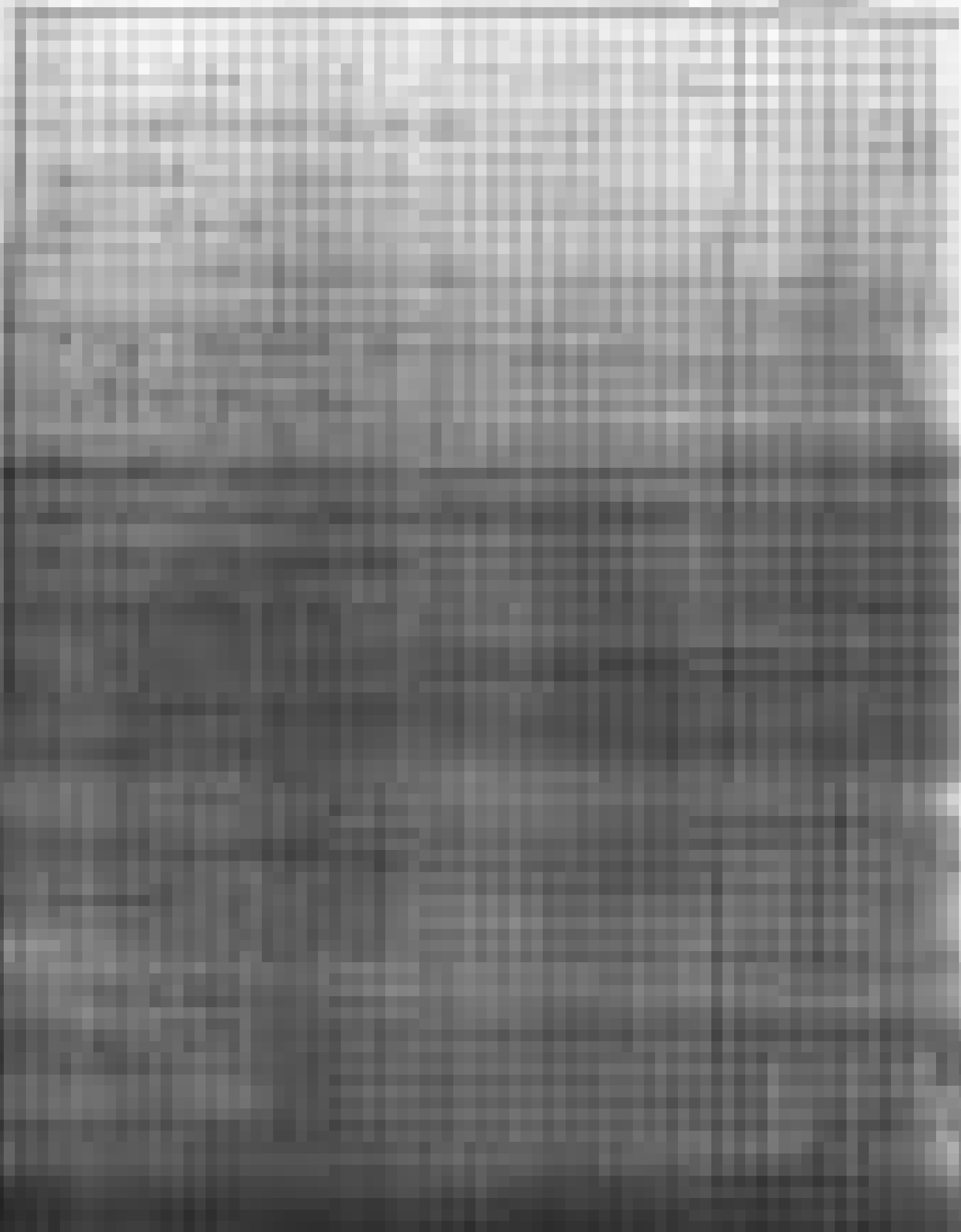
V_u = 30.8 x 5/8 x 5 = 96 kN

v_u = 96 x 10^3 / .85 x 300 x 530 = .71

ρ_w = .0057 .64

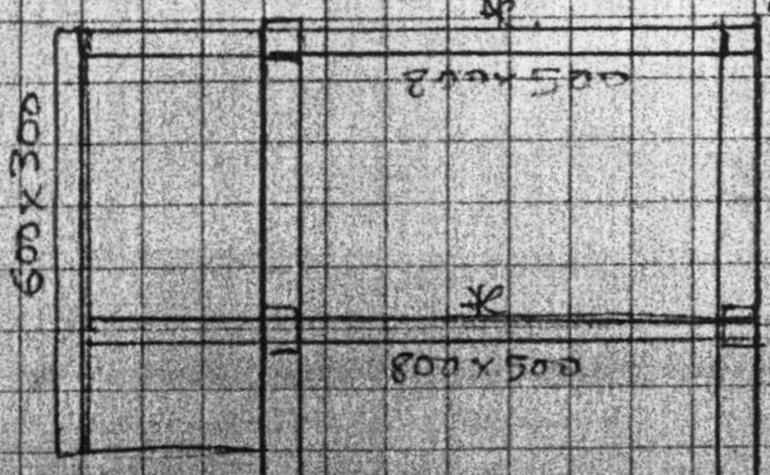
s_{max} = 157 x 380 / .35 x 300 = 568

⇒ HR10 @ 200



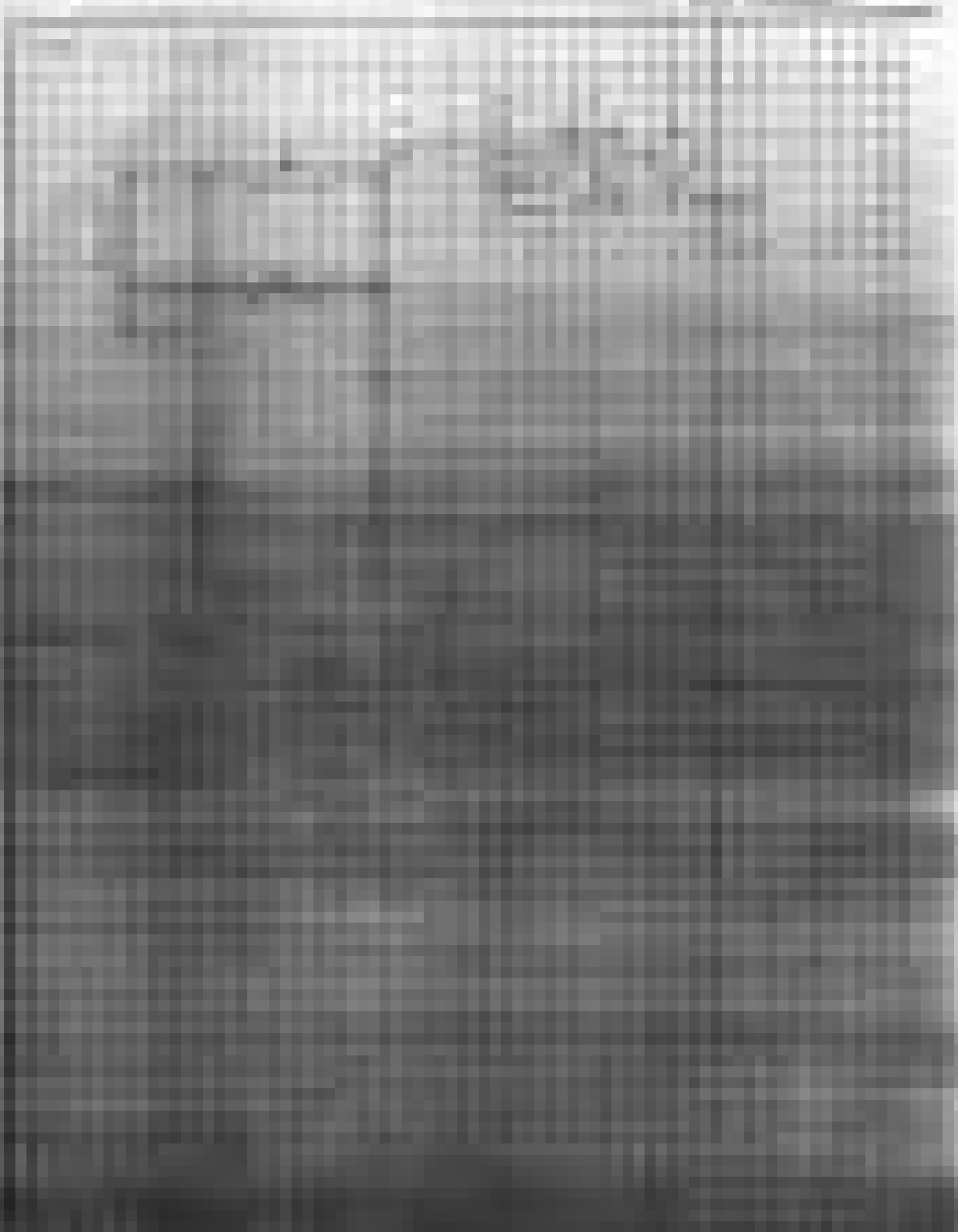
Level 1 Floor

800 x 350 Col. reduced to 500 x 350 @ lev 3 (Reduce long reo. from 10HD20 to 8HD20)



*800 x 500 beams 4HD24 T&B
3 legs HR10 @ 100 for 1600 from face (not on cantilever)
HR10 @ 300 rem.
HR10 @ 200 cantilever.

600 x 300 beams 2HD24 T & B
HR10 @ 200



600 x 300 beam continued

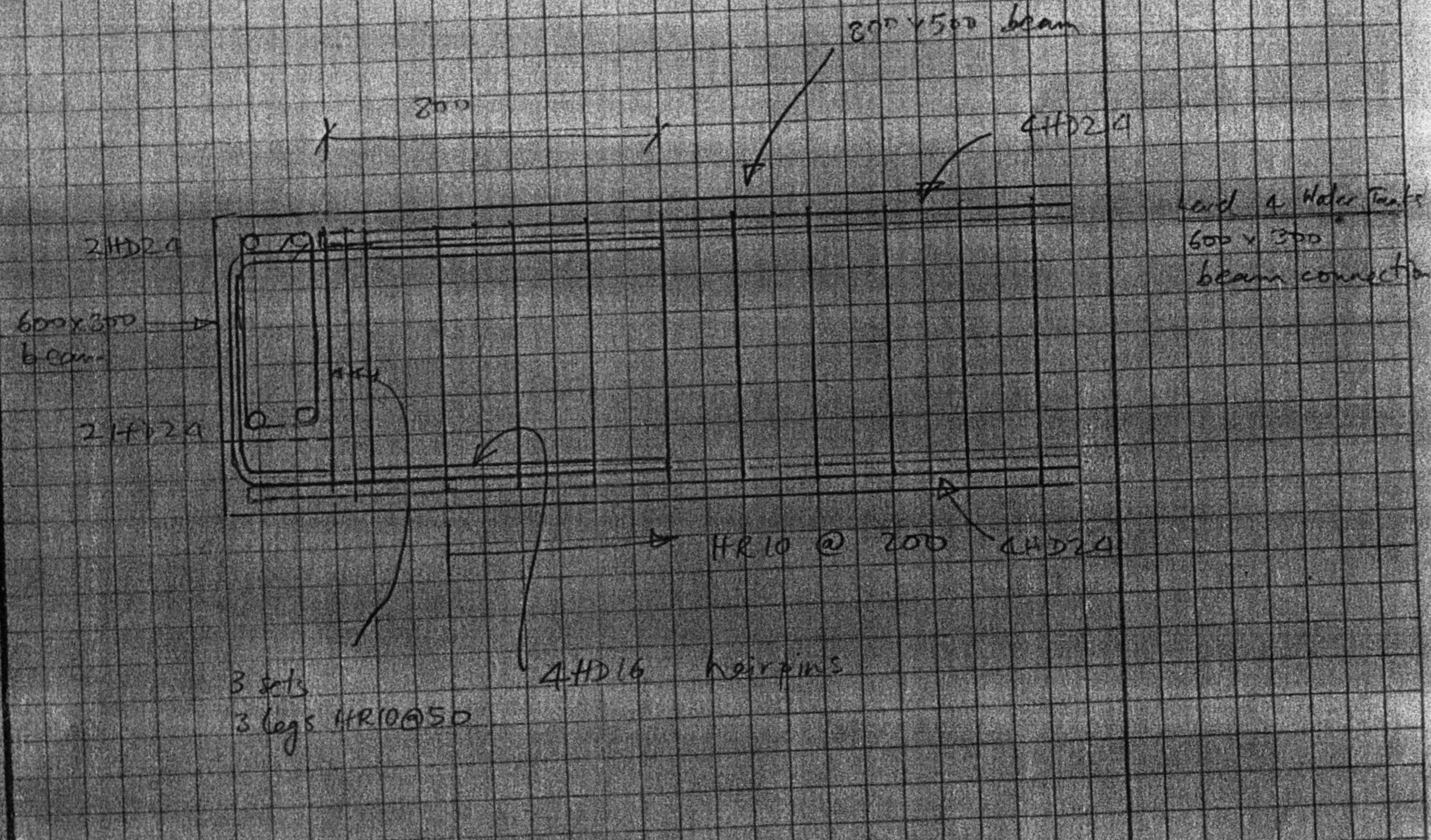
Ref $V_u = P_u / \phi \mu f$ = 166 000 / .85 x .7 x 380 = 734 mm²

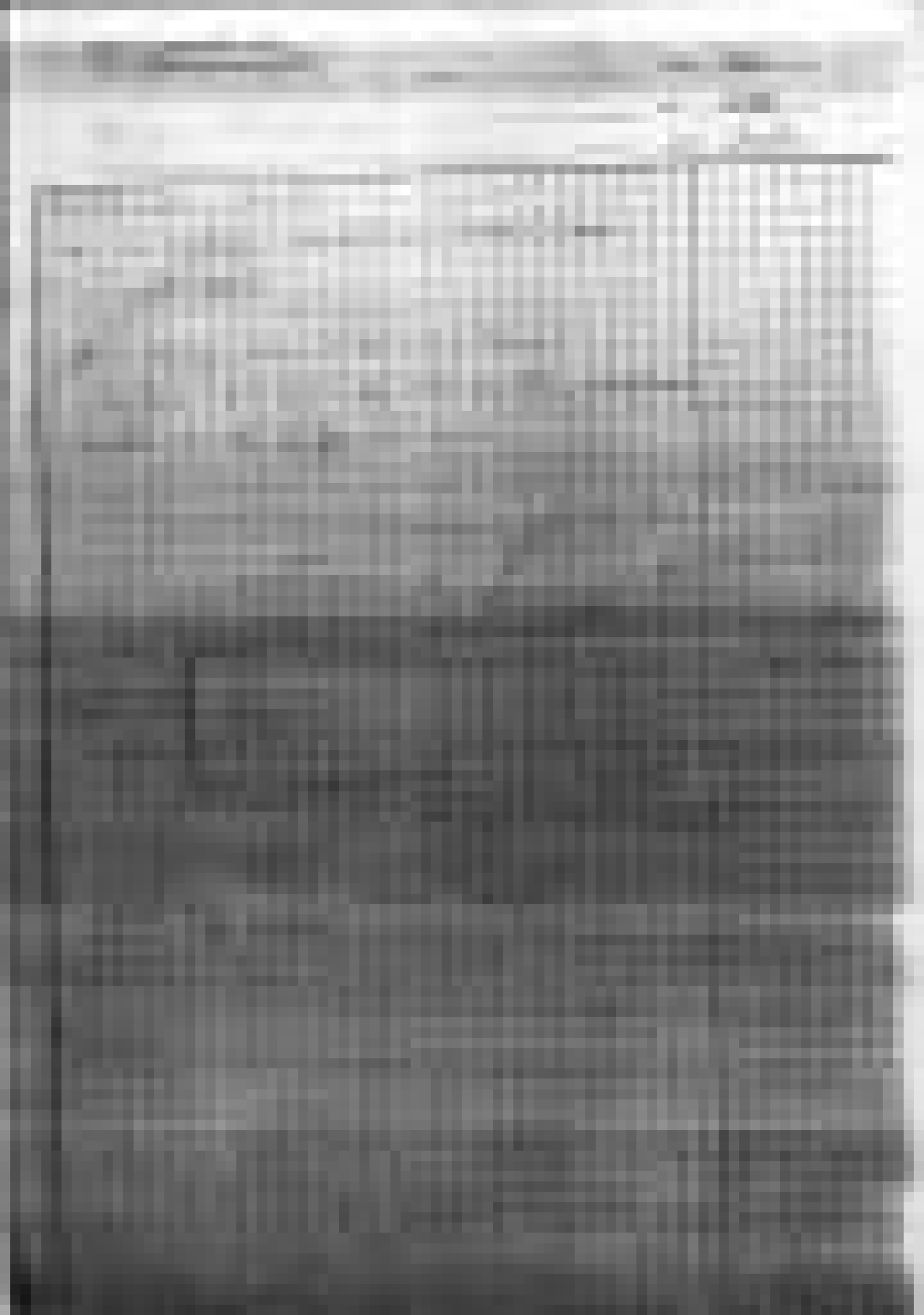
⇒ 4HD16

$A_v = V_u / \phi f_y$ = 166 x 10³ / .85 x 380 = 514 mm²

514 / 236 = 2.2 sets 3 legs HR10 w/i d/2 = 365 of beam

Require 3 sets 3 legs 4R10 @ 50





SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. _____ PAGE 56

JOB _____ BY WJM

_____ DATE 7/10/86

Mom. at 1/4 - 14 3·2 m

$W_p = 1 \times 8 \times 5 = 40$ kN

$R_p = 1.5$ $C_{p\,max} = .16$ $C_{p\,min} = .3$

$C_p = 1.5 K_z S_p M_p R_p C_d$

$C_p = 1.5 \times \frac{19}{9} \times 1 \times .8 \times 1.5 \times .1 = .38$

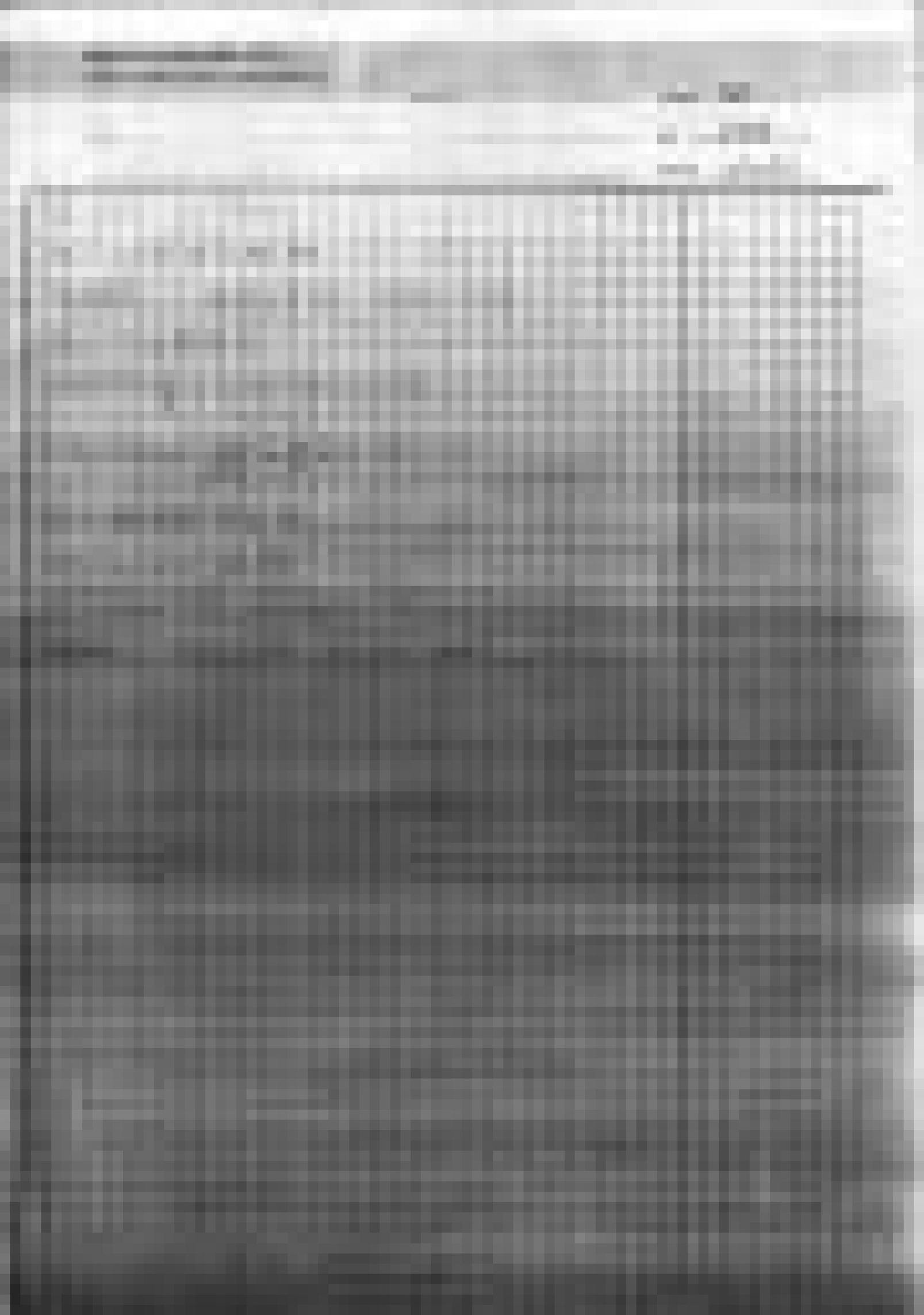
$\propto K_z Z R C_{p\,min} = \frac{9}{15.8} \times \frac{19}{9} \times 1 \times .3 = .36$

$F_p = .38 \times 40 = 15.2$ kN

$M = 15.2 \times 3.2 = 49$ kNm

$R_u = 49 \times 10^6 / .9 \times 800 \times 430^2 = .37$

$\Rightarrow$ OK (Cb OK for min. steel)



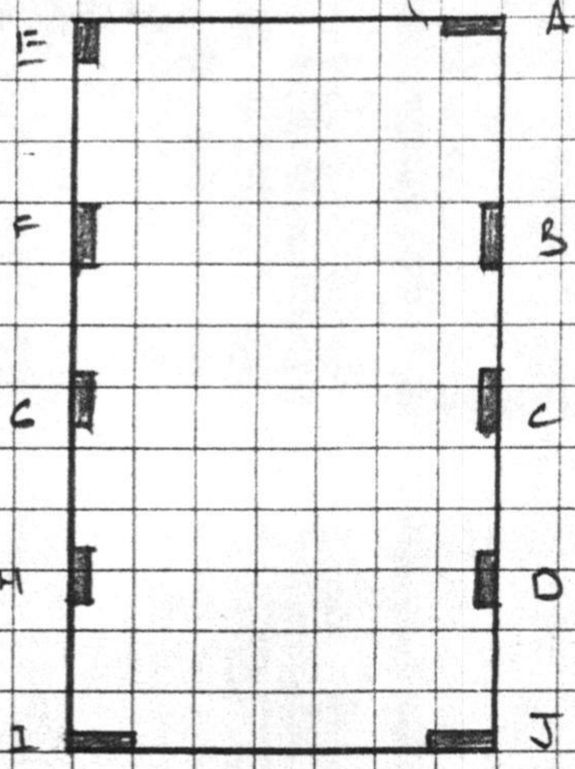
SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No 1868 PAGE F | 1

JOB _____ BY MJO

_____ DATE 10/86



N-S torsion

$1530 \times \frac{.45}{.6} = \pm 1224$

Gravity $Q_A = \frac{3000}{3} = 1000$ KPa.

Seismic $Q_A = \frac{3000}{2} = 1500$ KPa.

Uplift 2m ϕ, 7m depth.

Allowable $= \frac{5000}{2} = 2500$ KN.

Column	D	L	D+L	E'Quake. E	W	N	S	D+L+.8E	.70+.8E
A	705	262	967	1530	-1530	431 1224	-431 -1224	2291	-831
B	1041	557	1598			293	-293	1832	
C	1250	625	1875			156	-156	2000	
D	1175	600	1775			-568	568	2229	
E	700	260	960	-1530	1530	872 -1224	-872 1224	2184	-734
F	1187	580	1767			-539	+539	2198	
G	250	238	488			65	-65	540	
H	1056	583	1639			+217	-217	1813	
I	761	270	1031	-1530	1530	-486 1224	486 -1224	2255	-692
J &	700		700	1530	-1530	- -1224	- 1224	1924	-734

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868 PAGE F/2

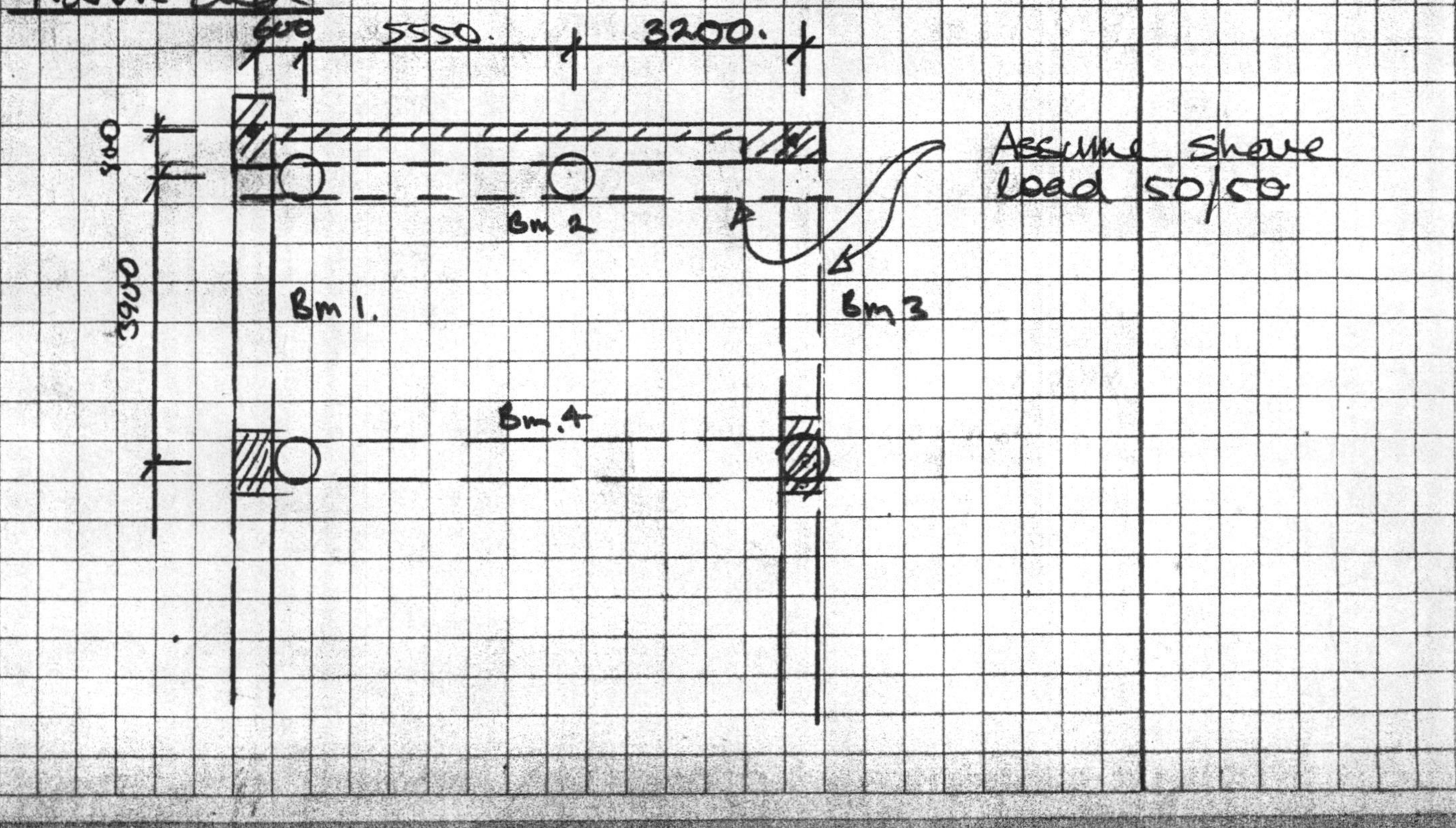
JOB BY MJO

DATE 10/86.

Pile	D+L	D+L+'8E	·7D+'8E	Pile Area G.	Pile Area S.	Pile Bell ϕ.
A	967	2291	-631	·967	1·53	1400
B	1598	1832		1·598	1·22	1426
C	1675	2000		1·875	1·33	1545
D	1775	2229		1·775	1·49	1503
E	960	2184	-734	·96	1·46	1363
F	1767	2198		1·767	1·47	1500
G	488	540		·488	·36	788
H	1639	1813		1·639	1·21	1444
I	1031	2255	-692	1·031	1·50	1382
J	~~967~~ 700	2291	-734.	·967	1·53	1400.

Piles shifted to avoid Tunnel.

North End.



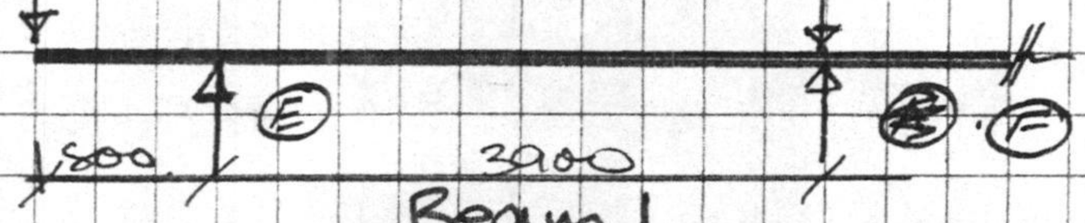
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868 PAGE F/3

JOB BY MJO.

DATE 10/86.

D+L	960	1767.
.8E (N)	-107.	431
.8E (S)	107	-431
.8E (E)	-1224	
.8E (W).	+1224	



BEAM 1

Beam 1.

Reactions

$\frac{6}{3a} = .205$ $1 + \frac{3}{2} \times .205 = 1.307.$

$\frac{3}{2} \times .205 = .307.$

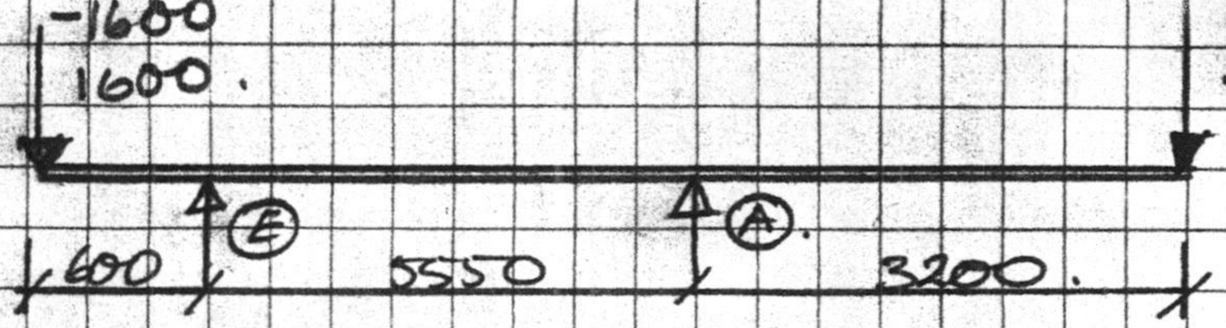
D+L	1255	1767-233 = 1534
.8E (N)	-140	431 +43 = 474
" (S)	140	-431 -43 = -474
" (E)	-1600	376
" (W).	1600.	-376.

Moments.

D+L	-768.
.8E N	86
" S	-86
" E	979
" W	-979.

Beam 2.

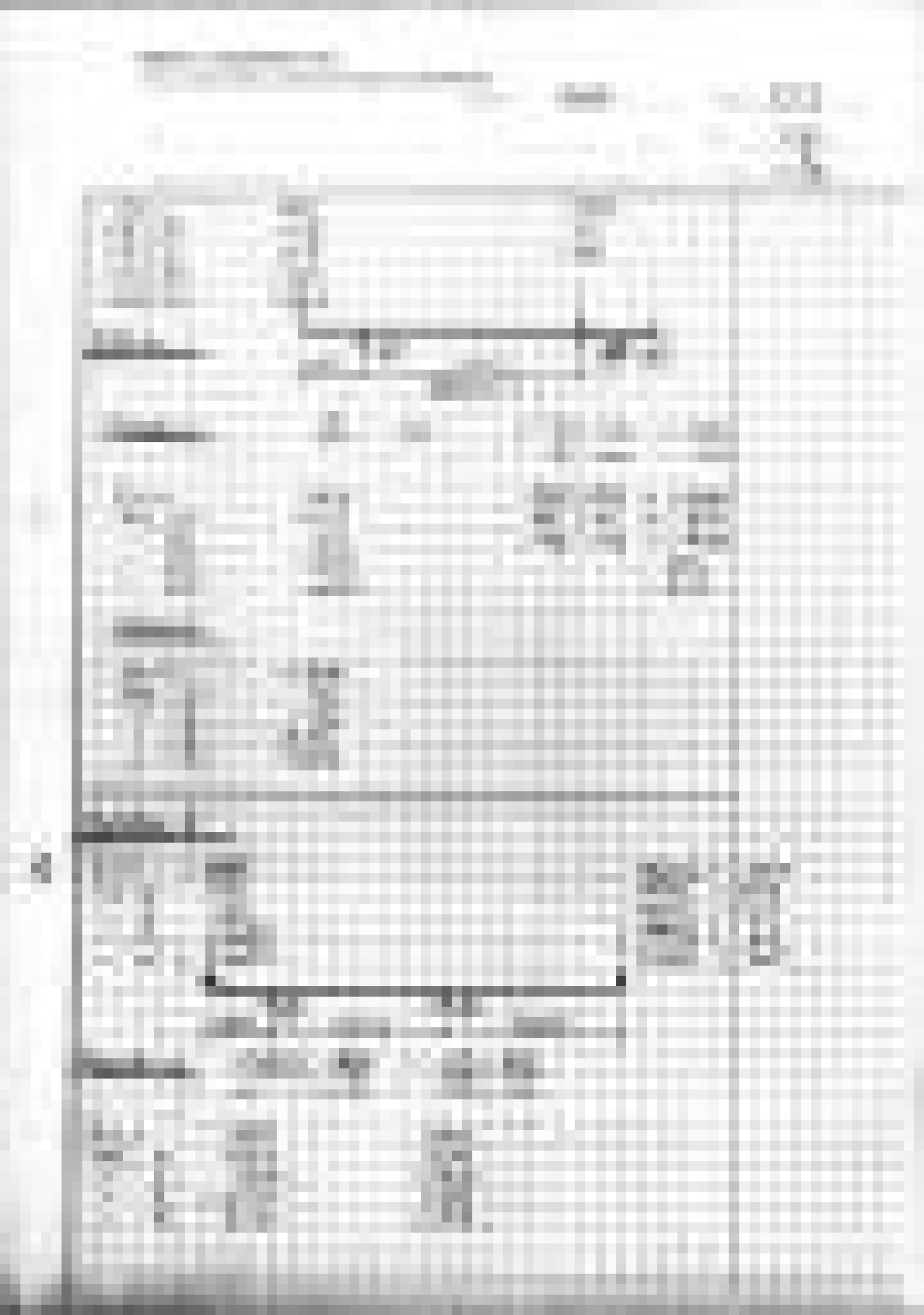
D+L	1255	967/2 = 484
.8E N	-140	1655/2 = .828
" S	140	-1655/2 = -828
" E	-1600	1224/2 = 612
" W	1600.	-1224/2 = -612.



Reactions: $\times \frac{6.15}{5.55} = \times \frac{3.2}{5.55} - \times \frac{.6}{5.55} + \frac{5.75}{5.55}$

$= \times 1.1 - \times .58 = 1.58x - .12$

D+L	1100	614
.8E N	-634	1325
" S	634	-1325
" E	-2115	1159
" W.	2115	-1159.



Moments.

D+L		-753	-1549
SE	N	84	-2650
"	S	-84	2650
"	E	960	-1958
"	N.	-960.	1958.

Beam 3.

D+L		484	1598	1875
SE	N	828	234	125
"	S	-828	-234	-125.
"	E	612	-	
"	W	-612.	-	

Reactions.

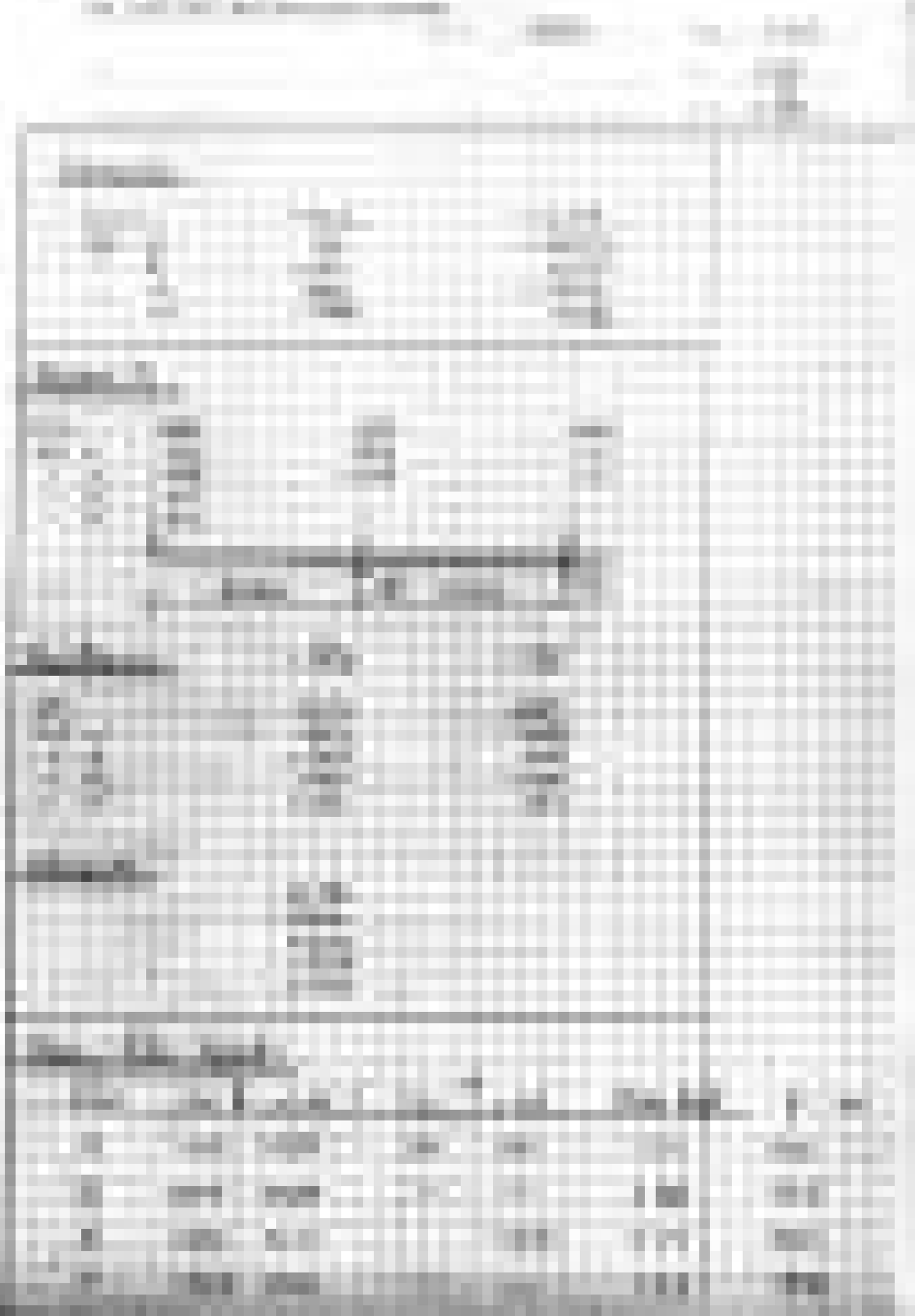
		× 9.5/5.0	- 1.5/5
D+L		2517	1439.
SE	N	1807	-620
"	S	-1807	620
"	E	1162	-551
"	W.	-1162	551.

Moments.

	-2178.
	-3726
	3726
	-2754
	-2754

Max. Pile loads.

Pile	D+L ↓	+0.8E ↓	D+L ↑	+8E ↑	Area load'd	ϕ. mm
A	614	1939	—	711	1.29	1281
B	2517	4324	—	—	2.88	1915
E	1100	3215		-1015	2.14	165
F	1534	2008	—	—	1.53	1396



Ground Beams.

Beam 1

Max V_u = $1.48 \times 960 + \frac{1600}{.8}$ = 3420 kN

Max M_u = $1.48 \times 768 + \frac{979}{.8}$ = 2360 kNm.

@ $v_c \leq .2 \times 25 = 5$ MPa.

Require $b.d = \frac{3420000}{.85 \times 5}$ = 804894 mm^2

(600 × 1340)

Say 1500 × 600 beam.

$R_u = \frac{2360\ E6}{.9 \times 1300^2 \times 600}$ = 2.59 MPa.

∴ OK.

Beam 1
1500 × 600.

Beam 2.

Max V_u = $1.48 \times 1255 + \frac{1600}{.8}$ = 3857 kN

Only 600 long ∴ corbel.

At other End.

$V_u = 1.48 \times 484 + \frac{825}{.8}$ = 1751 kN

$M_u = 1549 \times 1.48 + \frac{2650}{.8}$ = 5605 kNm.

1500 × 800 beam.

R_u = 4.6 MPa.

Beam 2
1500 × 800.

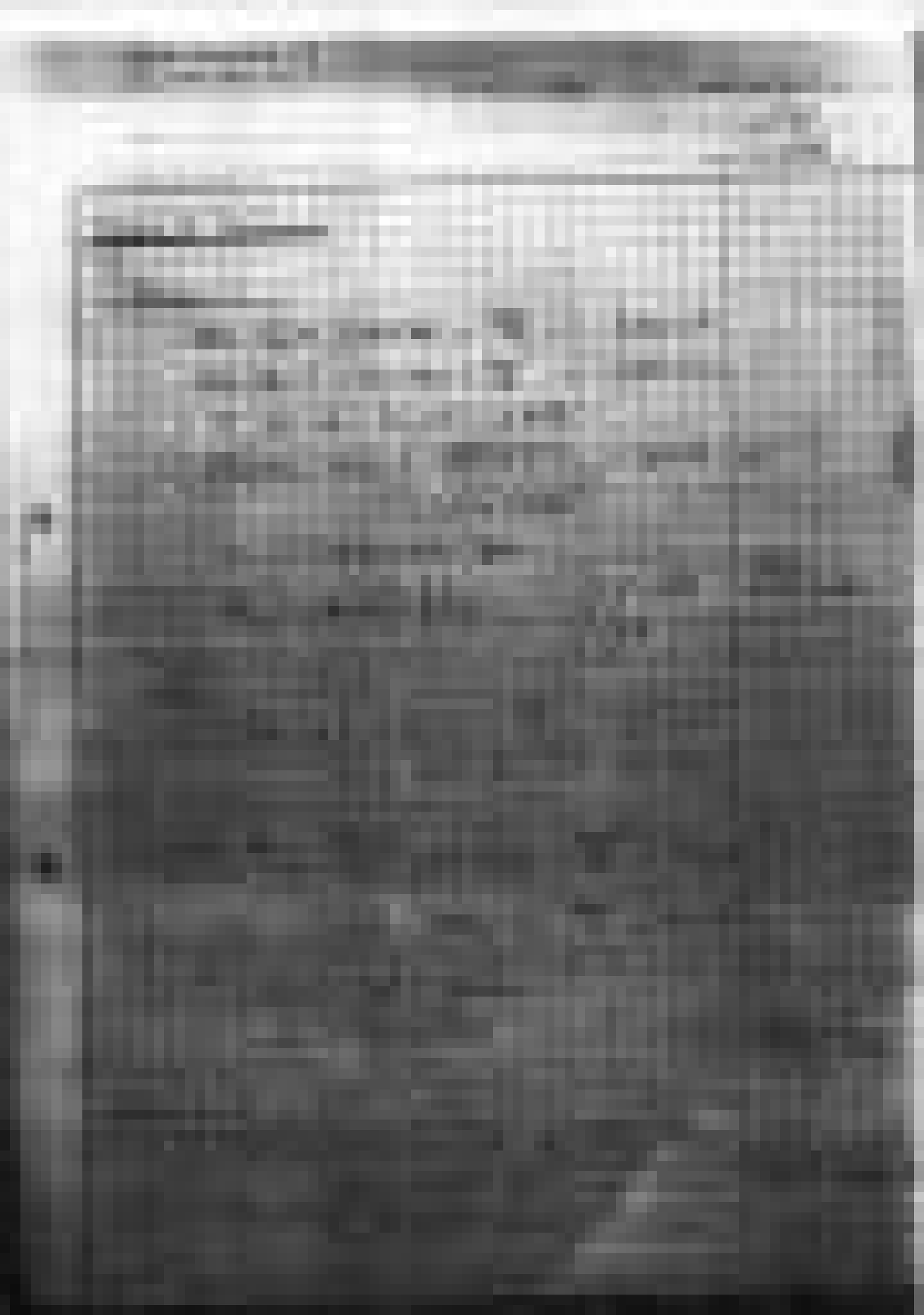
Beam 3.

$M_u \simeq 1.48 \times 2178 + \frac{3226}{.8}$ = 7880 kNm.

2000 × 800 Beam.

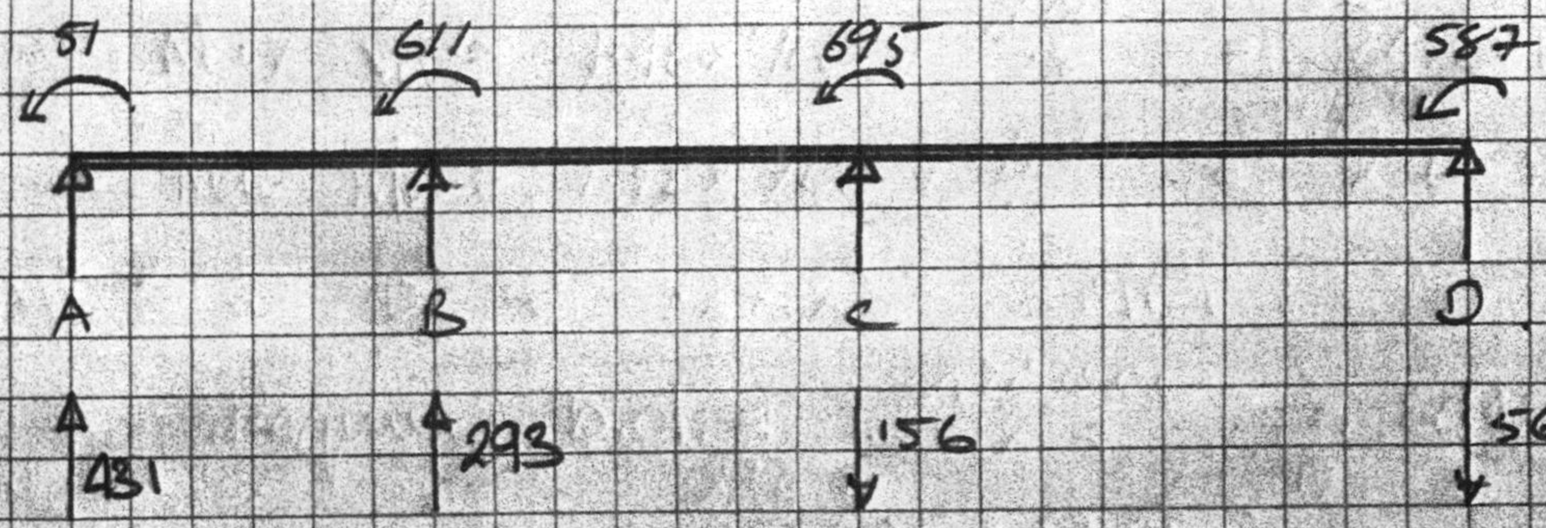
R_u = 3.38 MPa.

Beam 3
2000 × 800.

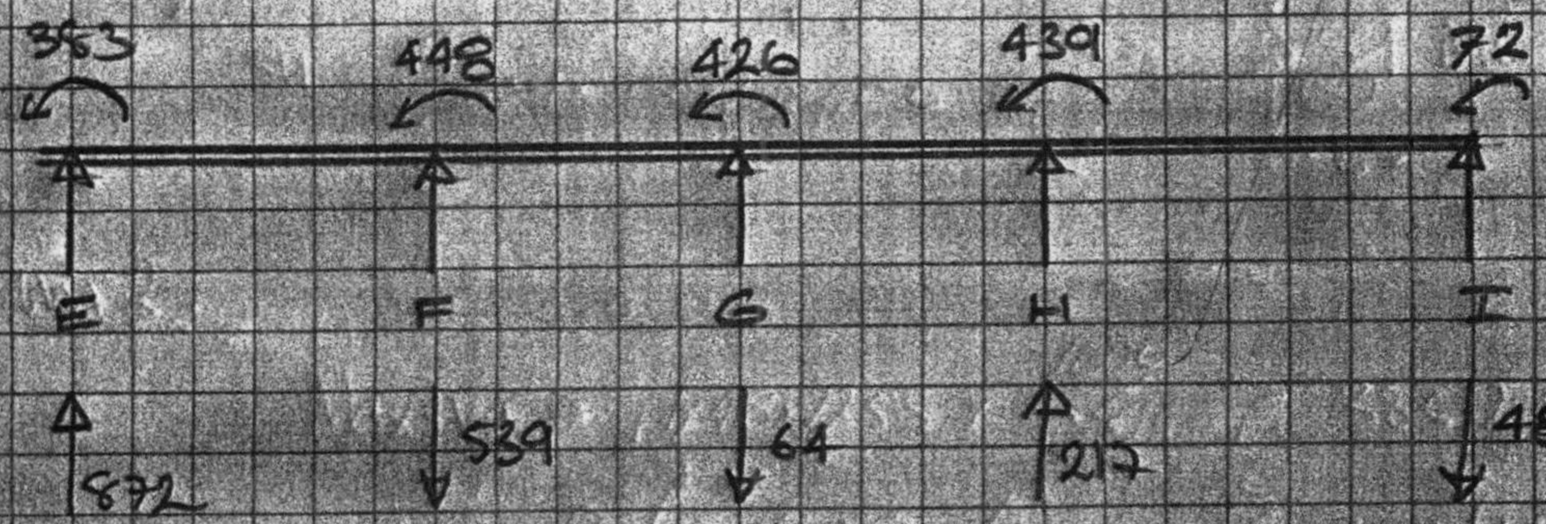


Ground beam forces from Seismic Frame.

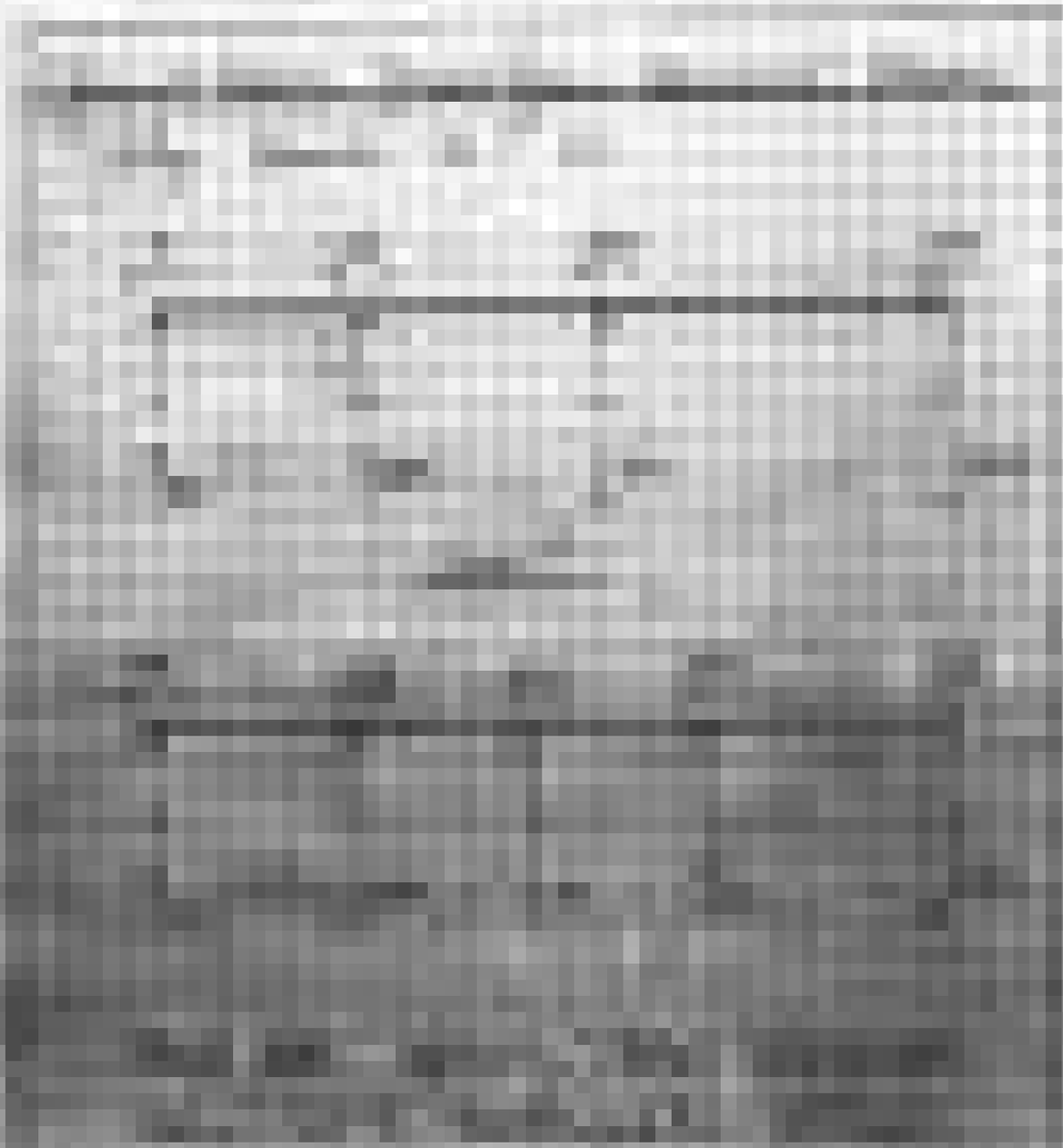
Refer Sheets 21 - 32.



EAST.



Must add column base moments when N-S earthquake critical.



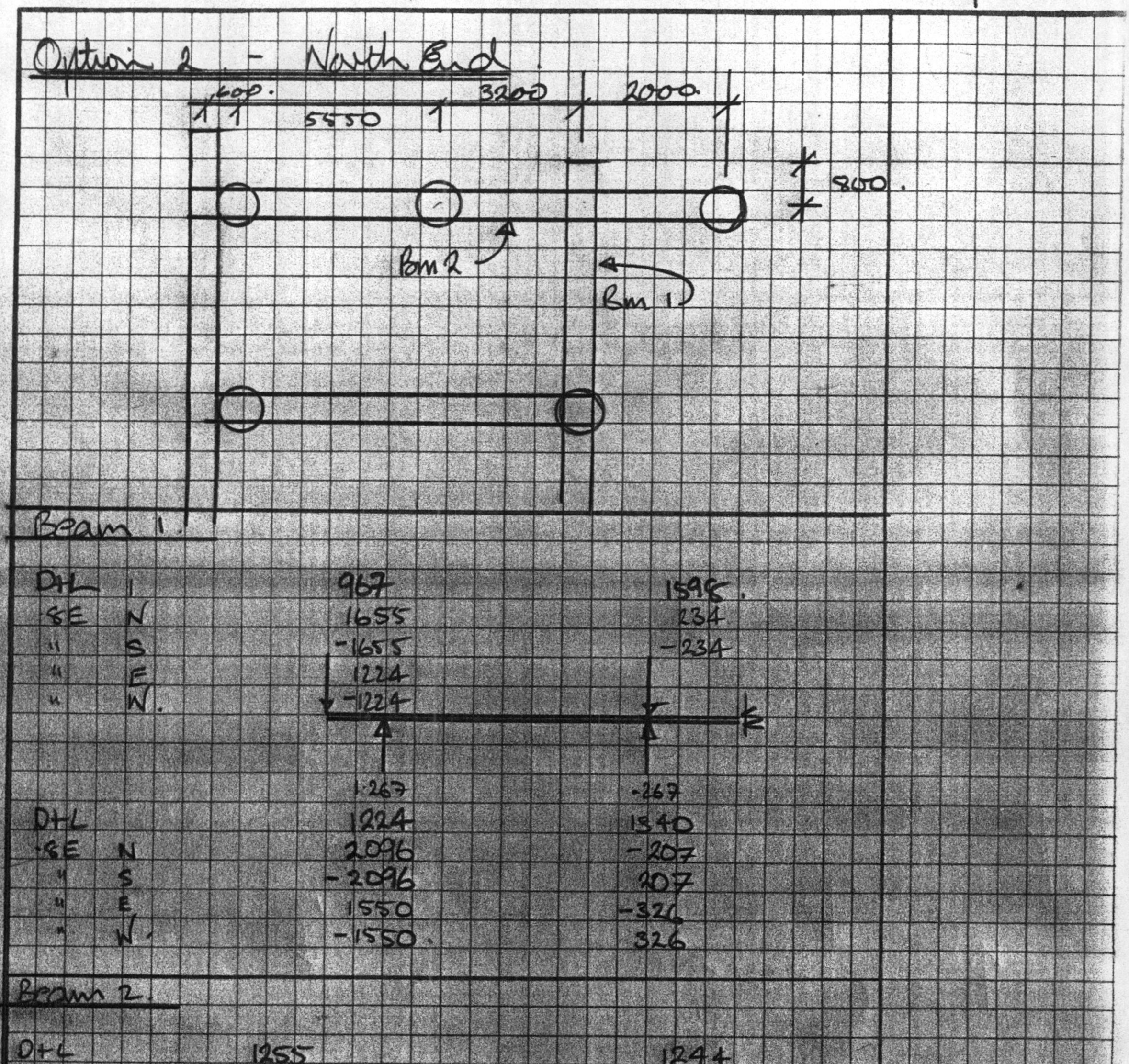
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

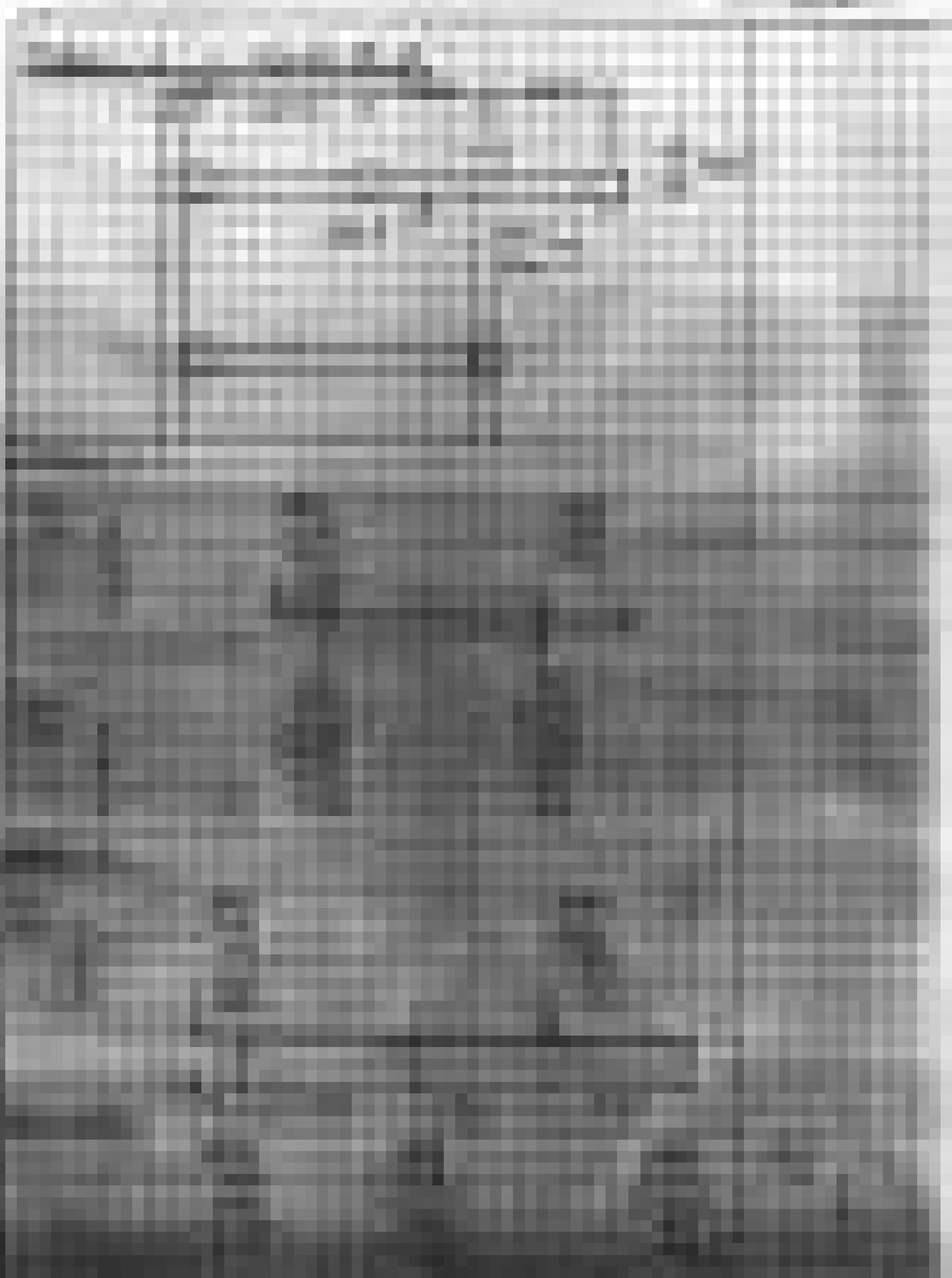
JOB No. 1868 PAGE F/8

JOB BY MJO.

DATE 10/96.

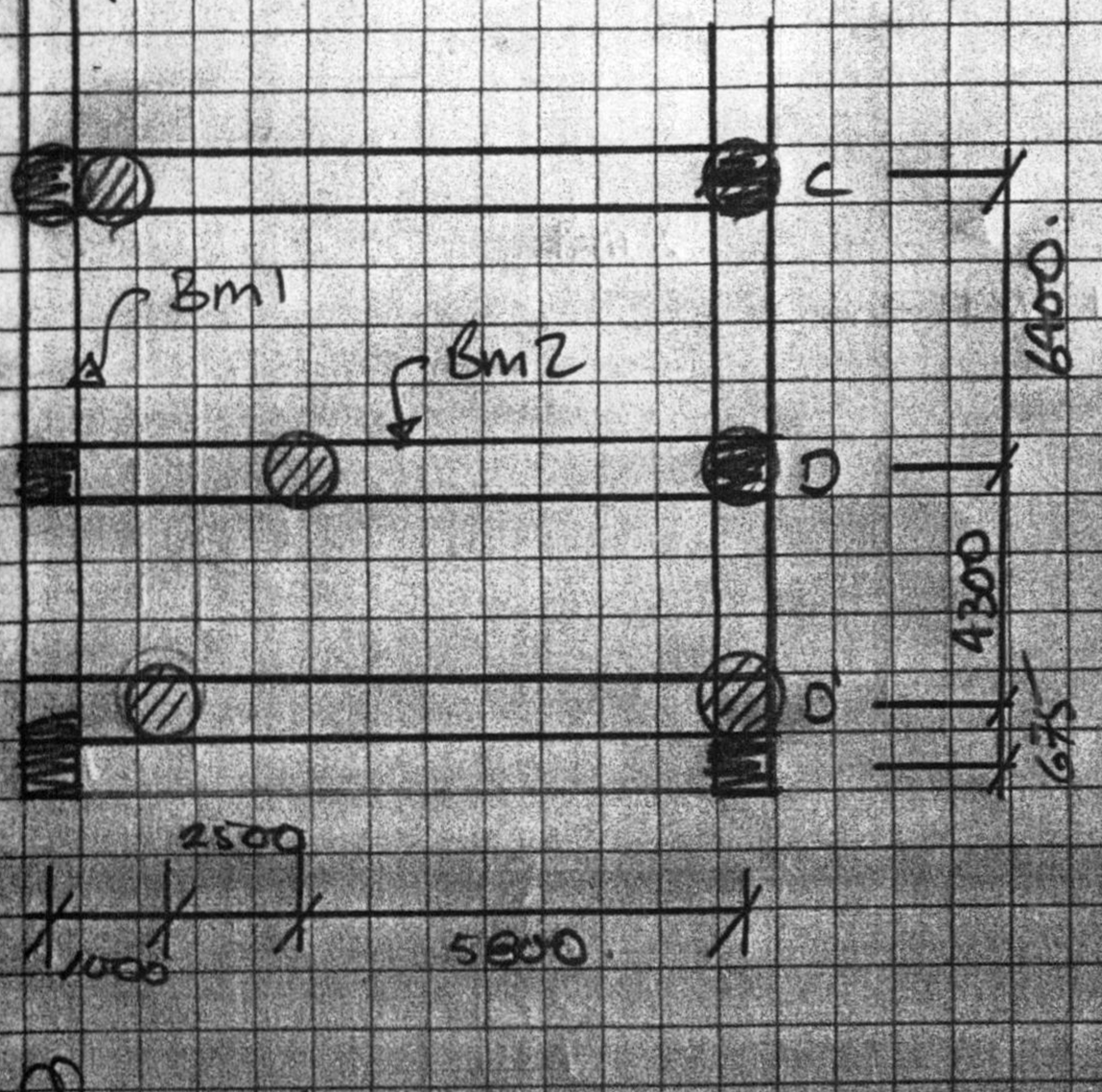
Option 2 - North End.



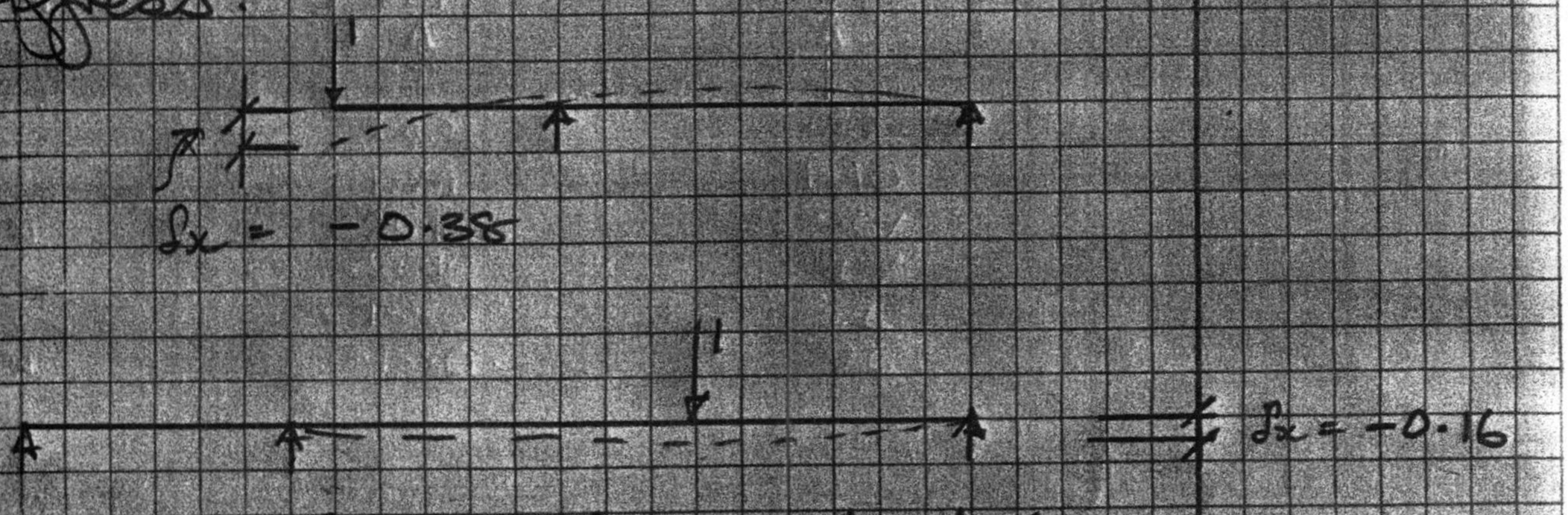


South End.

459
1 1 700.

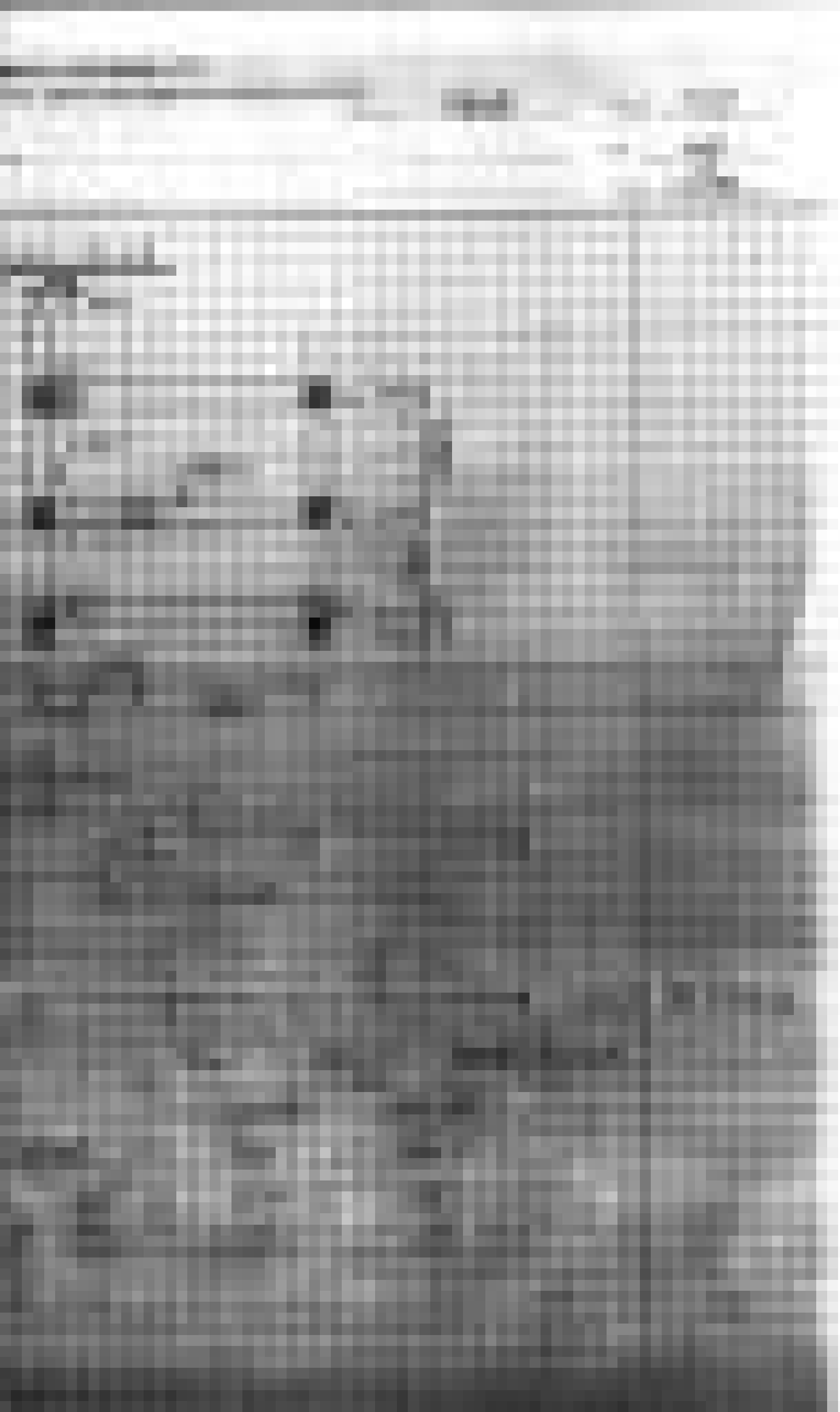


Stiffness:



Bm1 : Bm2 load share
≃ 1 : .421.
(70.4%) (29.6%)

Load.	Bm1	Bm2
L	1639	1154	485
N	217	153	64
S	-217	-153	-64
E	-	-	-
W	-	-	-

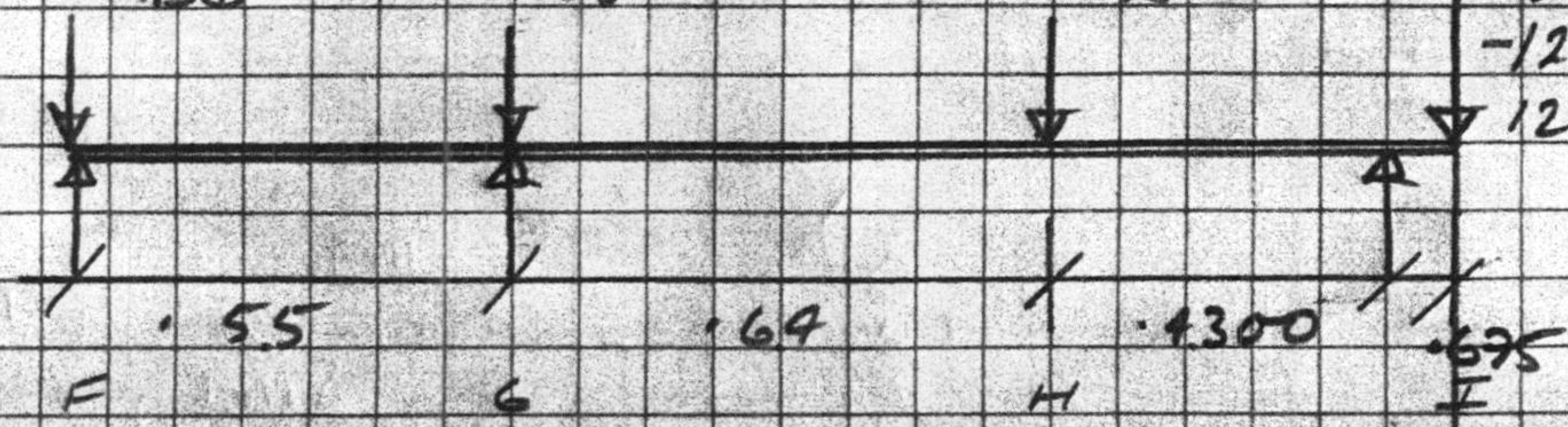


SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868 | PAGE F/10
JOB | BY MXO.
DATE 10/86.

Beam 1:

D+L	1767	488	1154	1031
·8E N	-430	-65	122	590
" S	430	+65	-122	-590.
" E				-1224
" W.				1224



Reactions:

D+L	1516	1330	1596
·8E N	-456	24	650
" S	+456	-24	-650
" E			-1224
" W			·1224

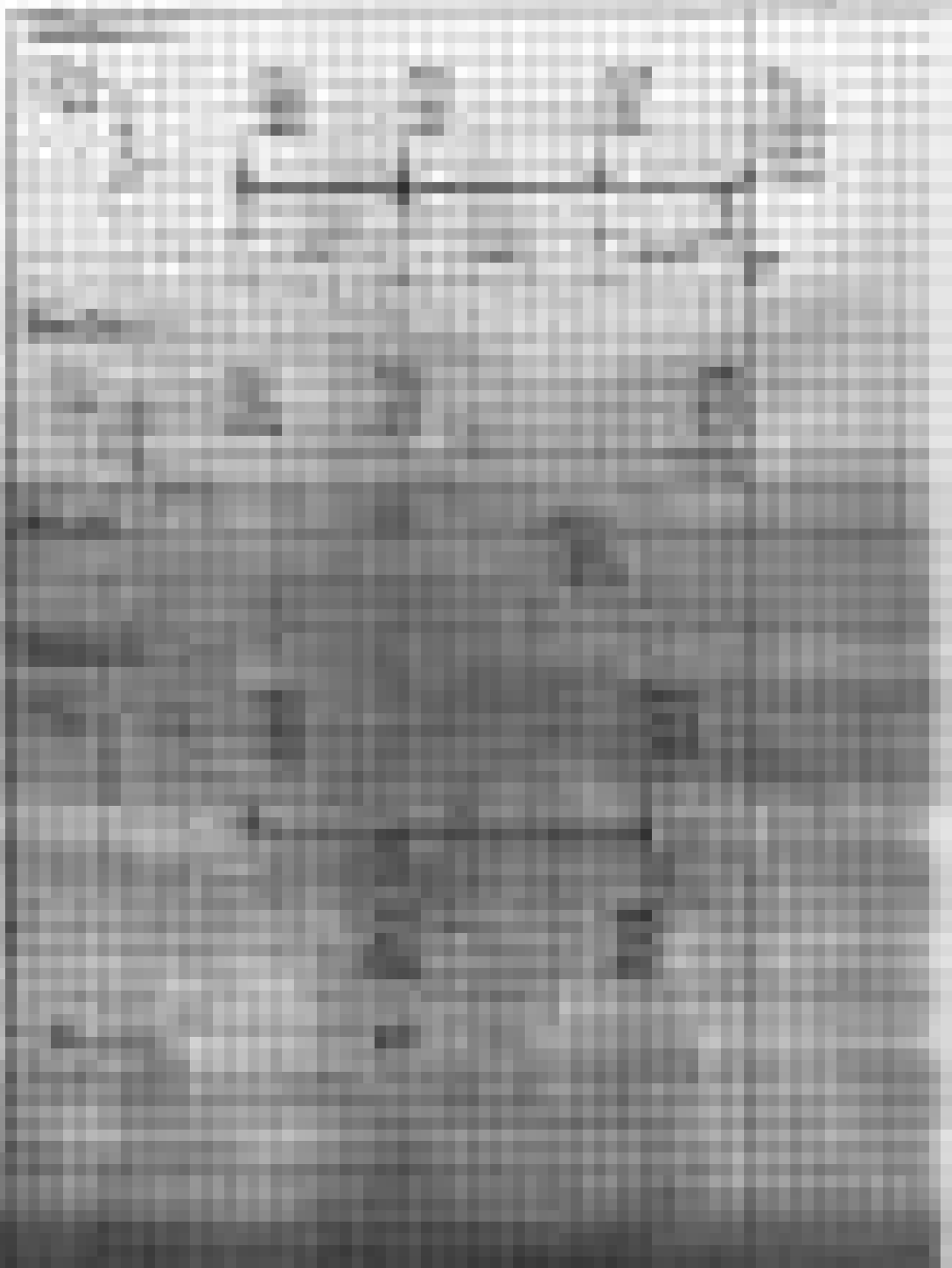
Moments: -1373. 2411 255 -255

Beam 2:

D+L	485	1775
·8E N	64	-454
" S	-64	454
" E	-	
" W.	-	

777	1482
102	492
-102	492

Moments. 1697



SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868 PAGE F|11

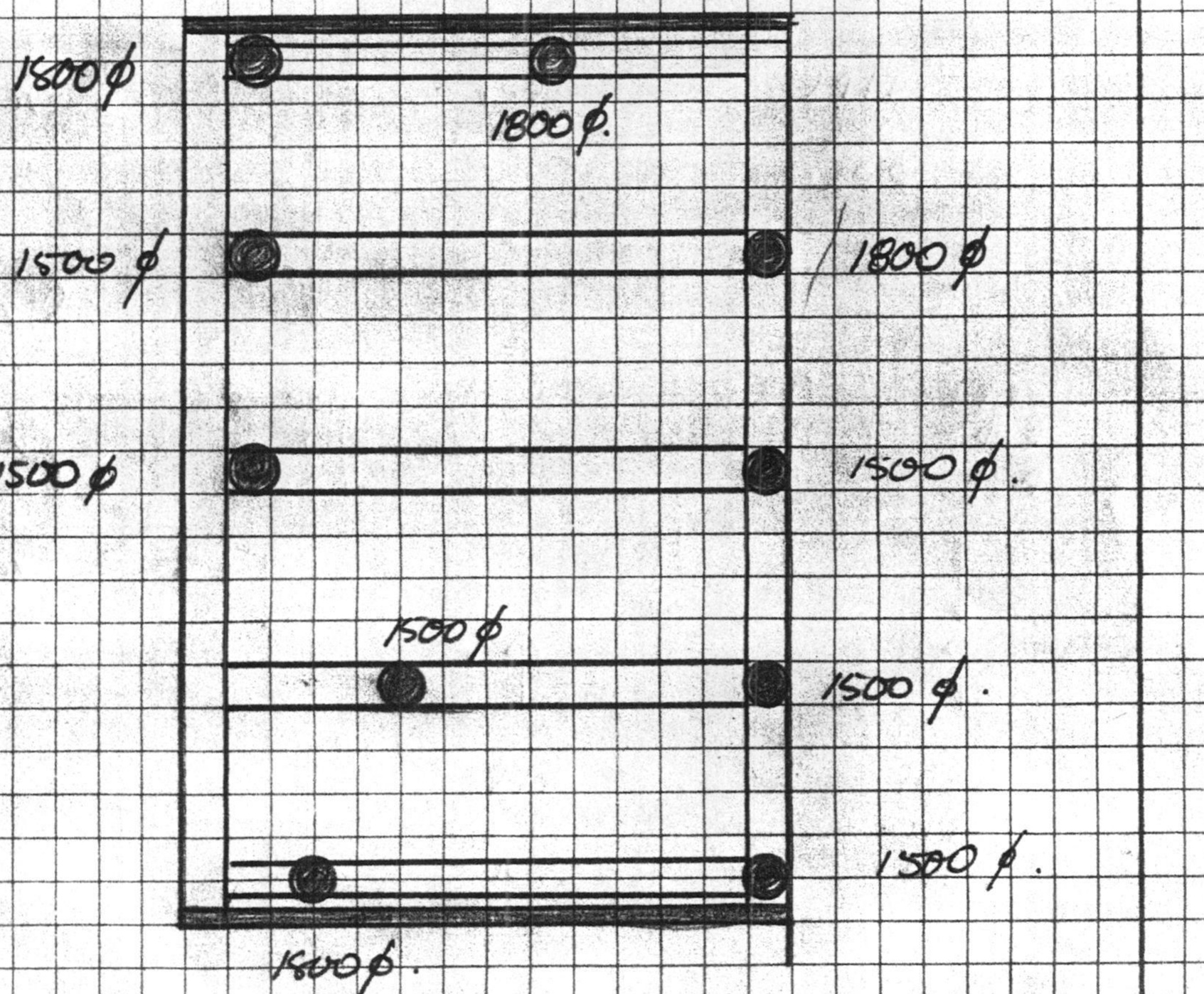
JOB _____ BY MJO

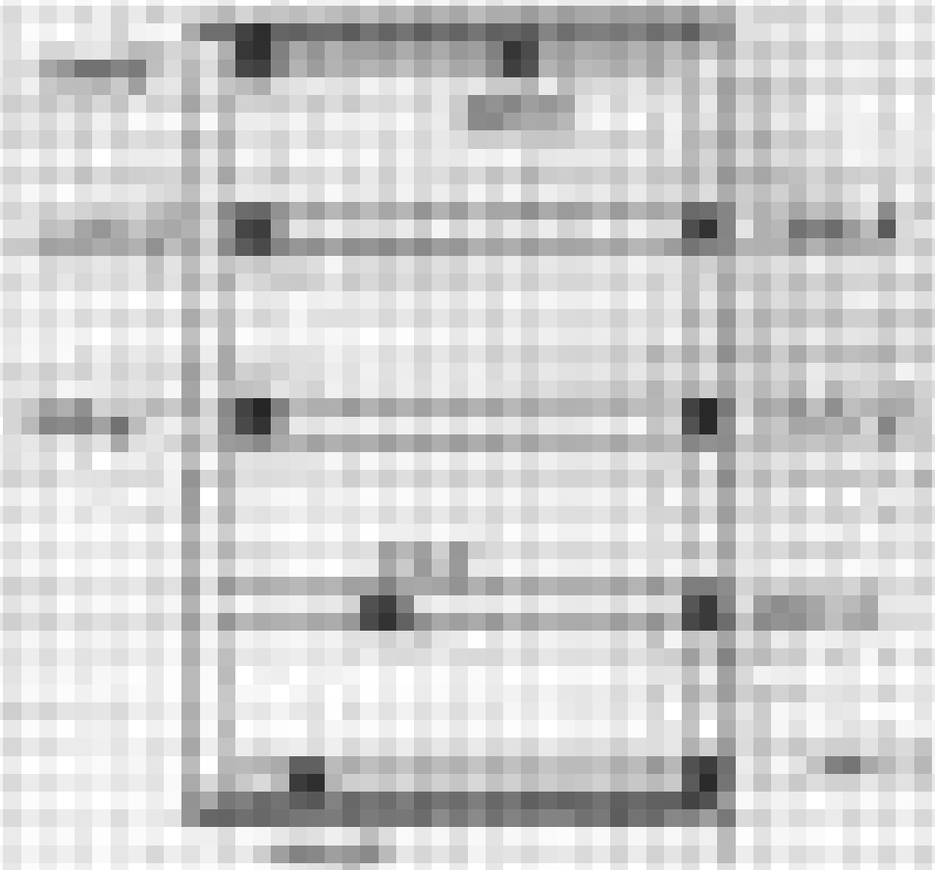
_____ DATE 10/86

Piles

	D+L ↓ +0·8E	D+L ↑ +0·8E.		Pile Area	φ mm.
F	1516	1972		1·52	1391
G	1330	1354	NO	1·33	1301
I	1596	2820	TENSION	1·88	1547
H'	777	879		·78	997
D	1482	1974		1·48	1372.

All pile stems. 900 φ.





Lateral load

V_b = 2055 kN

V_{Piles}

$P_p = k_p \gamma d = 3 \times 18 \times 1.5 = 81$ kPa

$P_p = .5 \times 81 \times 1.5 = 60.8$ kN/m

$V = 2 \times 9.6 \times 60.8 = 1167$ kN

$V_{piles\ rqd} = 2055 - 1167 = 888$ kN

⇒ V/pile = 89 kN/pile

Say, pile fixed 1 D into rock

$M_u = 89 \times 7.4 = 659$ kNm $g = .8$

$M_i / f_c' D^3 = .040$ $k_r m = .15$ $f_t = .0089 = 70$k

$P_i = 0$

Check beam cap for lateral pressure

$w_u = 60.8$ kN/m $W = 60.8$

$M_u = 2Wa/3 = 2 \times 60.8 \times 1.5/3 = 60.8$ kNm

$R_u = 60.8 \times 10^6 / .9 \times 1000 \times 520^2 = .25$ $\rho = .0005$

$A_s = 260$ mm²/m ⇒ HR10 @ 300 O.K.

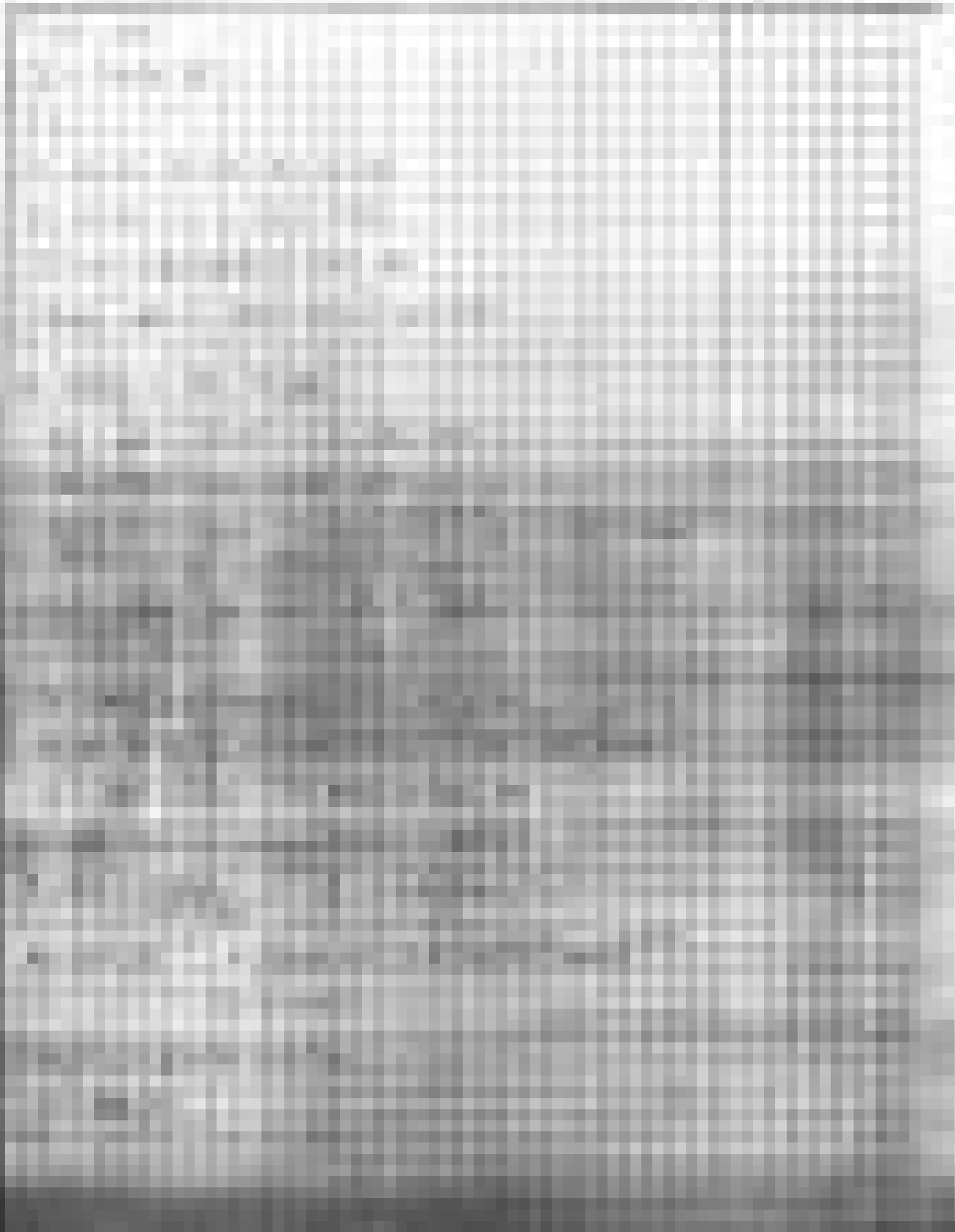
Try full load on piles - Reese & Matlock

$P = P_T/n = 2055/10$ $f = 7$ kPa/mm
$= 205.5$ kN

$T = (EI/f)^{0.2} = (23.5 \times 10^6 \times 3.22 \times 10^{-2} / 7 \times 10^3)^{0.2}$
$= 2.551$

$L/T = 7/2.551 = 2.74$

z = depth/T.



SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. 1868 PAGE F/12.

JOB BY WJM

DATE 8/10/86

Depth	z	Fd'	Fm'	εp (mm)	Mp (kNm)
0	0	1.05	−0.95	4.7	−498
1	.39	1.00	−0.57	4.5	−299
2	.78	0.80	−0.22	〃	−115
3	1.18	0.65	−0.07	〃	−37
4	1.57	0.38	0.06		31
5	1.96	0.22	0.08	OK	42
6	2.35	0	0.04		21
7	2.74	−0.15	−0.02		−10

$$\delta_p = F_d' \left(\frac{PT^3}{EI}\right) = F_d' \left(\frac{205.5 \times 2.551^3}{23.5\times10^6 \times 3.22\times10^{-2}}\right) = 4.508\times10^{-3} F_d' \text{ (m)}$$

$$= 4.508\ F_d' \text{ (mm)}$$

$$M_p = F_m' (PT) = F_m' (205.5 \times 2.551) = 524.23\ F_m'$$

$M_u/f_c' D^3 = 498\times10^6 / .9\times25\times900^3 = .030$

From P_i ave = 0 (conservative) $\Rightarrow \rho_{tm} = .10 \quad \rho_t = .0056$

$A_g = .636\times10^6\ mm^2$

$\rho_{t\,min} = 2200 / f_y\sqrt{2A_g} = .0051$

$A_s = .0056\ A_g = 3562\ mm^2$

$\Rightarrow$ 12HD20 OK

Shear $V_u = 205.5$ kN

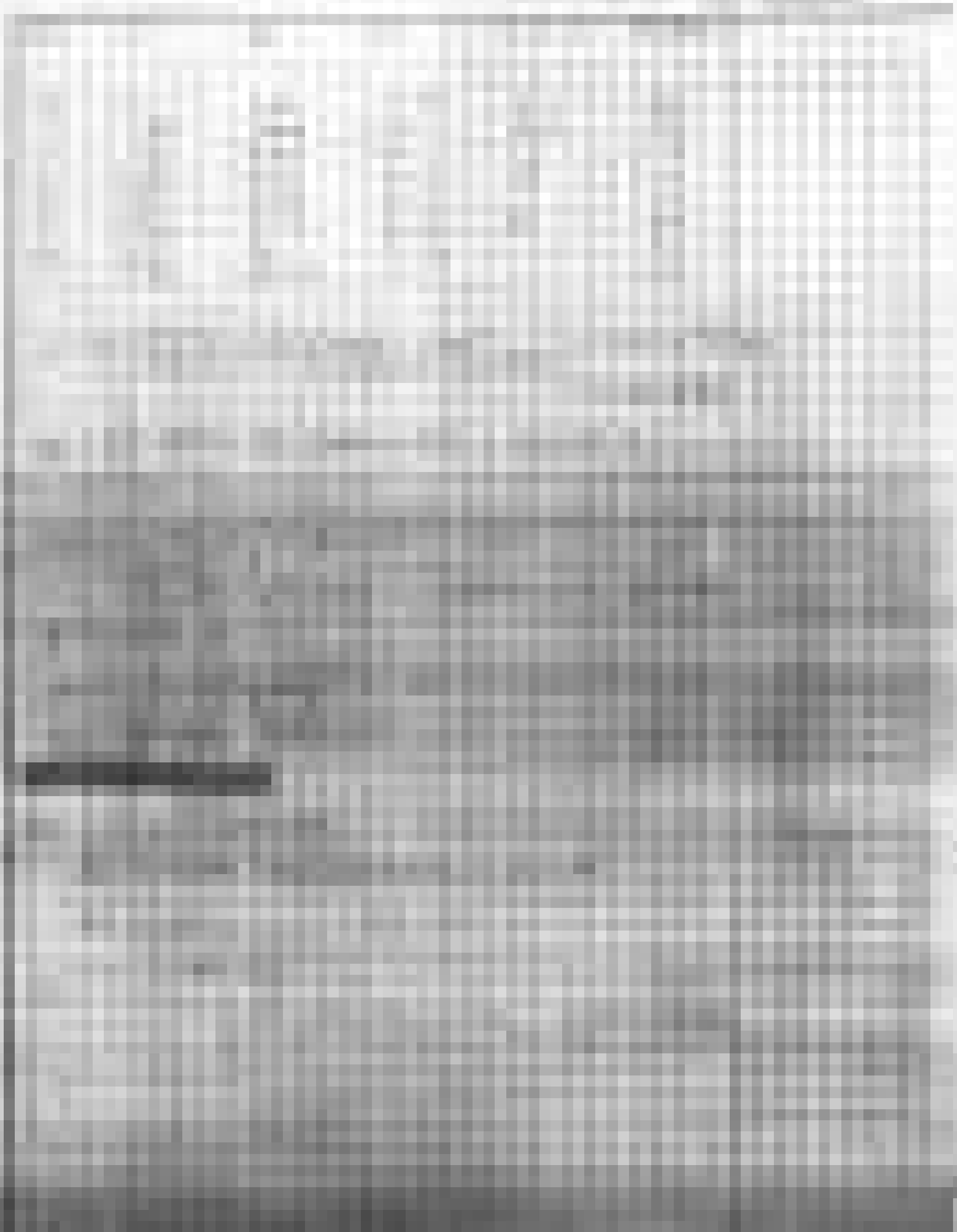
$v_i = 205\,500 / .85\times600\times600 = .67$ MPa

$v_c = .61 \qquad v_s = .06$

$A_v\,min = .35\,b_w\,s / f_y$

$s_{max} = 157\times320 / .35\times600 = 239 \Rightarrow$ HP D(a) 250 spiral

min.



SMITH LEUCHARS LTD
CIVIL & STRUCTURAL ENGINEERS

JOB No. 1868 PAGE F/13.

JOB BY WJM

DATE 9/10/86

Transverse Reo ϕ12 @ 52 = 654.3

Minimum ϕ reo = 900/5 = 180

6 x 2 = 120

200

ϕ reo = 900

$0.45\left(\frac{A_g}{A_c} - 1\right) = 0.45\left(\frac{\pi \times 450^2}{\pi \times 385^2} - 1\right) = 0.165$

$\rho_s = 0.165 \frac{f'_c}{f_{yh}}\left(0.5 + \frac{0.25\ P_e}{\phi f'_c A_g}\right)$ $P_e = 3711 \times \frac{9.3}{9} = 3847.1$

$= 0.165 \times \frac{25}{380}\left(0.5 + \frac{1.25 \times 3847 \times 10^3}{0.7 \times 25 \times \pi \times 450^2}\right) = 0.0091$

$\rho_s = \frac{A_f \pi d_s}{s_h \pi d_s^2/4} = \frac{4 A_f}{s_h d_s}$

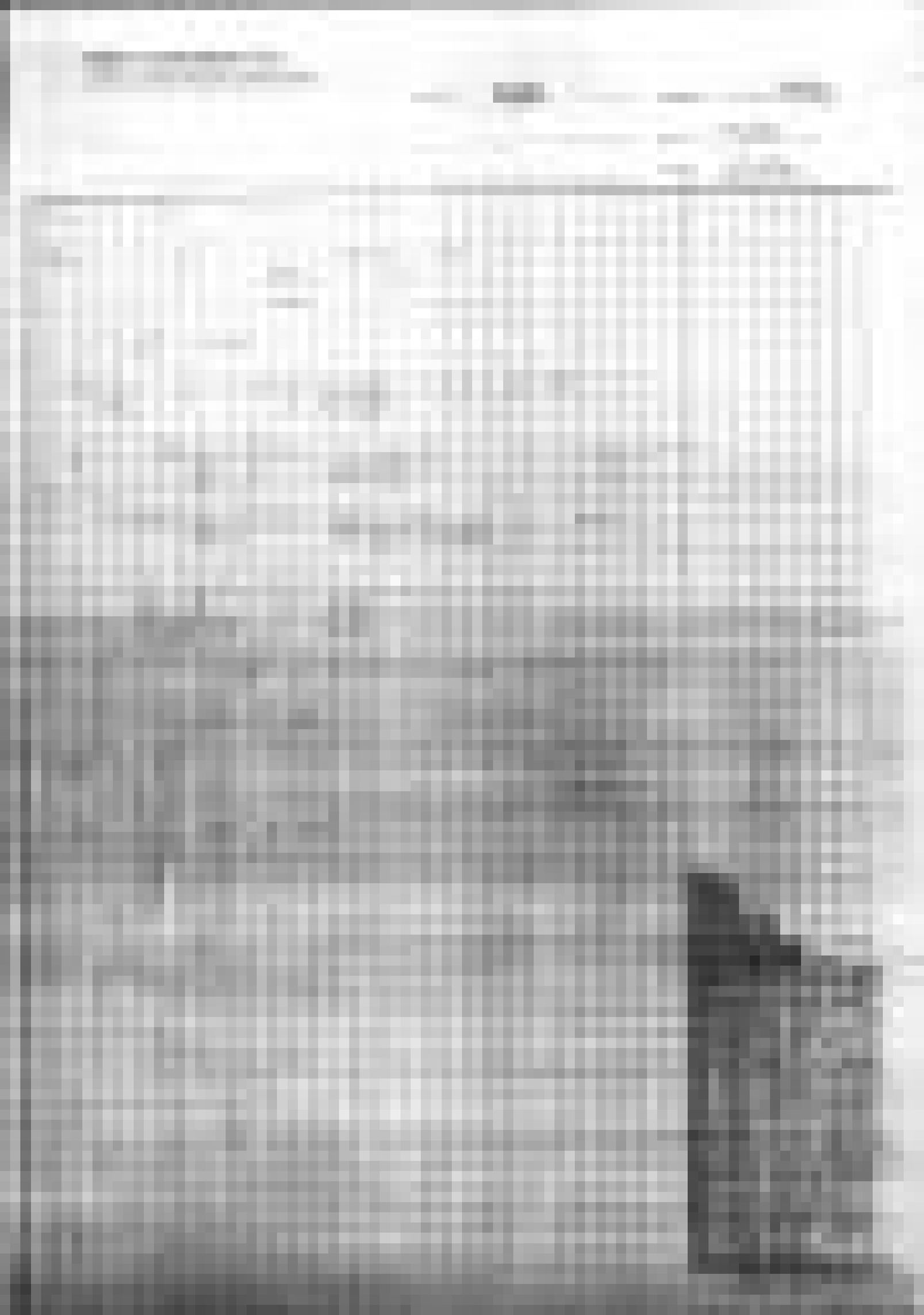
$\therefore$ HR12 $0.009 = 4 \times 113/s_h \times 770$

$s_h = 65$ $\Rightarrow$ HR12 @ 60

$1.5 d_c$ = HH reo $0.5 \rho_s$ $\Rightarrow$ use @ 120 for 2700 (3 pile ϕ's)

From HR12 @ 300.

Piles
900 ϕ
25 MPa
12-H0250.
Spec. Hall (Cn 1.5c)
piles 1800 ϕ bell
Middle pile on west frame - no bell
remainder 1500 ϕ bell
HR12 @ 60 for 900 from beam face
HR12 @ 120 for next 2700
HR12 @ 300 rem.

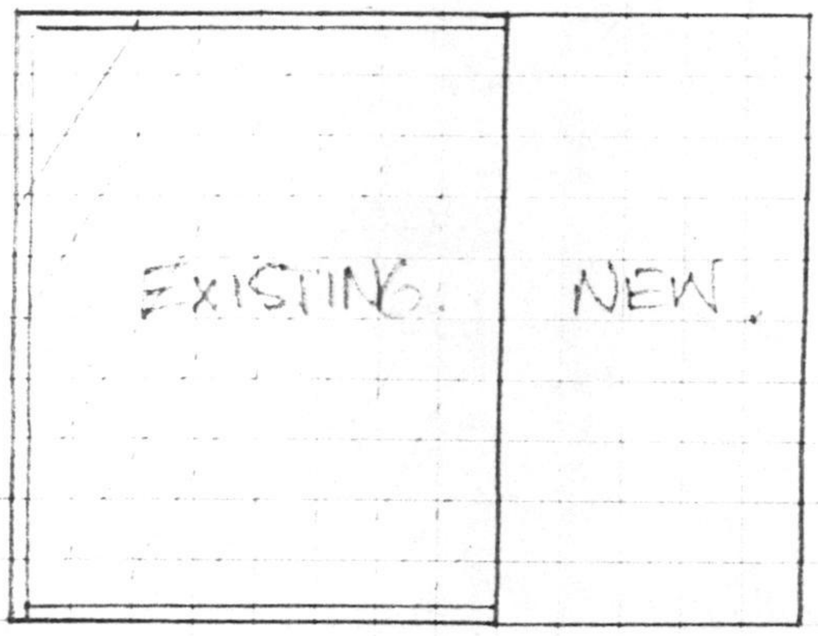


SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

1868.

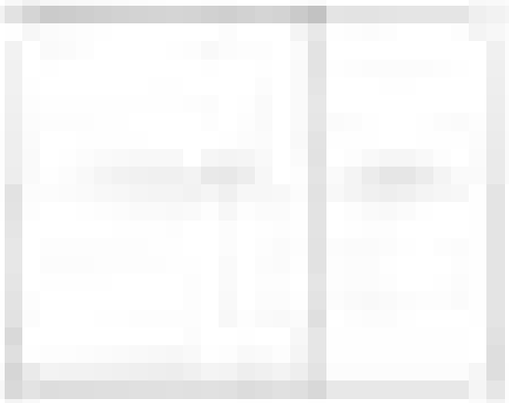
P/O
M/O
8/86

Strengthening of Existing Blg.



Design Philosophy

1. Strengthen to 2/3 P165
2. Tie existing to new for overall earthquake loads by diagonal steel bracing.
3. Strengthen all existing brick walls & parapets for face loading with structural steel members dowelled to brickwork. Centres determined by brick strength spanning horizontally.
4. Carry floor level reactions to diagonal bracing by a combination of diaphragm action and steel trimming members. (which will also carry existing floor joists should brick walls fail)



SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No 1868 — 2/1

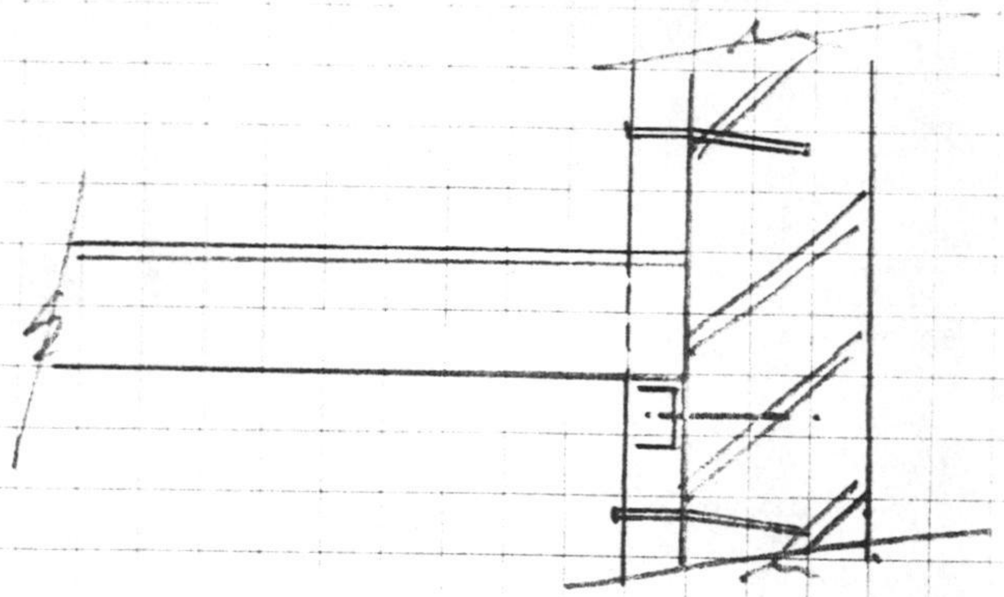
WWWC & LI — MJO. 8/86.

Strengthening Scheme.

Existing Walls.

Design Assumptions.

Design to support wall from loads
+ Floor gravity.



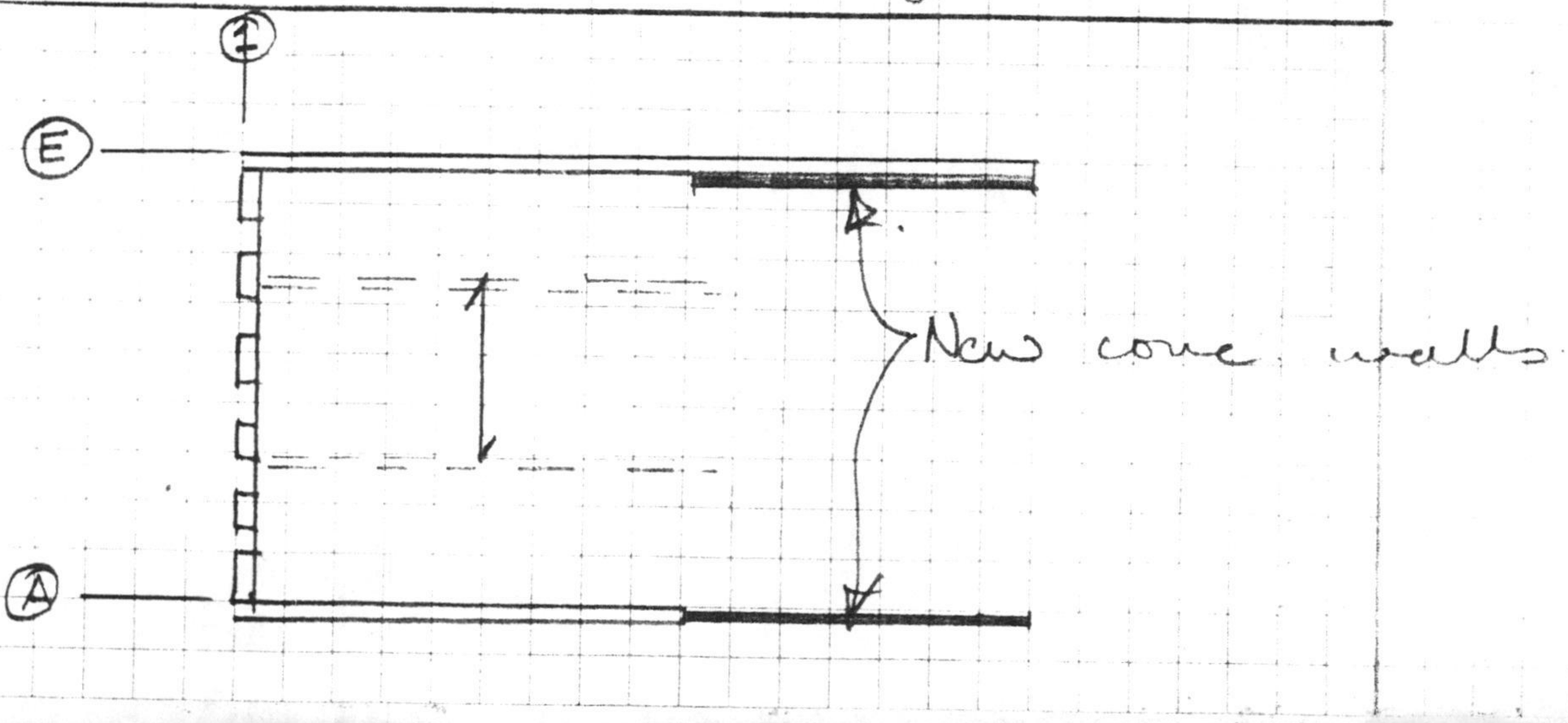
Face loading: $\frac{2}{3} \times 1965$

Treat as veneer: Veneer = $\frac{2}{3} \times 6 \times .12 = .48$

connections = $\frac{2}{3} \times 2 \times = .96$

NZS 4203 $C_p = 2.0$.

Use $C_p = 0.48$. for walls.
& $C_p = 1.0$ for connections.



Wall Grid (A) & (E).

Floor span = 4.5m

2 → C = 240 brick
C → 2 = 360 "
2 → G = 480 "

Brick Strength spanning horizontally.

Allowable Tension = say 2×10 = 20psi (= 136 KPa).

$$M = \frac{WL^2}{10.} \text{ say}$$

$W = t \times 22 \times .48. = 10.6t$ KN/m/m.

$f_{bt} = \frac{M}{S}$. $Z = \frac{1 \times t^2}{6} = \frac{t^2}{6}$ m³/m.

$$136 = \frac{10.6 \times t \times L^2 \times 6}{10 \times t^2}$$

$$\therefore L = 4.62t \text{ m.}$$

240 wall : Max Brick span = 2.27m.
360 " " " " = 2.77m
480 " " " " = 3.2m.

Use 3.0 steel c/c for 360 & 480 walls.
& 2.3 " " " 240 walls.

$10.6 \times .24 \times 2.3 \times 1.2$ — continuity = 7 KN/m.
$10.6 \times .48 \times 3.0 \times 1.2$ = 18.3 KN/m.

Steel: Assume steel fully laterally supported.

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

1868.

P/3

M.D.
8/86.

Floor/Floor.	span	loads. axial	face	Calc.	size.
Roof → 2nd C	2400.	10 KN	5 KNm.	$\frac{5}{1.33 \times 165} = 23 cm^3$	102 x 51 ⊏
2nd C → G.	5000 max.	10 + $2 \times 2 \times \frac{4.5}{2} \times 3$ = 37	57 KNm.	$\frac{57}{.2} = 286 cm^3$	200 UB 30.

$f_{ac} = \frac{37000}{3600} = 10 MPa.$

$\delta = \frac{5 \times 5000^4 \times 18.3}{384 \times 210E5 \times 29.95G.}$

$= 24 mm \ (= 005L)$

will refine for $\frac{5}{384}$ smaller spans & wall t^3 later.

Floor Support. (if wall collapses).

Span = 3m.

load $\simeq (.5 + 1.5) \times \frac{4.5}{2} = 4.5 KN/m.$

M = 5 KNm.

$\frac{5}{.165} = 31 cm^3$

102 x 51 ⊏ OK. 102 x 51 ⊏.

Ground → 1st Partitions

Span = 4.267.

240 mm brick 127 x 64 ⊏.

Support at say 2.3. m ↔.

M = $7 \times \frac{4.2.7^2}{8}$ = 16 KNm.

Axial = 15 KN.

$\frac{16}{1.33 \cdot 165} = 73 cm^3$ 127 x 64 ⊏.

Refuse Destruct for Tradie Sidewalk.

Roof → 2nd Ceiling:

Span = 2.0m.
W = 7 KN/m
M = $\frac{2^2}{8} \times 7$ = 3.5 KNm.

$\frac{3.5}{.2}$ = 17.5 cm²

Use 102×51 MSC (E). (or 70×70×3.6 RHS).
2.3m cts.

Second Floor:

Span = 3.3m
W = 18.3 × $\frac{.36}{.48}$ = 13.7 KN/m
M = 18.7 KNm.
Z = $\frac{18.7}{.2}$ = 93 cm³

Use 120×80×8 RHS. - 3000 cts.

First Floor.

Span = 3.6m.
W = 18.3 KN/m
M = 29.6 KNm.

Z = 148 cm³.

Use 200×100×5.0 RHS. - 3000 cts.

Ground Floor.

480 wall. M = 18.3 × $\frac{4.2^2}{8}$ = 40.3
Z = 201 cm³

Use 200×100×8 RHS. 2000 cts.

240 wall. M = 16 KNm
Z = 73 cm³

Use 100×100×6.3 RHS.

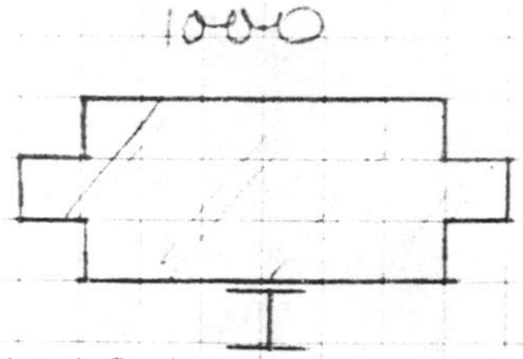
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB NO 1868 SHEET NO P/4

BY MJC DATE

Wall Lyrid (1).

Large Piers.



Max spacing = 1000.

$W = 1.0 \times .65 \times 22 \times .48 = 6.86$ KN/m.

$M = 6.86 \times \frac{4^2}{8} = 13.7$ KNm.

$\frac{13.7}{.2} = 68.5 cm^3$.

152 x 76 [. ($Z = 112 cm^3$) 152x76 [

$\delta = 12.8mm = .0032 L$ ∴ OK. or 100x100x6.3 RHS

Small piers.

500 x 650

$M = \frac{13.7}{2} = 6.9$ KNm.

$\frac{6.9}{.18} = 38 cm^3$

102 x 51 [. or 102x51 [or 90x90x3.6 RHS

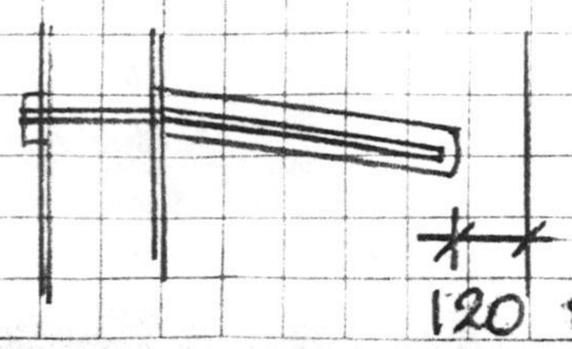
Connections.

From previous testing use max. all. load = 15 KN. (D12 dowels)

Max loading = 8.3 KN/m.

∴ Use D12 (M12) dowels.

@ Say 600 c/s max.



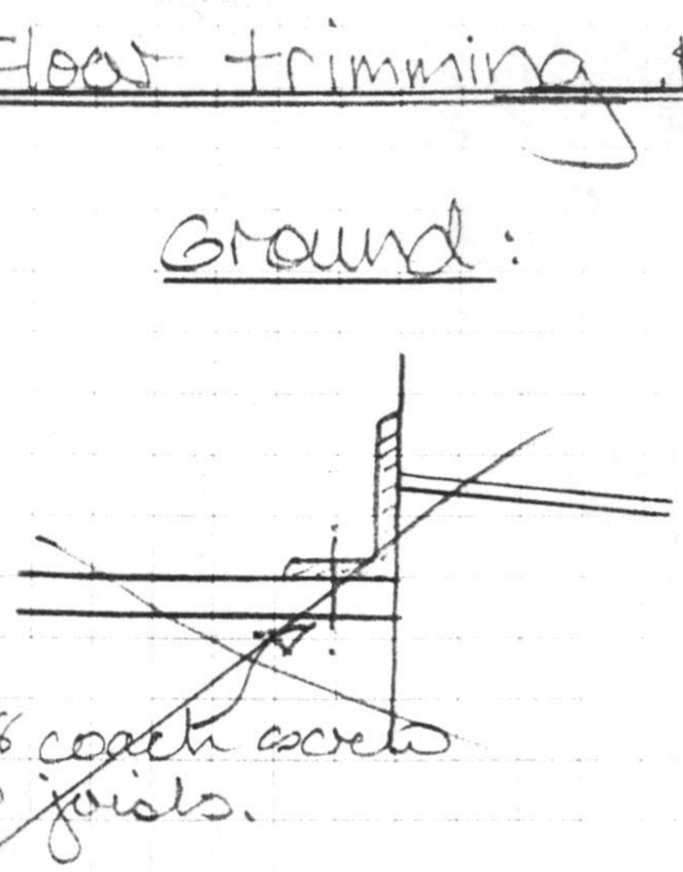
SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

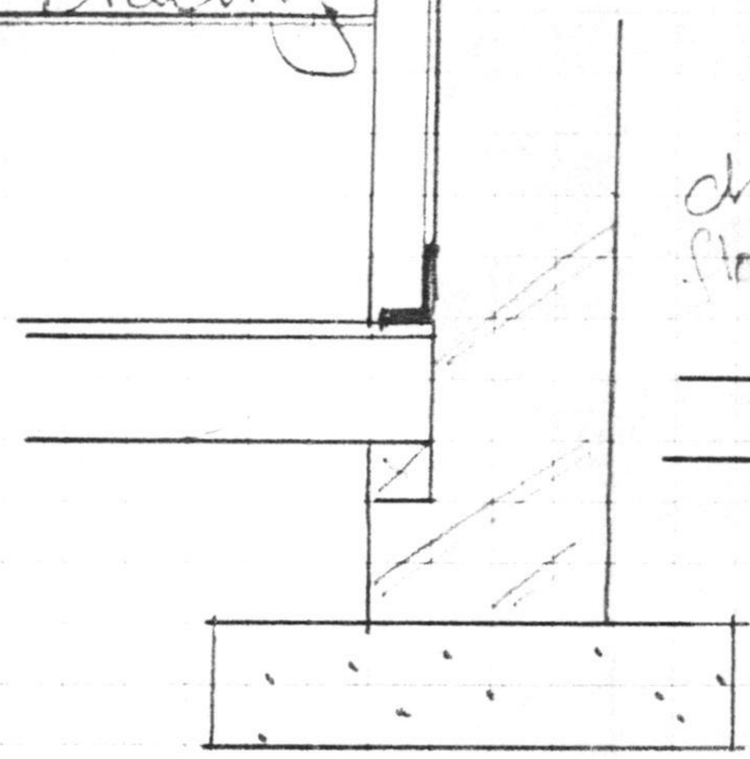
1868 .

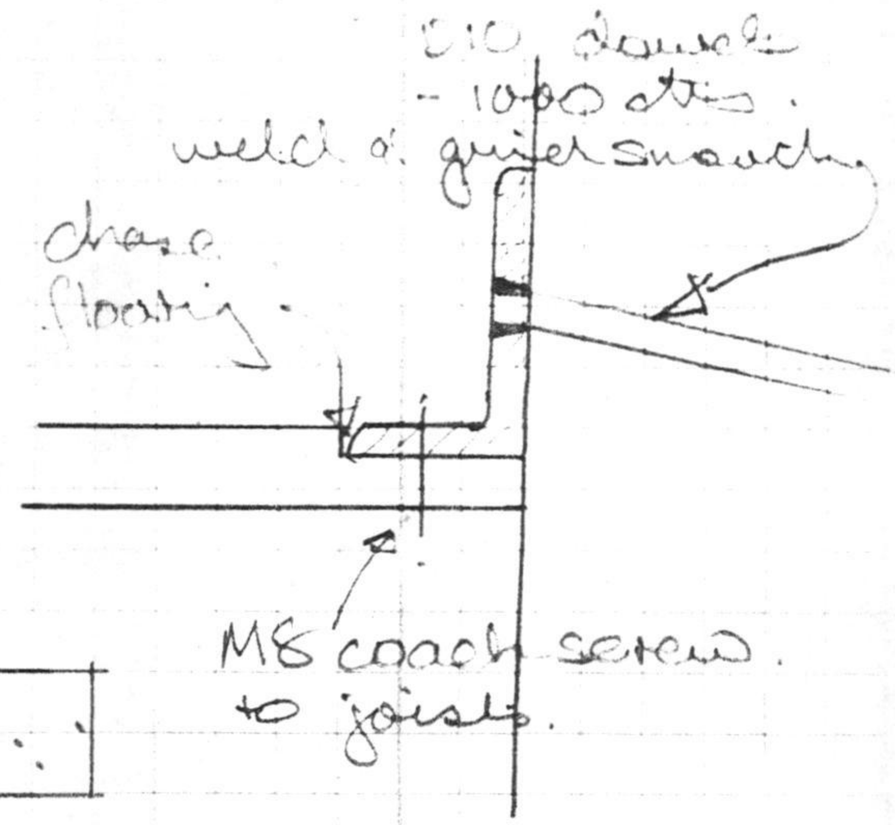
P/5
MXO.
10/86.

Floor trimming & Bracing

Ground:

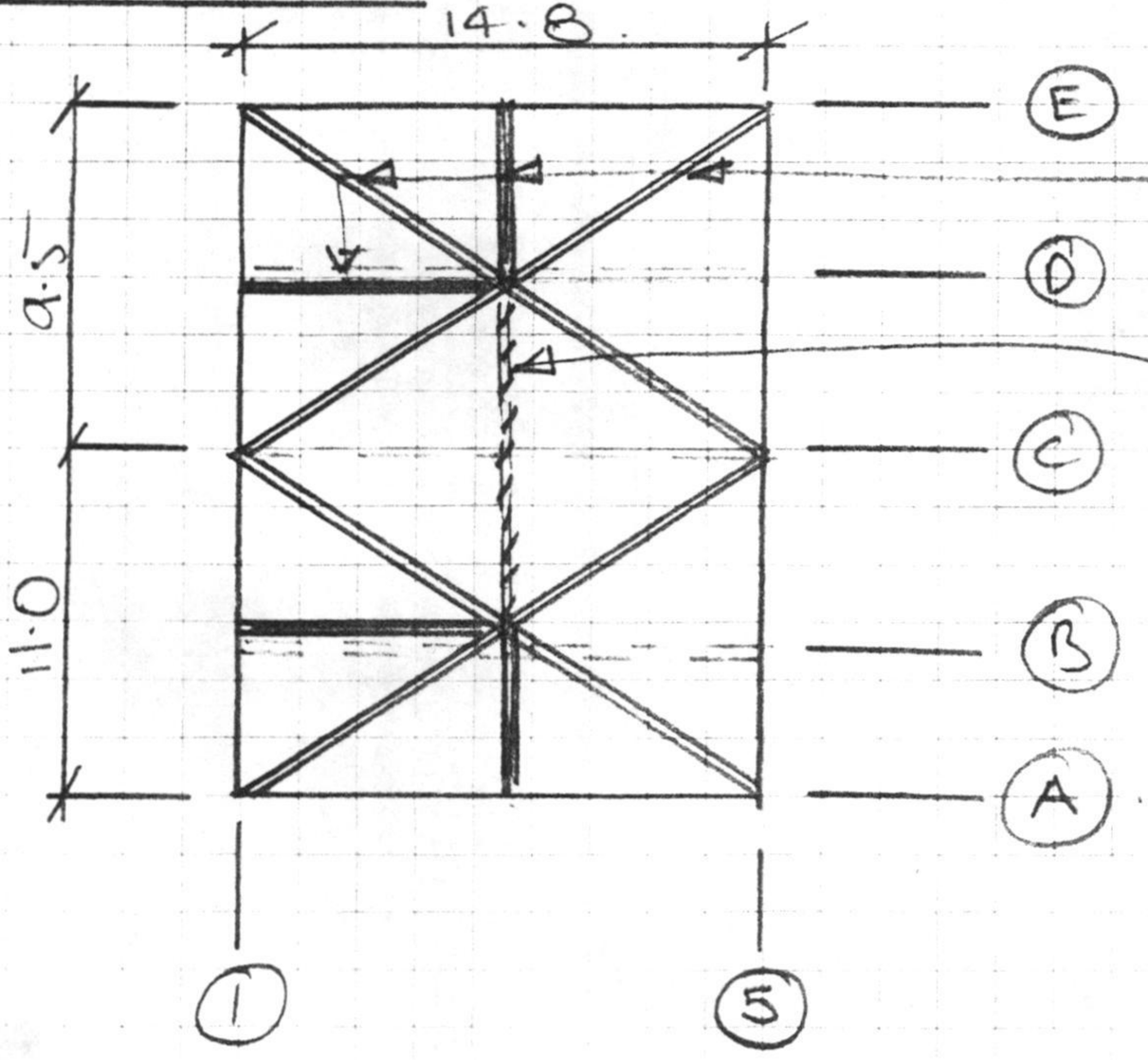


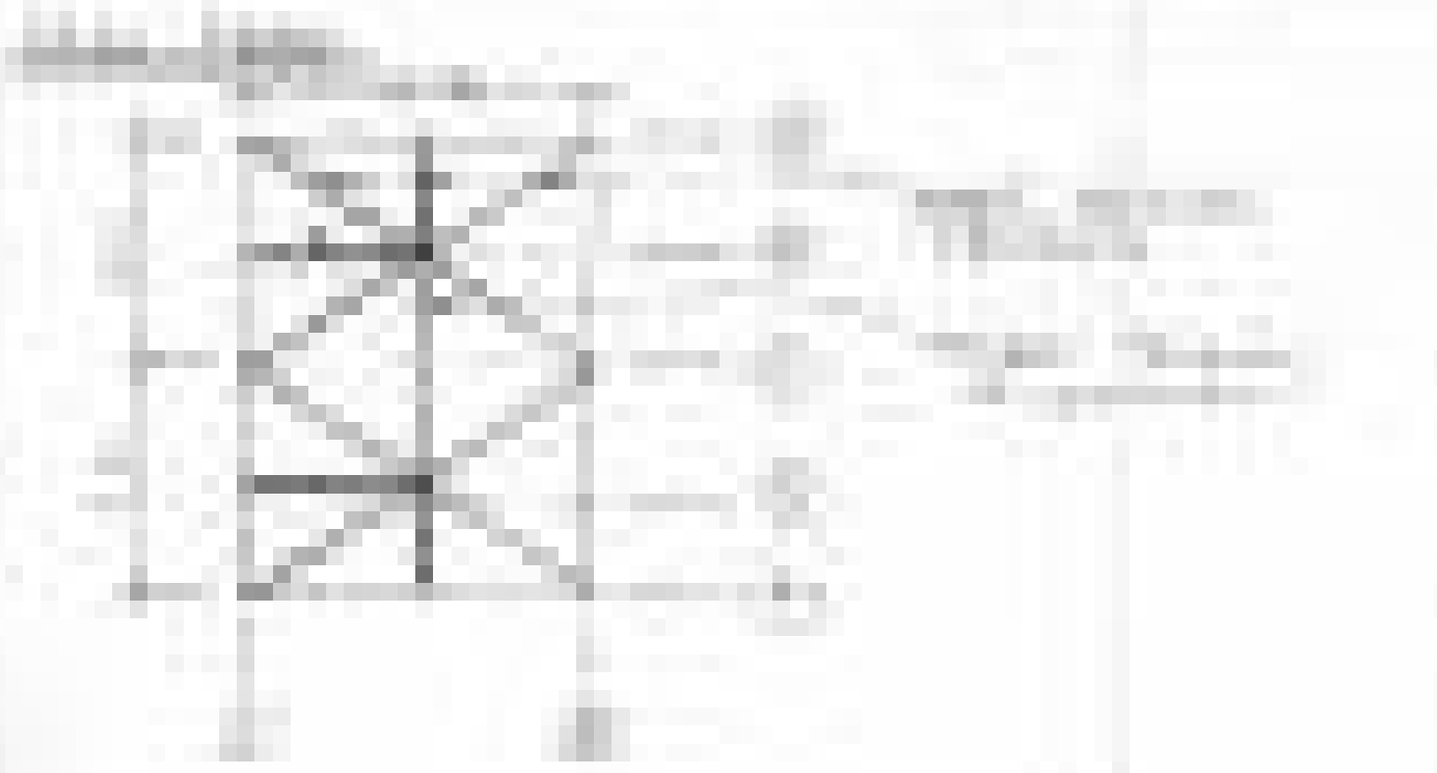




Spread load to floor & foundation brickwork by 102 x 76 x 6.5 angle. welded to vertical ~~members~~. members.

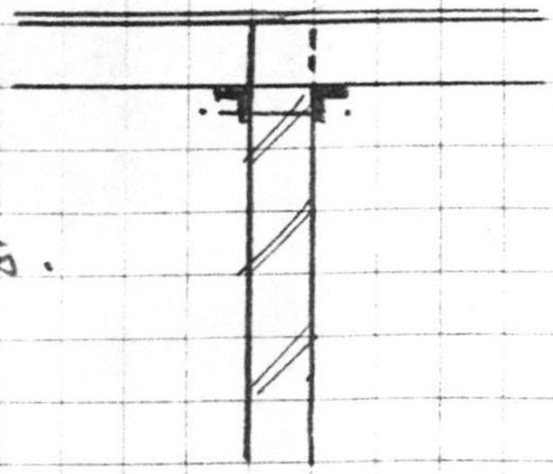
First Floor.





Floor Trim

Walls B, C & O.



Connect walls & vertical steel to central floor joists. which transfer load to diagonal bracing.

Use angles each side - composite action.

So Span = $\frac{14.8}{2}$ = 7.4m.

Load = $7 \times \frac{4.7}{2} \times \frac{1}{2.3}$ = 7.15 KN/m.

M = $7.15 \times \frac{2.4^2}{8}$ = 49 KNm.

T = C = $\frac{49}{.25}$ = 196 KN.

At. $f_T = F_c$ = 150 MPa.

Use 80×80×8 L.

End reaction = $7.15 \times \frac{2.4}{2}$ = 26 KN.

Horizontal shear = $\frac{26}{.25}$ = 104 N/mm

Too high.

∴ ~~Screw~~ Trim tops of RHS sections with ~~150~~ 80×80×8 L and use diaphragm action to transfer load to central floor joists.

Check. Joist load: = 26KN × 3 = 78 KN.

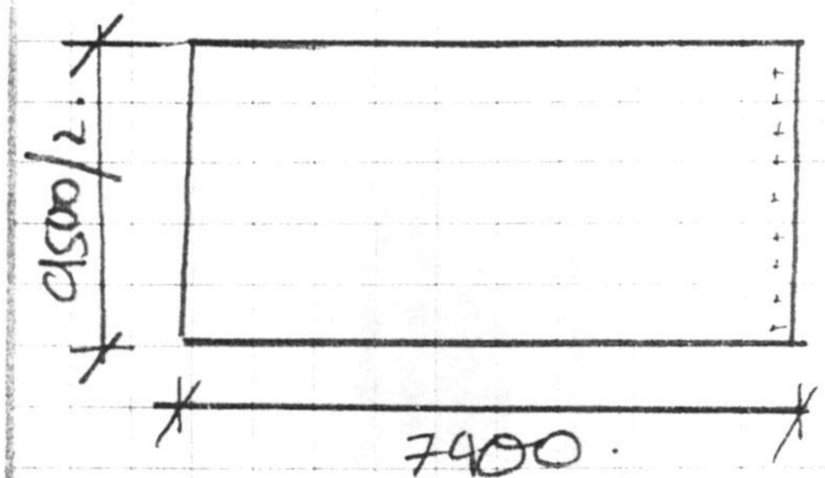
350×57 joists : $f_{ac} = \frac{78}{.35 \times 57}$ = 3.91 MPa. ∴ OK.

1868. P/7
M/O.
10/85.

Walls. (A) & (E) Similar. except use of basic wall
As is wall (1).

Diaphragm & fixing

20mm Particle board.



~~Max Shear~~ =

Load = $\frac{3.3+3.6}{2} \times 15.3/3 = 21$ KN/m $\times \frac{4}{48}$

$21 \times \frac{2.4}{2} = 78$ KN.

$\frac{78000}{9500 \times 20} \times 2 = .82$ MPa.

$\frac{78}{9.5} \times 2 = 16$ KN/m.

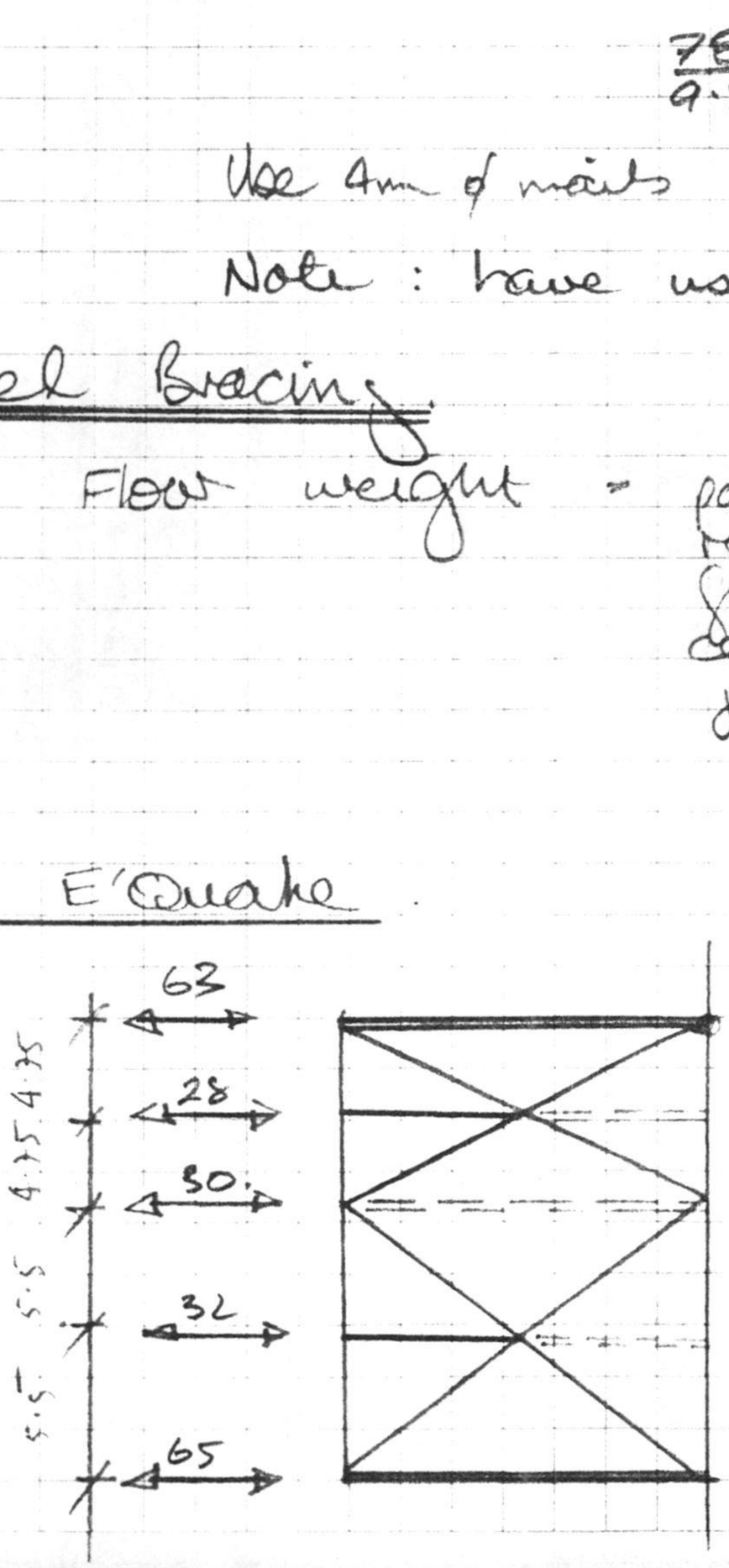
Use 4mm ø nails @ $\frac{.98}{16} = 60$mm centres.

Note: have used $K_x = 4.8$.

Steel Bracing.

Floor weight - particle board = .116
roc board = .10
flooring = .18
ceiling = .29
joists = .24
.90 KPa.

E-W E'Quake.



$F_S = C . K_x . W_S$

$K_x = \frac{\int_x}{C W_{3x}}$

$= \frac{2.34}{.1 \times 40.98} < 1.$

Use C = ~~.4~~ .01
K = 1.0.

1868. P/8

1140.
9
10/86

Wall (E) + (A) load = 491 × .1 = 49.2 KN.

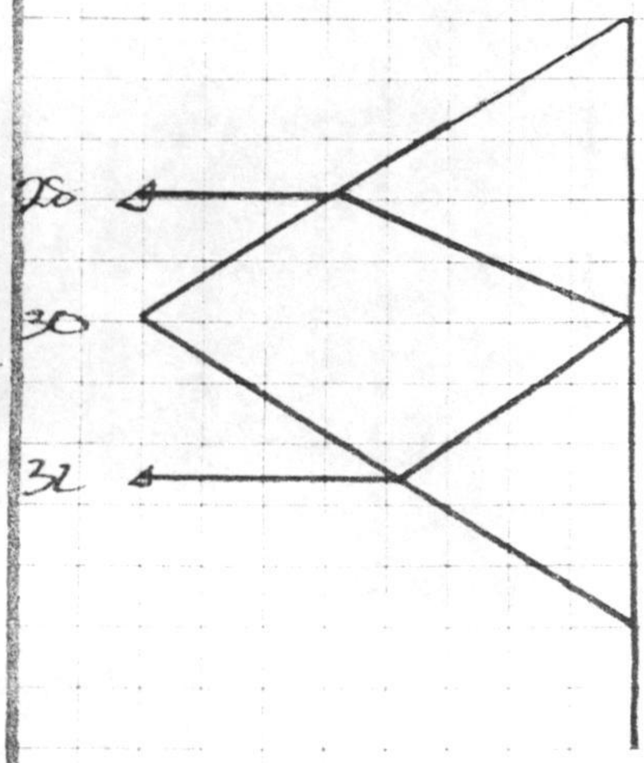
UDL = (290 + 470 + 161 + 322) × .1 / 21.5 = 5.8 KN/m.

49.2 + 5.8 × 9.5/4 = 63 KN
49.2 + 5.8 × 11/4 = 65 "
5.8 × 4.75 = 28 "
5.8 × 5.5 = 32 "
5.8 × (5.5+9.75)/2 = 30 "

Line (F) + (A) ties : Have provided
102 × 51 ⊏ : Tall = 1330 × .2 = 266 KN.

Lines (B) (C) + (D) Compression
Max C = 32 KN.
@ Fac = 1.5 × 7.1 = 10.65 MPa
need 3004 mm²
Use 150 × 50 timber blocking.

Bracing.



Max Tie force
< (32 + 30/2) × √(5.5² + 7.4²)/7.4 (9.22)
= 58 KN.
∴ need 58/.2 = 292 mm² steel
6 30 × 10 R
or 60 × 5 R.

Max reactions

Line.	←	↖ or ↙
A	65	39
C		20 + 20.
E	63	39

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

1868

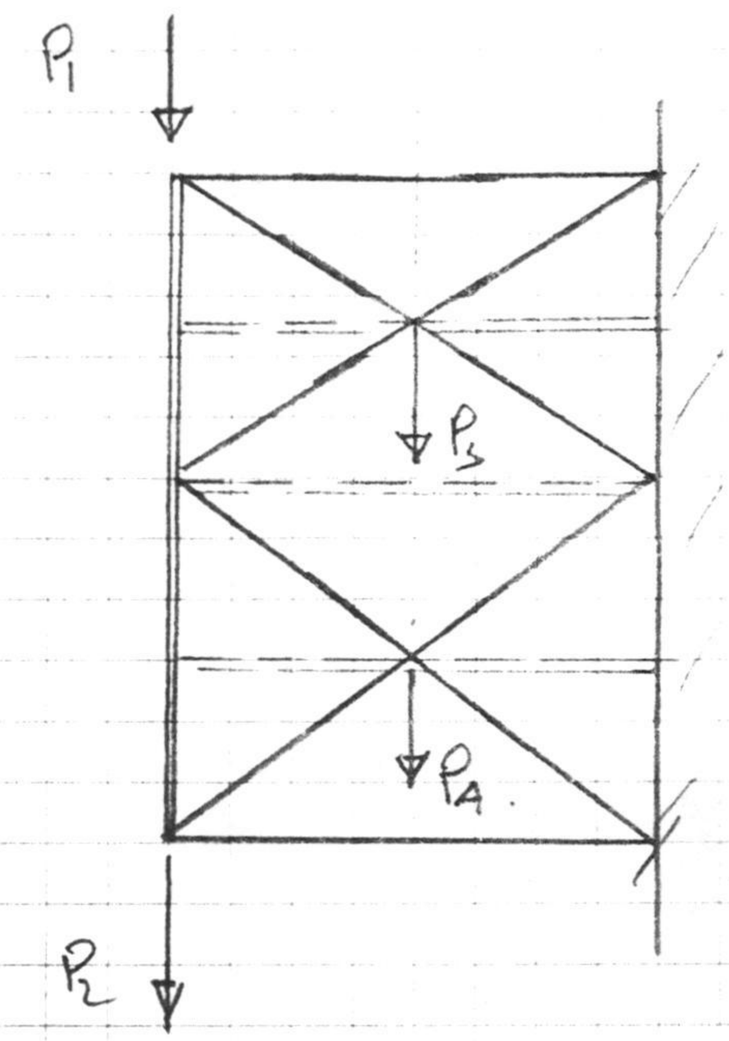
P/9

M/O.

10/86.

North South E'Quake

North use 2nd floor E'Quake load to maximum design.

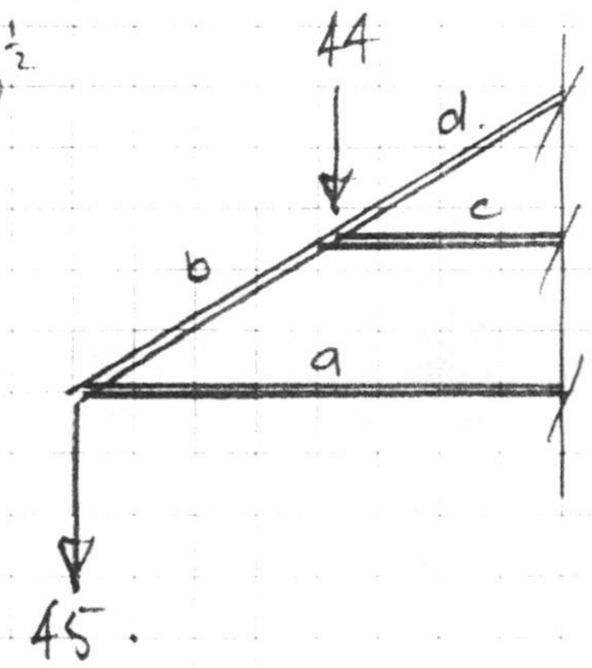


$P_1 = P_2$ = wall ① $\frac{470}{2} \times .1$ = 23.5
+ walls Ⓐ & Ⓔ $\frac{492}{4} \times .1$ = 12.3
+ floor $\frac{(322+161+290)}{14.8} \times \frac{14.8}{4} \times \frac{.1}{2}$ = 9.7

∠ = 45KN.

$P_2 = P_3$ = Walls Ⓐ & Ⓔ 12.3×2 = 24.6
floor 9.7×2 = 19.4
44.0 KN.

$(4.75^2 + 7.4^2)^{\frac{1}{2}}$
= 8.79.



Member.	Force. C	Force. T
a	70	
b		83
c	69	
d.		165

$T = 83\,kN \quad A = \frac{83}{.2} = 415\,mm^2$: 50×10 PL

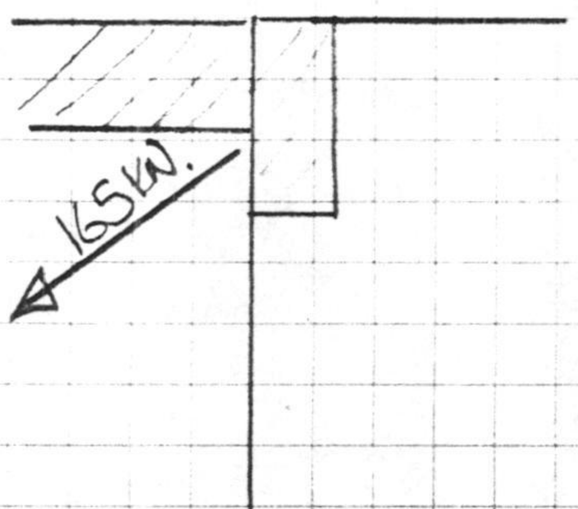
$T = 165\,kN$: 100×10 PL

$C = 70\,kN.$

$F_{ac} = 10.69\,MPa \quad \therefore A = 6572$

Use 150×100 blocking.

Reactions



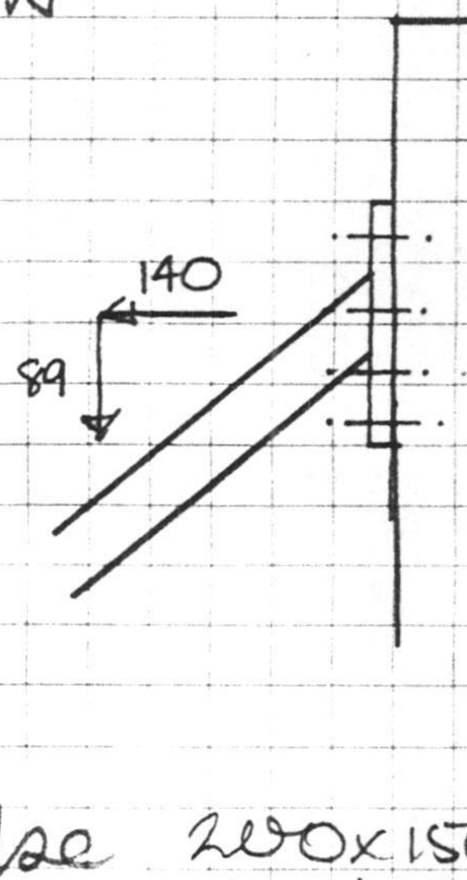
Welding.

Using 8mm FW

need $\frac{165}{.77}$

$= 214mm$ weld.

∴ Butt weld end Plate.



Say have ~~8~~ bolts.

6 - M20. bolts.

$F_V = 16 \times 1.2 = 21.6\,kN.$

$F_T = 35 \times 1.33 = 47$

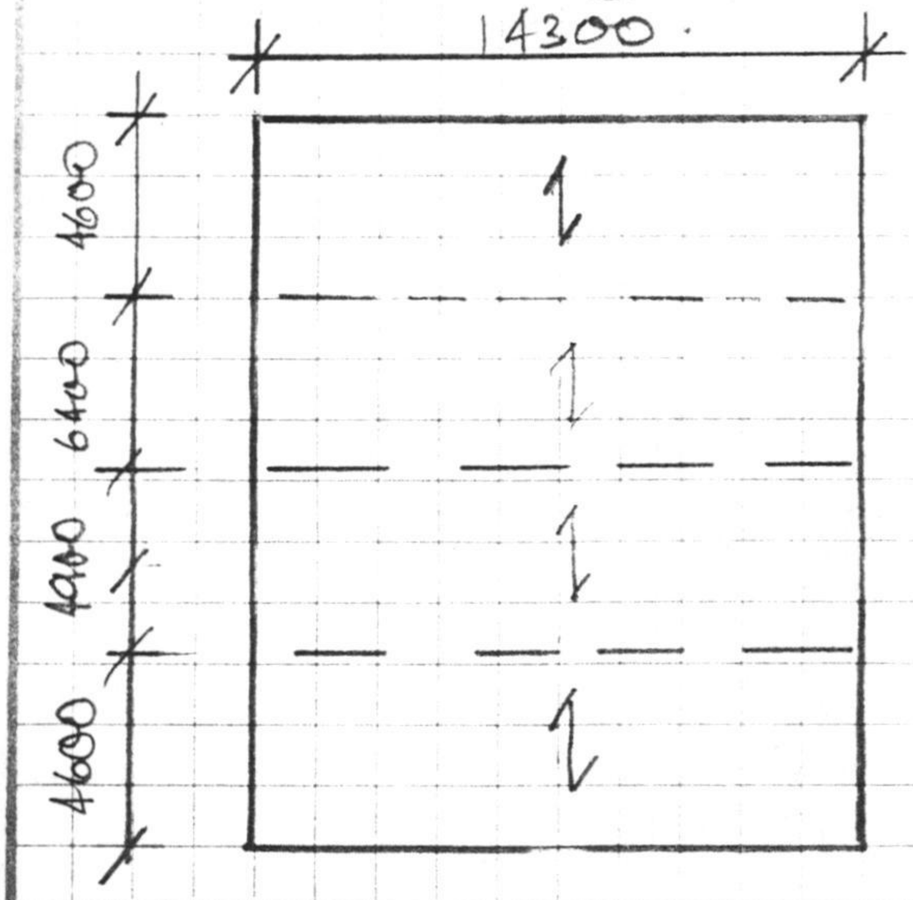
$\left(\left(\frac{89}{6 \times 21.6}\right)^2 + \left(\frac{140}{6 \times 47}\right)^2\right)^{\frac{1}{2}} = .847$

∴ OK.

Use $200 \times 150 \times 10$ PL.
6 - M20 Bolts.

Second Floor Strengthening

Replacement of Support Columns.



Dead: Particle Board = .14 KPa
Rockwool = .13
floors .037 × 5 = .19
joists .35 × .057 × 5/.45 = .27
ceiling 2 × .13 = .26
Σ = .98 KPa.

Live: = 3.0 KPa

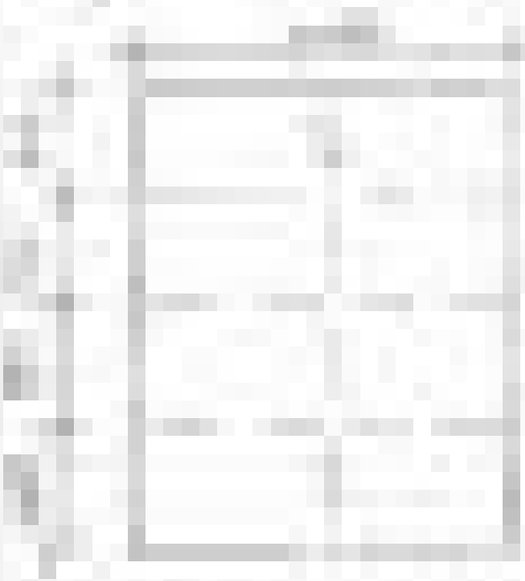
Consider using a pair of beams:

Max. W = 3.98 × $\left(\frac{6.4+4.9}{2}\right)$ + 2×1 = 24.5 KN/m.

(Σ load = 350 KN).

Try 2 × 530UB92's

Z = 2080 × 2 cm³
I = 554 E6 mm⁴ × 2
$\frac{My}{D/T}$ = 45.1
= 34.1



Laterally restrain @ 2920 mm crs.

$M = 24.5 \times \frac{14.3^2}{8} = 626$ KNm.

$f_{bc} = \frac{626}{2 \times .2080} = 150$ MPa.

$\delta_{live} = \frac{5 \times 3 \times 5.65 \times 14300^4}{384 \times 2.1E5 \times 2 \times 554 E6}$

$= 39.7$ mm $= .0028L$ $\left(\frac{L}{360}\right)$.

$\delta_{D+L} = .0028 \times \frac{24.5}{3 \times 5.65} = .004L$ $\left(\frac{L}{250}\right)$.

If restrict δ_{live} to 25 mm.

Requir $I = \frac{3 \times 5.65 \times 14.3^3}{2 \times .337} \times \frac{572}{500}$

$= 841$ cm E6 mm^4

610 UB 113.

Use 610 UB 125. $\delta_{live} = \frac{841}{985} \times 25 = 21.3$ mm.

$\times \frac{5.5}{5.65} = 20.8$ mm.

100 mm long by 20 thick flange PL.

Direct Bearing $= 126 + 2.26 \times 100 + 20 \times 3.92$

$= 126 + 226 + 78 = 430$ KN.

Consider removing ~~replacing~~ East col. of middle row.

span $= 7.0$ m.

load $= \frac{24.5 \times 7}{3 \times 5.65 \times 7} = 172$ KN. $(= 86$/beam$)$.

310 UB 46.

$f_{bc} = \frac{150}{.648 \times 2} = 116$ MPa.

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No 1868. PAGE P/13

JOB BY MJO

DATE 10/86.

$$\delta_{live} = \frac{5 \times 3 \times 5.65 \times 7000^4}{384 \times 2.1E6 \times 2 \times 99.5E6}$$

$$= 12.7\,mm \quad (= .00181L) \quad \left(\frac{L}{510}\right)$$

SMITH LEUCHARS LTD
CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No. 1868. PAGE P/14

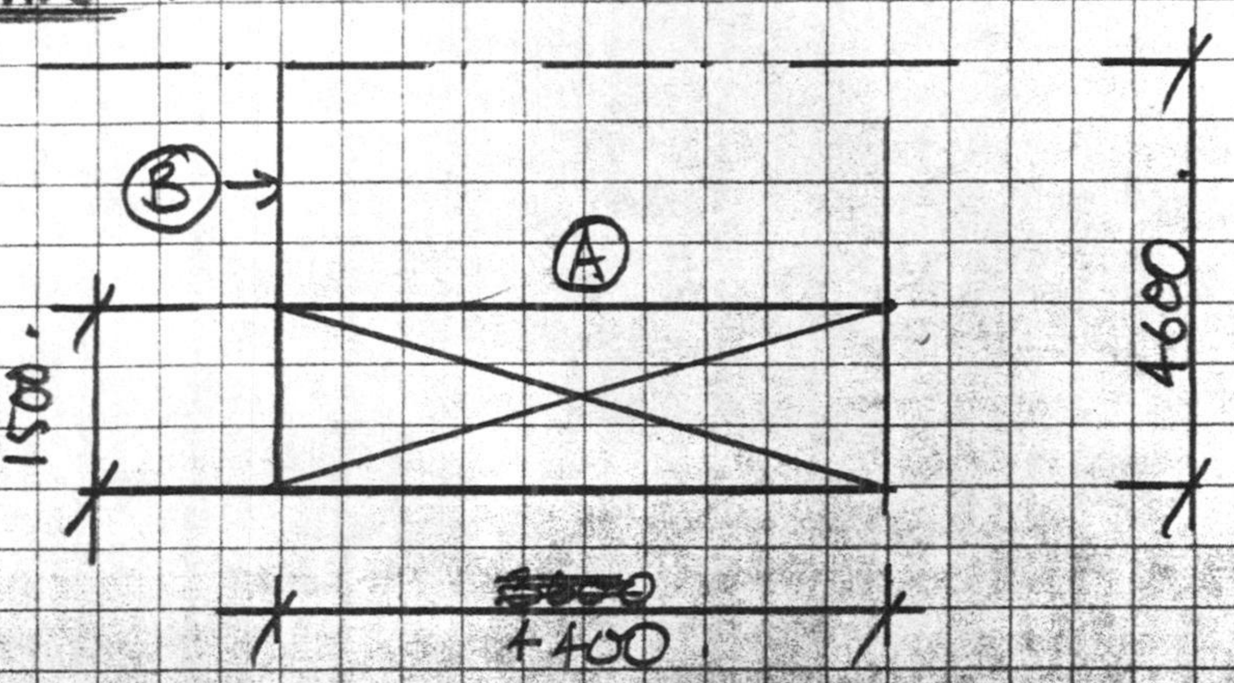
JOB _____ BY MJO.

DATE 10/86.

2nd Floor Bracing

Identical to 1st Floor but check realignment for stair opening.

Stair Trim.



Trim Beam (A):

Dead: Floor $1 \times \frac{3.1}{2}$ = 1.6 kN/m
Partition $.5 \times 3.5$ = 1.75
3.35 kN/m

Live $3.0 \times \frac{3.1}{2}$ = 4.65 kN/m.

Σ load = 7.915 kN/m.

M = 19.2 kNm.

Try 300×100 green gauged.

Z = 1354 cm³
I = 199.1E6 mm⁴
Fbc = 6×1.25 = 7.5 MPa.
E = 8000. MPa.

$f_{bc} = \frac{17.7}{1.354}$ = 13 MPa.

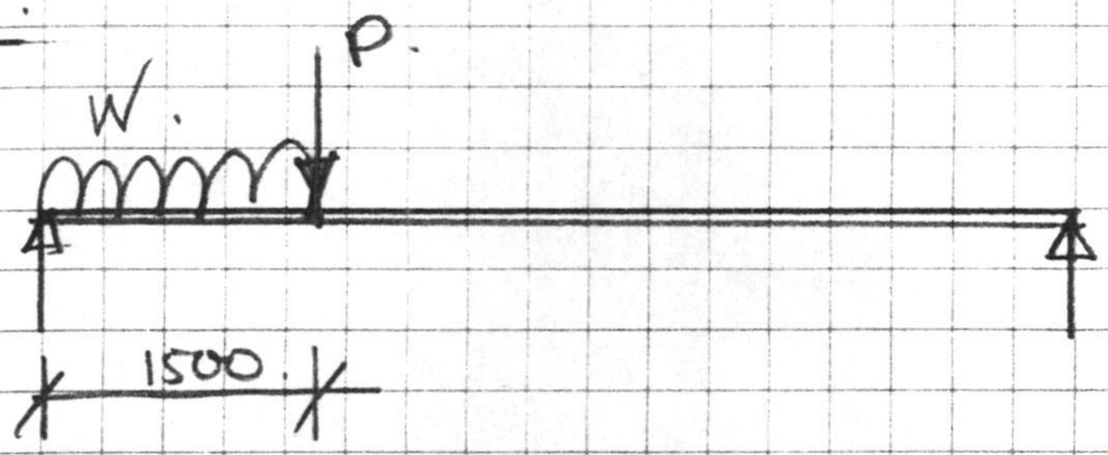
Try Steel. Fbc = 150 MPa.
Z = ~~116~~ cm³

178×76 MSC.

Live $\delta = \frac{5 \times 6.9 \times 3600^4}{384 \times 2.1E5 \times 13.6E6} = 5.4mm.$

$= .0015 L.$

Beam (B).



$P = \frac{7.95 \times \frac{4.4}{3.6}}{2} = \frac{17.5}{2} = 8.71\ KN$

$W = \text{Stairs}$

$= (1+3) \times \frac{5.7}{2} = \frac{11.4}{2} = 9.8\ KN/m.$

$R_L = \frac{(8.71 \times 3.1 + \frac{9.8 \times 1.5}{2} \times 3.85)}{4.6}$

$= 25.6\ KN. \quad 26\ KN$

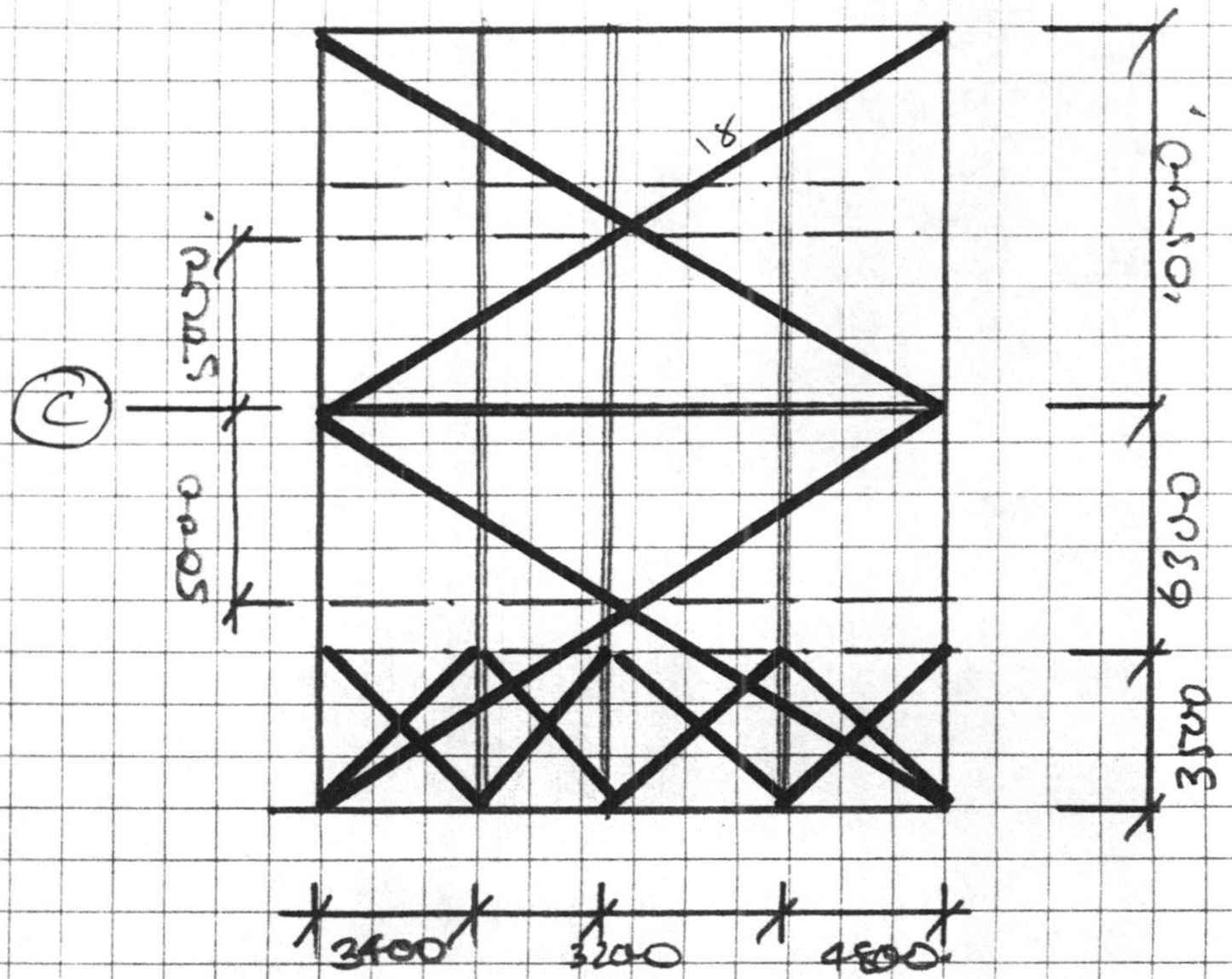
$\max M = (25.6 \times 1.5) - (9.8 \times \frac{1.5^2}{2})$

$= 27\ KNm.$

$\text{Requi } Z = \frac{27}{.165} = 162\ cm^3$

Use 203 x 76 MSC.

Roof Bracing



East - West.

Load Grid C

$$K_x = \frac{540}{4095} = .133.$$

$$P = .133 \times \left(2.5 \times .24 \times 22 + \frac{3.5}{2} \times .36 \times 22\right) \times 5$$

$$= 18\ KN$$

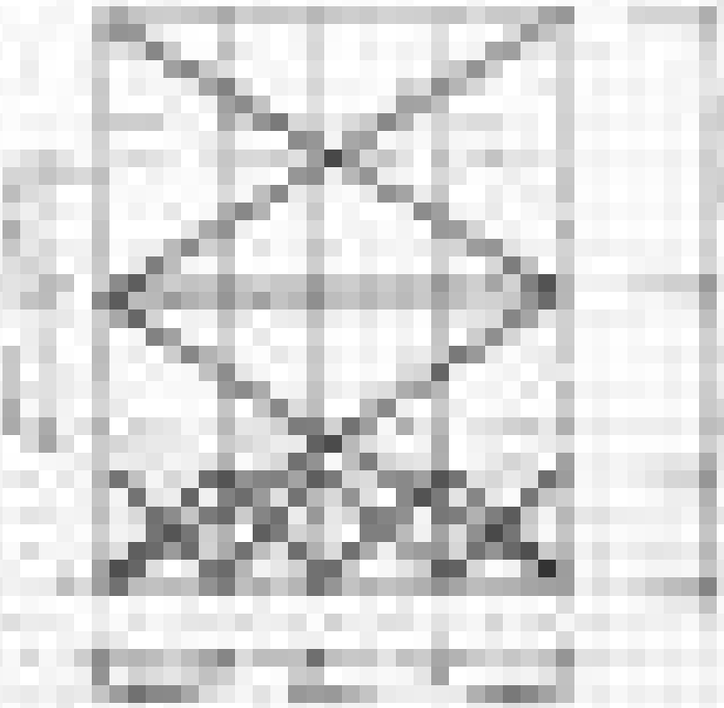
$$+ \text{Roof.}\quad 1.2 \times 5 \times 14.8 \times .133 = \underline{11.8}$$

$$29.8\ KN.$$

Tension: $T = 29.8 \times \frac{\sqrt{14.6^2 + 10.5^2}}{14.6} = 51\ KN.$

$$\frac{51}{.2} = 255\ mm^2$$

25 x 10 R (50 x 5 R).



(a) $T = 52.4 \times \frac{\sqrt{4.8^2 + 3.5^2}}{3.5} = 88.6.$

$A = \frac{88.6}{.2} = 443$

50 × 10 FR

(b) Use 50 × 10 FR also.

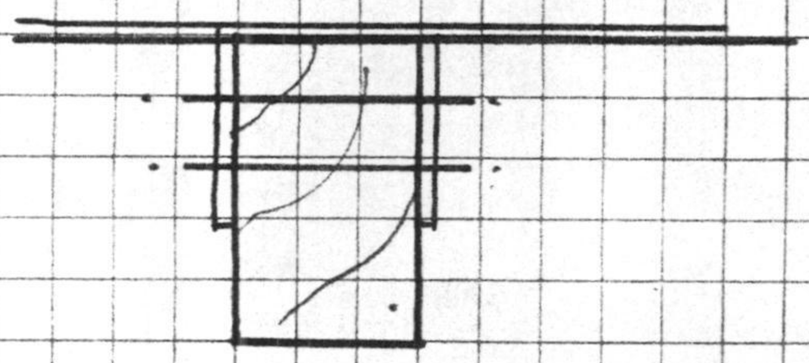
Truss bottom chords to take compression.

Max Tie/Strut load.

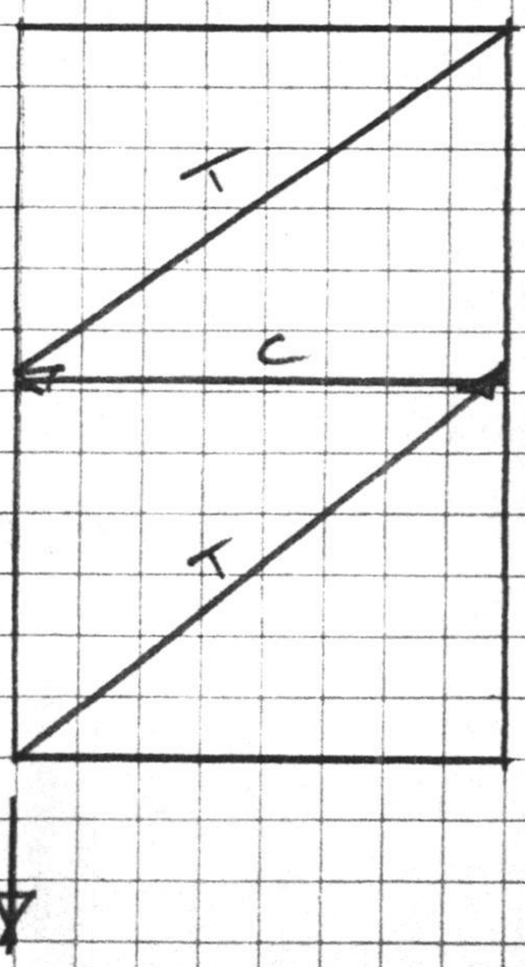
= ~~34.3~~ 52.4 − 43 = [illegible] kN.

or 59.6 − 35 = 24.6 kN.

Require 2 - M20 bolts.



Main Bracing.



$P = 59.6 + \frac{15}{5} \times 21.5$

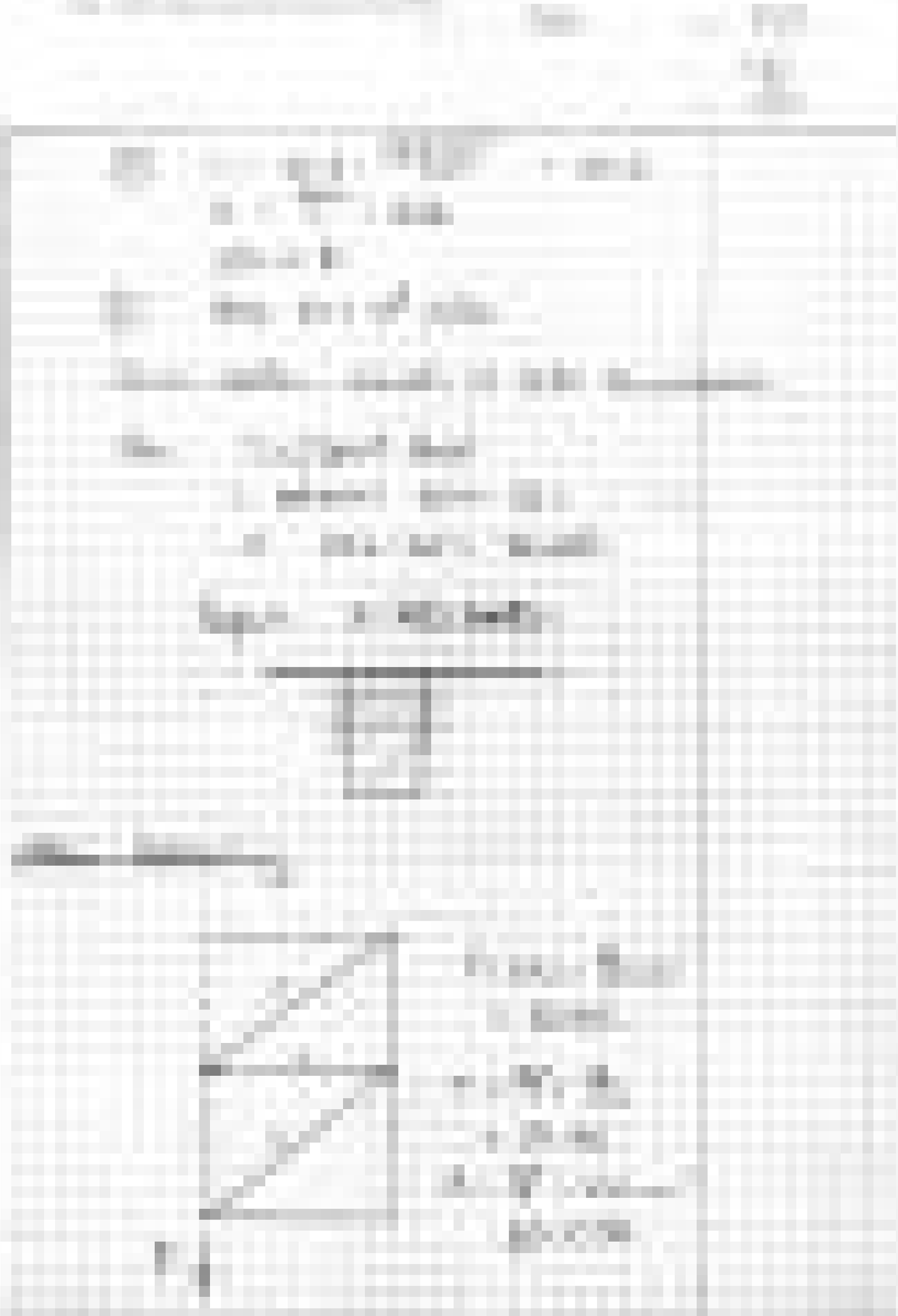
$= 137 kN.$

$T = \frac{137}{2} \times \frac{18}{10.5}$

$= 117 kN.$

$A = \frac{117}{.2} = 587 mm^2$

60 × 10 FR



$$C = 117 \times \frac{14.8}{18} = 95\,kN$$

Try 100x100x4 RHS.

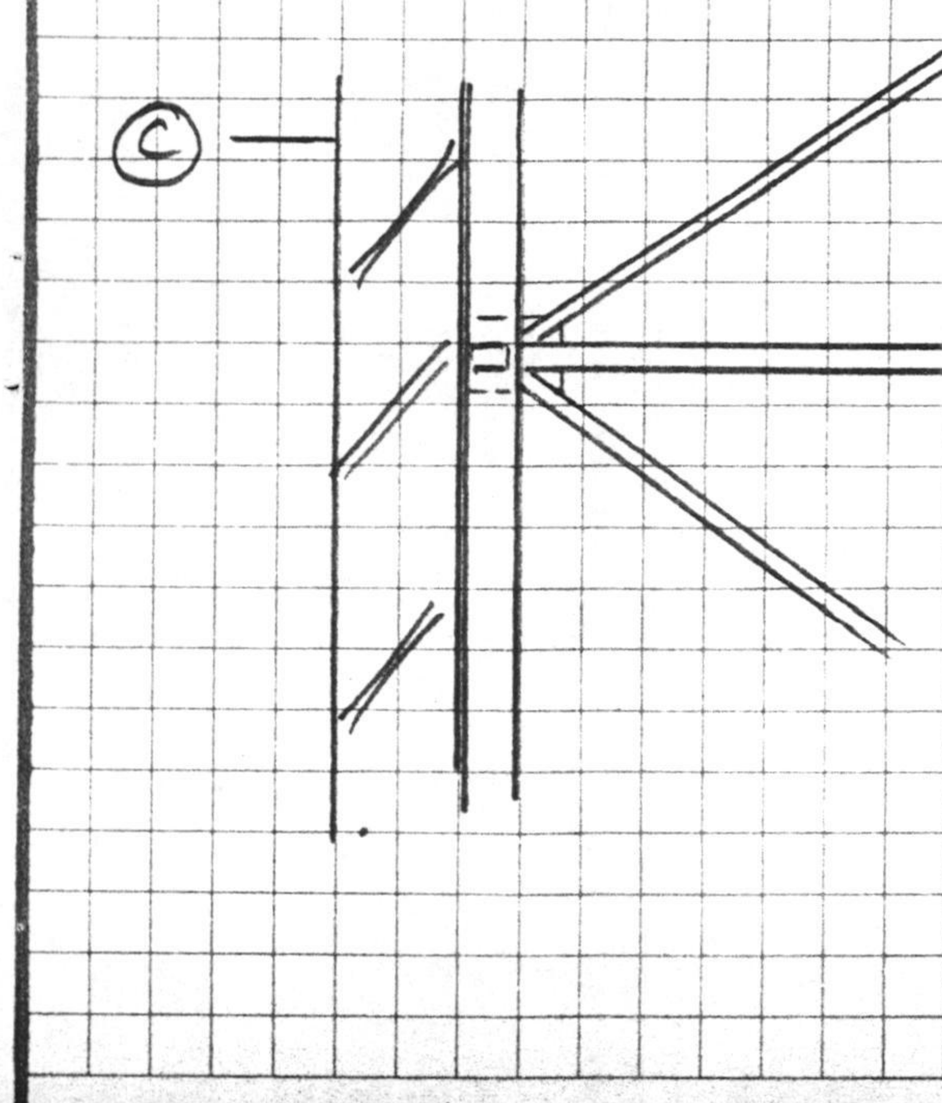
$$f_{ac} = \frac{95}{1.53} = 62\,MPa.$$

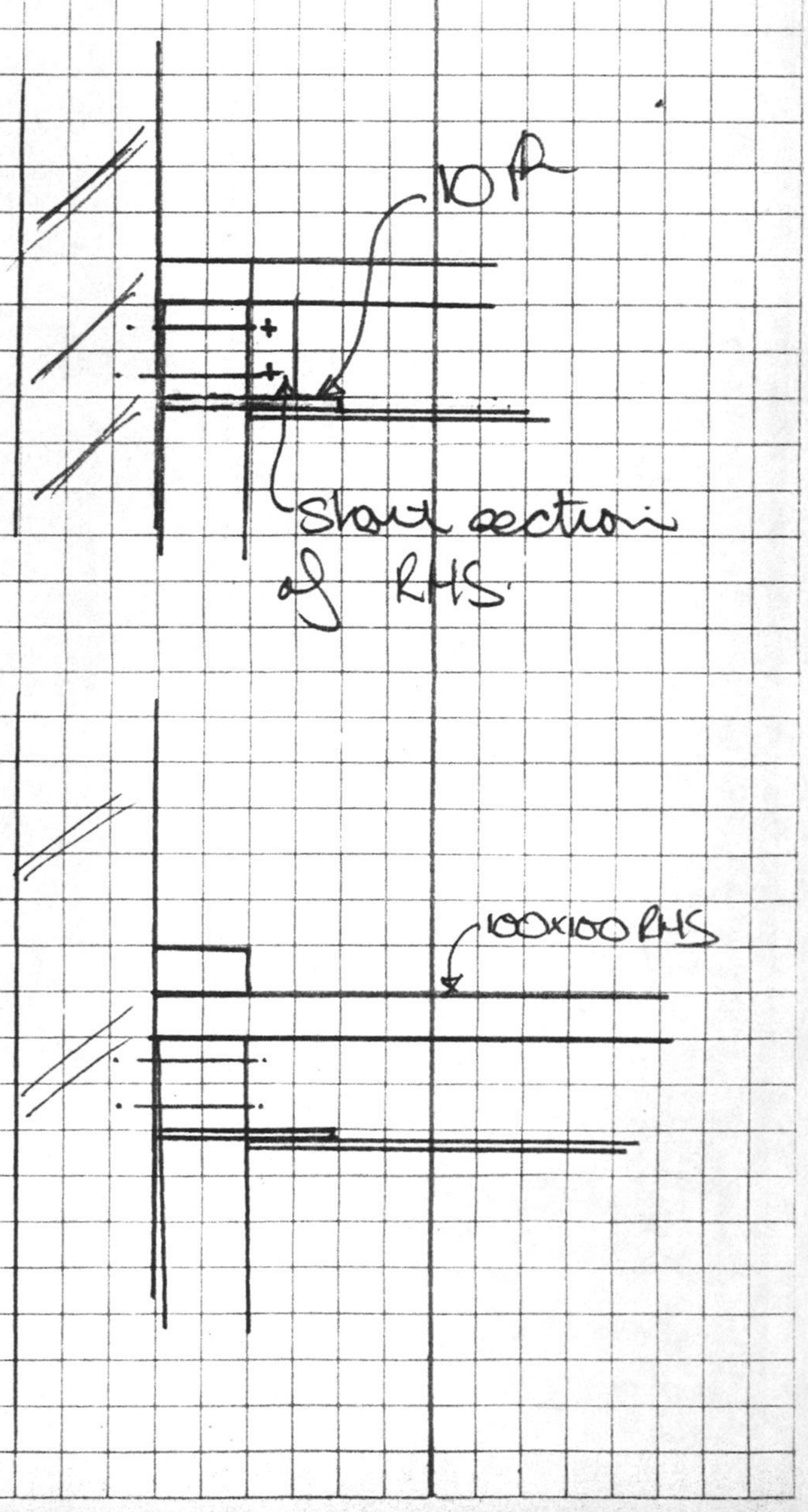
$$\frac{l}{r_y} = \frac{4800}{39.1} = 123$$

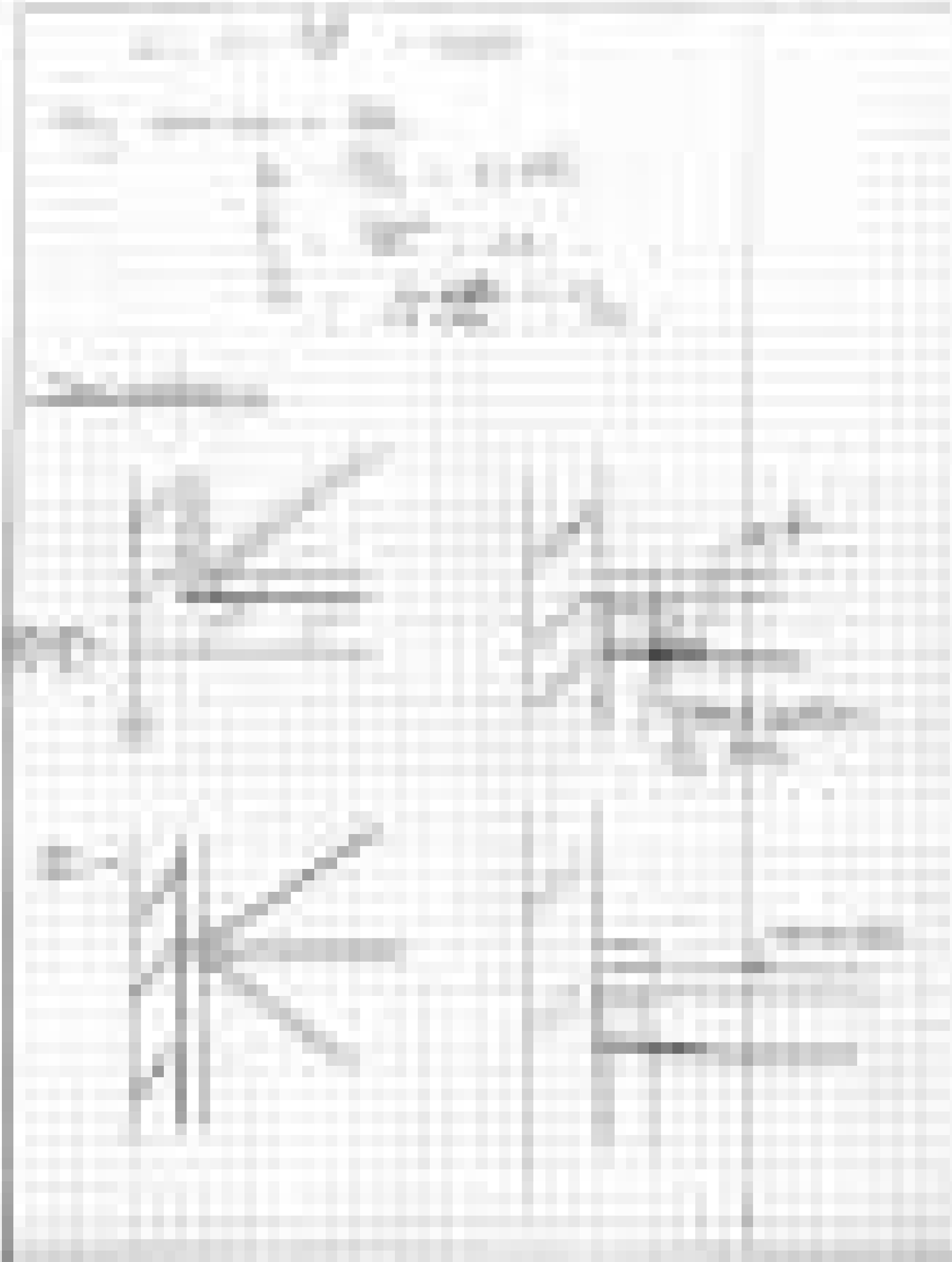
F_{ac} = 56 ~~MPa~~ x 1.33

= 74 MPa ∴ OK.

Connections







WORKS DEPARTMENT
CHECKING & COMMENTS FORM
Structural Branch to Building Branch

Code 3

8943

695

Stage 1 Piling

NATURE OF WORK Extension to Club Rooms	Dates when Plans Deposited	1 6.11.86 2 3	
NAME OF OWNER Wglon Working Mens Club	Dates received Structural Office	1 7.11.86 2 3	
ADDRESS OF NEW WORK 111 - 117 Cuba St	Date Calculations Received in Structural Office	1 7.11.86 2 3	
CONSULTING ENGINEER Smith Leuchars	Date of Inspection Time	A.M. P.M.	
ARCHITECT Keith Wilson.	Dates Returned to Building Branch	1 10.11.86 2 3	
BUILDER	Date Letter Sent File	1 2	

PROPOSAL		Signature	Date
	REFERRED BACK		
	ACCEPTED	[illegible]	10.11.86

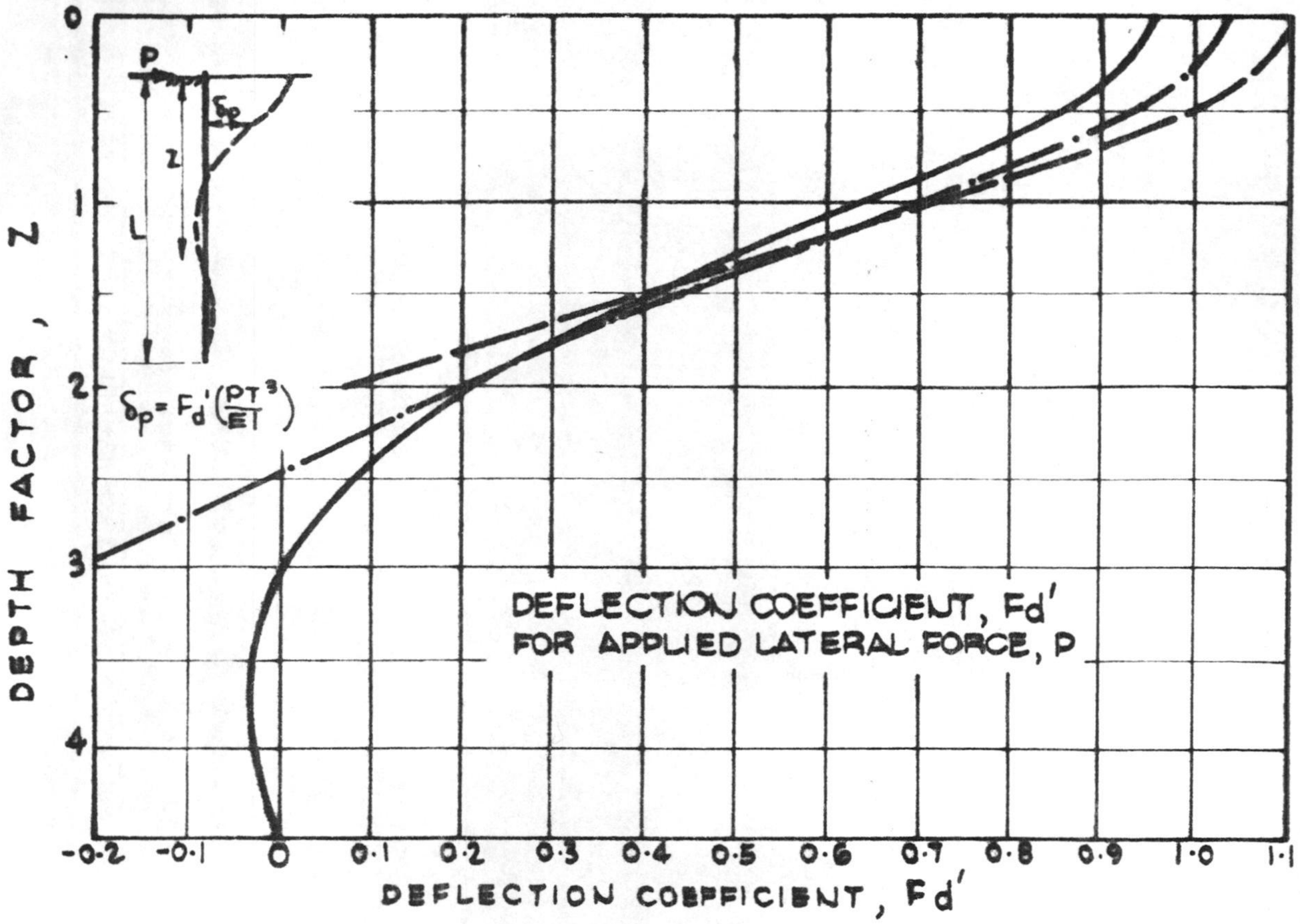
Referred Action required

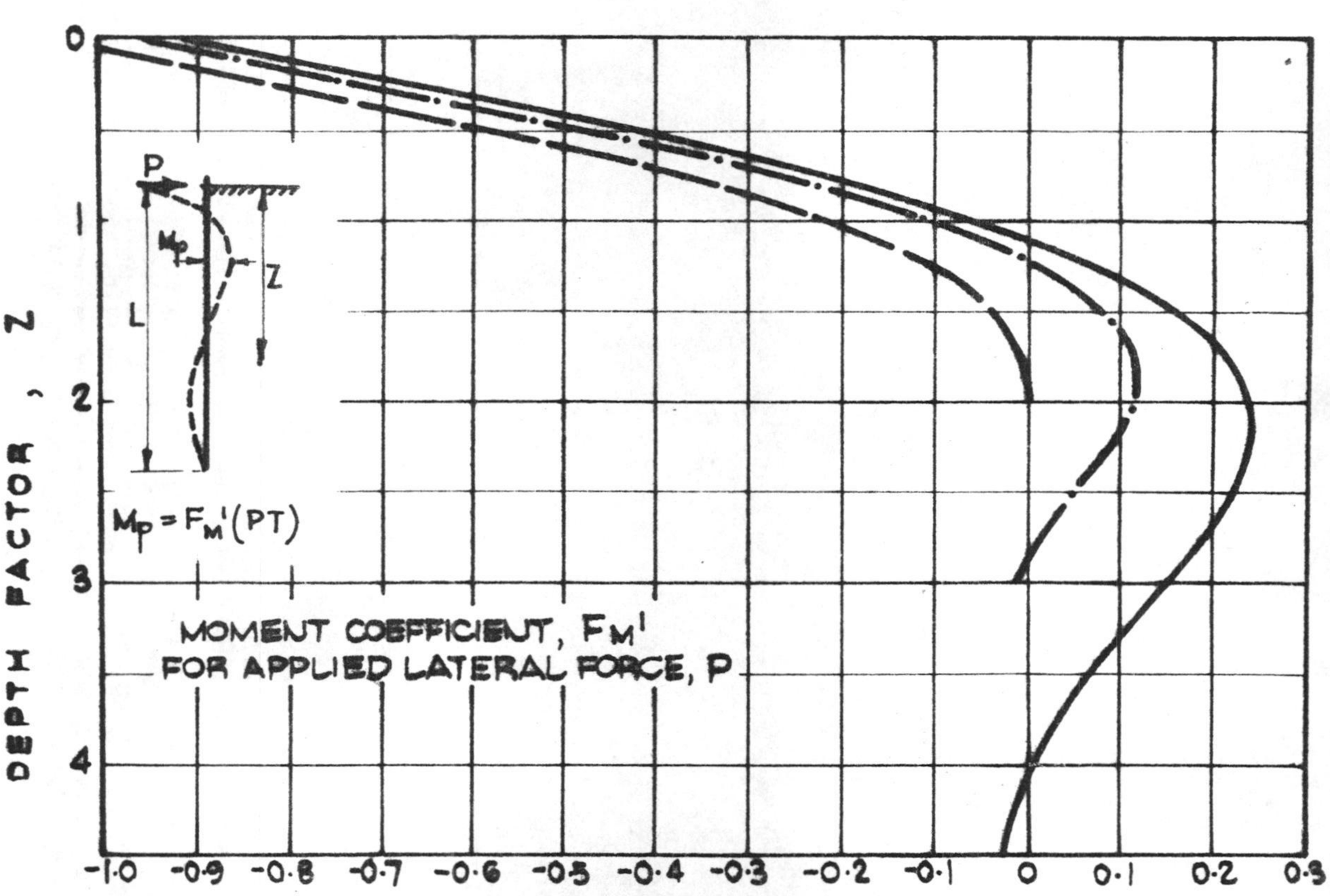
ACCEPTANCE SUBJECT TO FOLLOWING CONDITIONS:–

Engineer to supervise.

Note: Where new foundations are involved the building inspector is to be given 24 hours notice before concrete is placed.

Bm 10/11





KEY :

$\frac{L}{T} = 2$ ——— $\frac{L}{T} = 3$ —·—·— $\frac{L}{T} = 4$ & greater ———

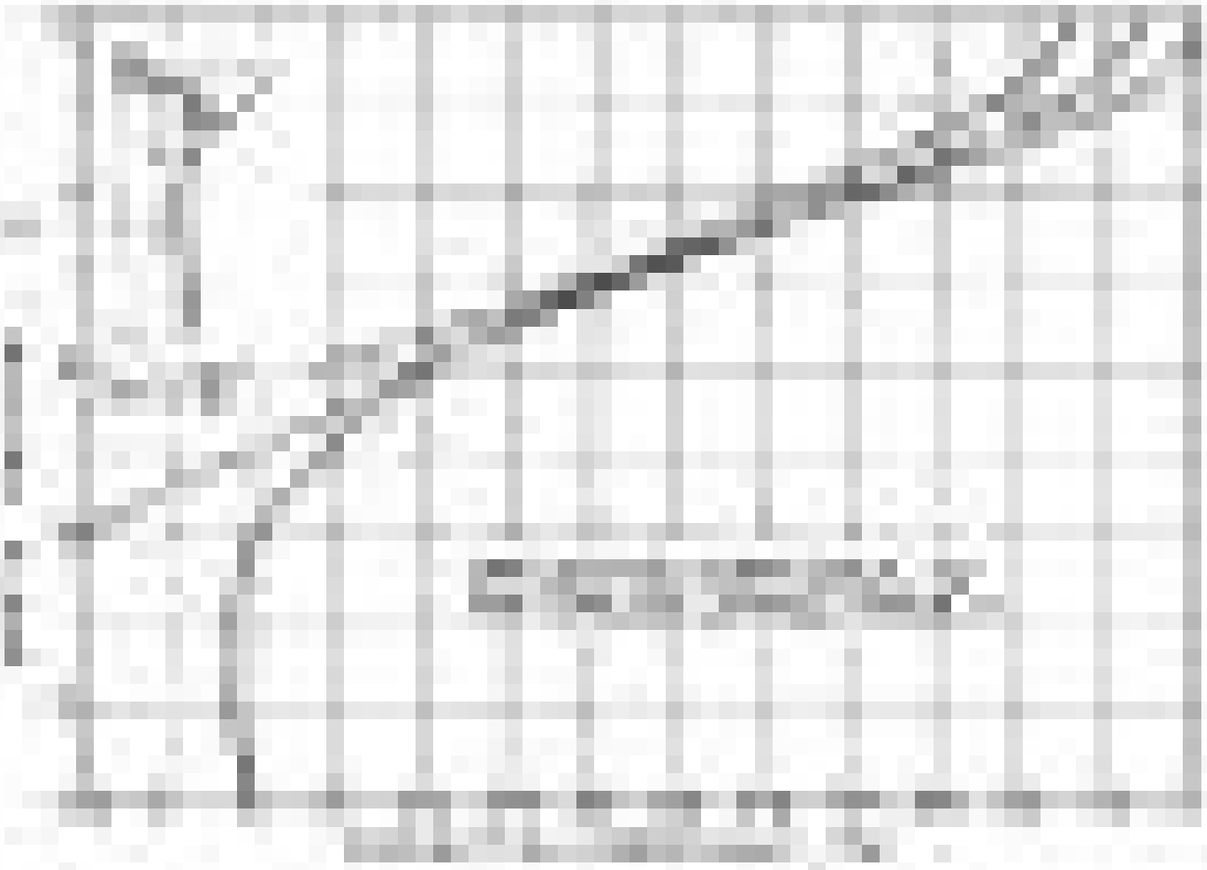
DESIGN PROCEDURE FOR LATERALLY LOADED PILES

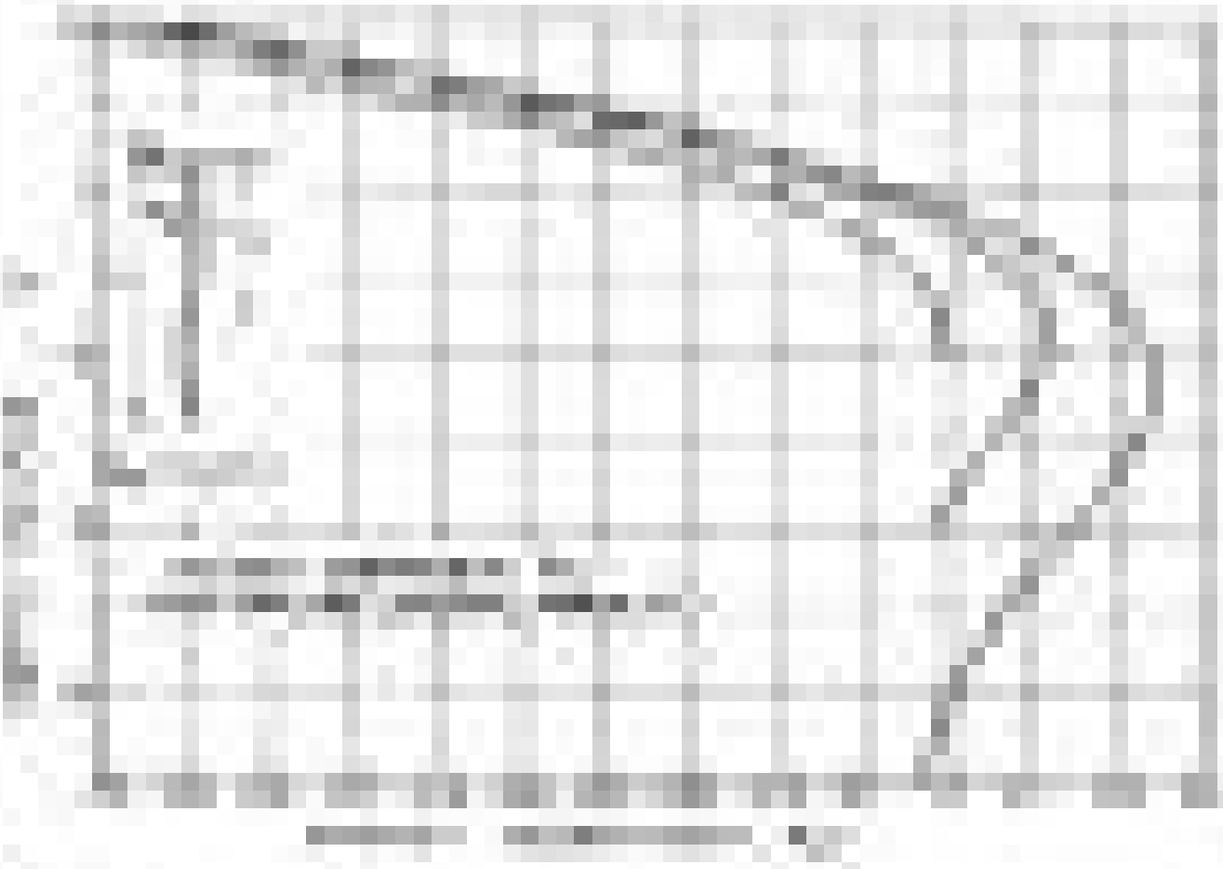
CASE 2 : FIXED AGAINST ROTATION AT GROUND SURFACE

BRICKELL MOSS RAINES & STEVENS LTD.

PLATE 5C

JOB ---- CLIENT ---- LOCATION ---- BY ---- CHECKED ---- DATE ----

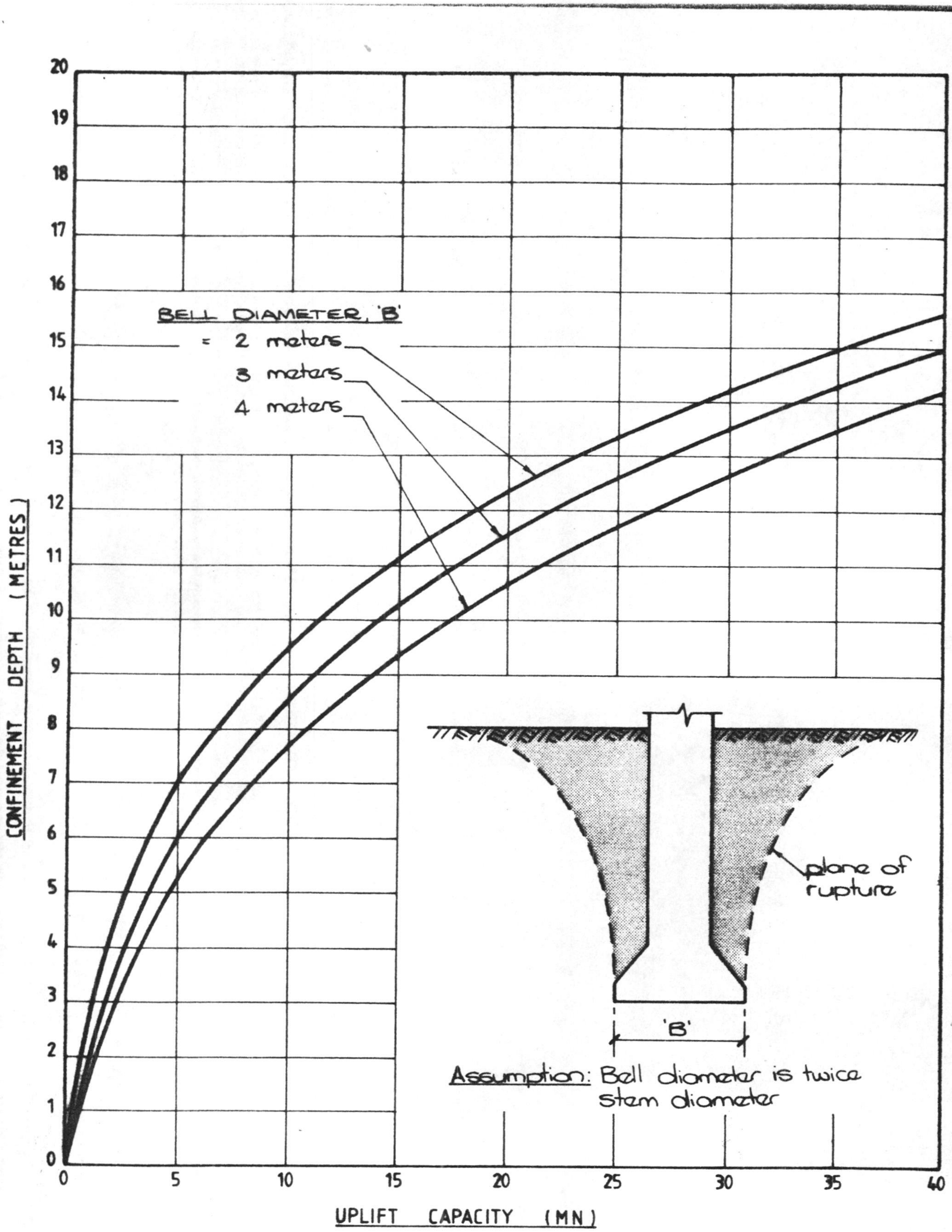




JOB _____ CLIENT _____

LOCATION _____

DRAWN _____ BY _____ CHECKED _____ DATE _____

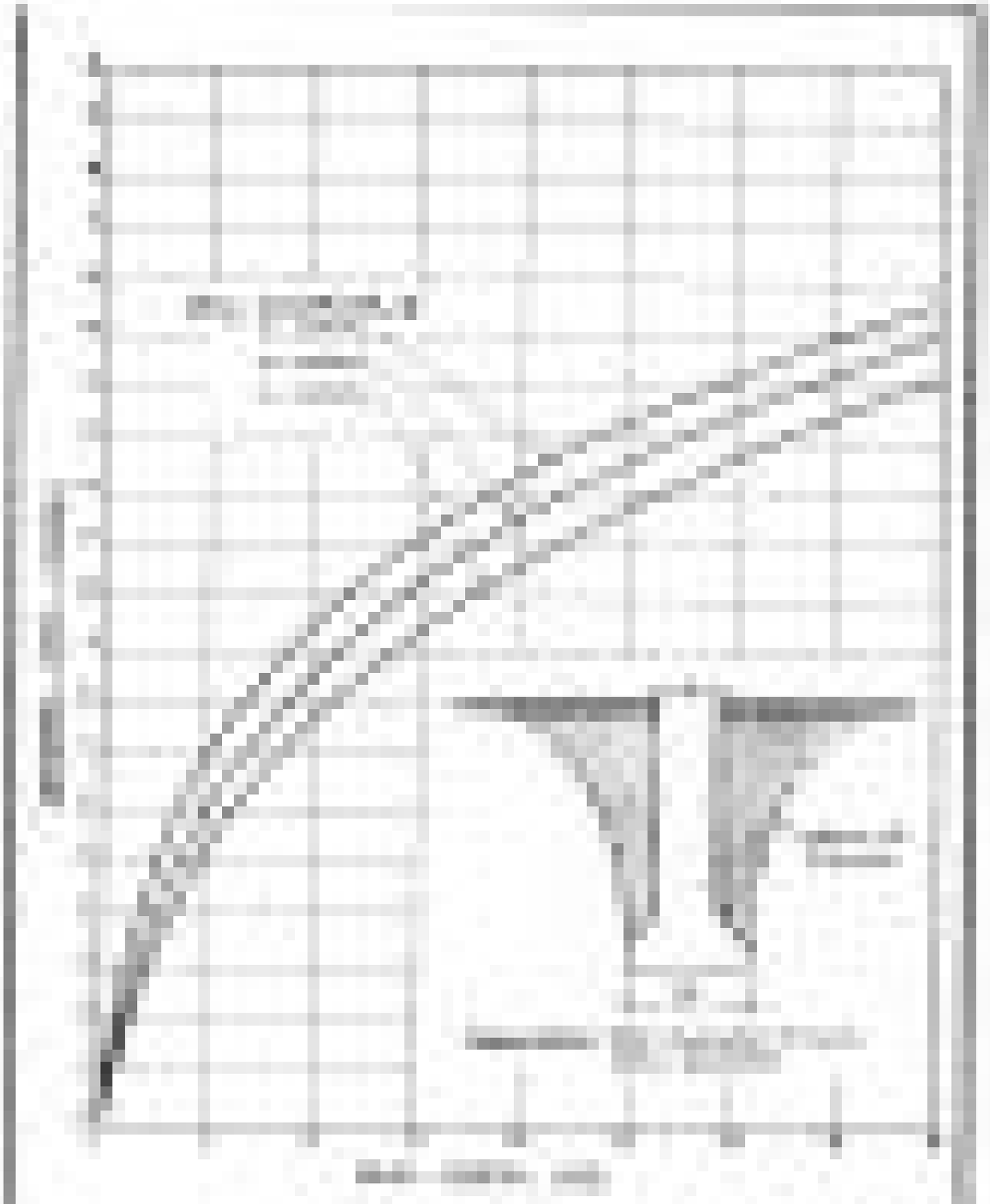


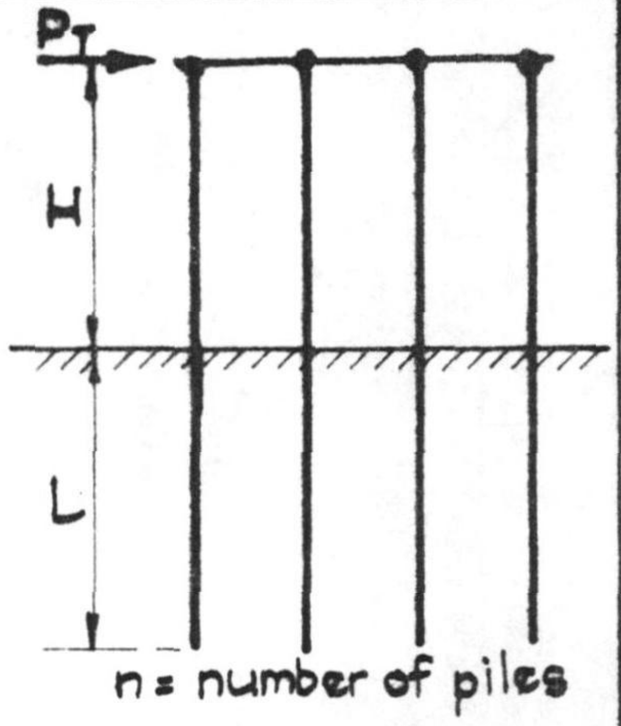
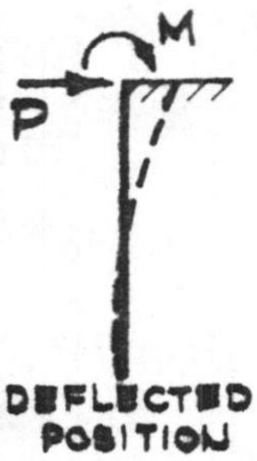
ULTIMATE UPLIFT CAPACITIES FOR BELLED PILES

REFERENCE: 'Resistance to breaking out of mushroom foundations for pylons,' by Dr. A. Balla.

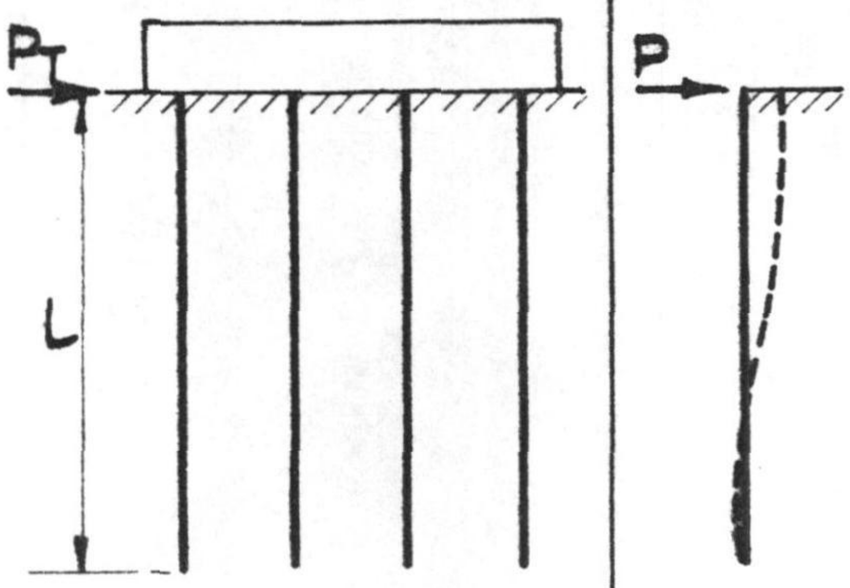
BRICKELL MOSS RAINES & STEVENS LTD.

PLATE 4



CONDITION	LOAD AT GROUND LINE	DESIGN PROCEDURE
	For each pile $P = \frac{P_T}{n}$ $M = PH$  DEFLECTED POSITION	1. Compute relative stiffness factor $T = \left(\frac{EI}{f}\right)^{1/5}$ 2. Select curve for relevant $\frac{L}{T}$ 3. Obtain coefficients F_d, F_M, F_V, or F_d', F_m', F_v', at depths desired. 4. Compute deflection, moment and shear at desired depths, using formulae of Plate

CASE 1. PILES WITH FLEXIBLE CAP OR HINGED END CONDITION

		1. Proceed as in step 1, case 1. 2. Compute deflection and moment at desired depths, using coefficients F_d', F_M' and formulae of Plate 3C 3. Maximum shear occurs at top of pile and equals $p = \frac{P_T}{n}$ in each pile.

CASE 2. PILES WITH RIGID CAP AT GROUND SURFACE

DEFINITIONS:

- P = Lateral force applied on pile
- H = Vertical distance between P and ground surface
- M = PH = Moment on pile applied at ground surface
- Z = Depth factor below ground to point to be checked, = $\frac{\text{depth}}{T}$
- f = Coefficient of soil modulus variation
- L = Length of pile below ground surface
- T = Relative stiffness factor
- E = Modulus of elasticity of pile
- I = Moment of inertia of pile cross section
- δ_p, M_p, V_p = Deflection, moment and shear at any depth, Z, due to force P
- δ_m, M_m, V_m = Deflection, moment and shear at any depth, Z, due to moment M

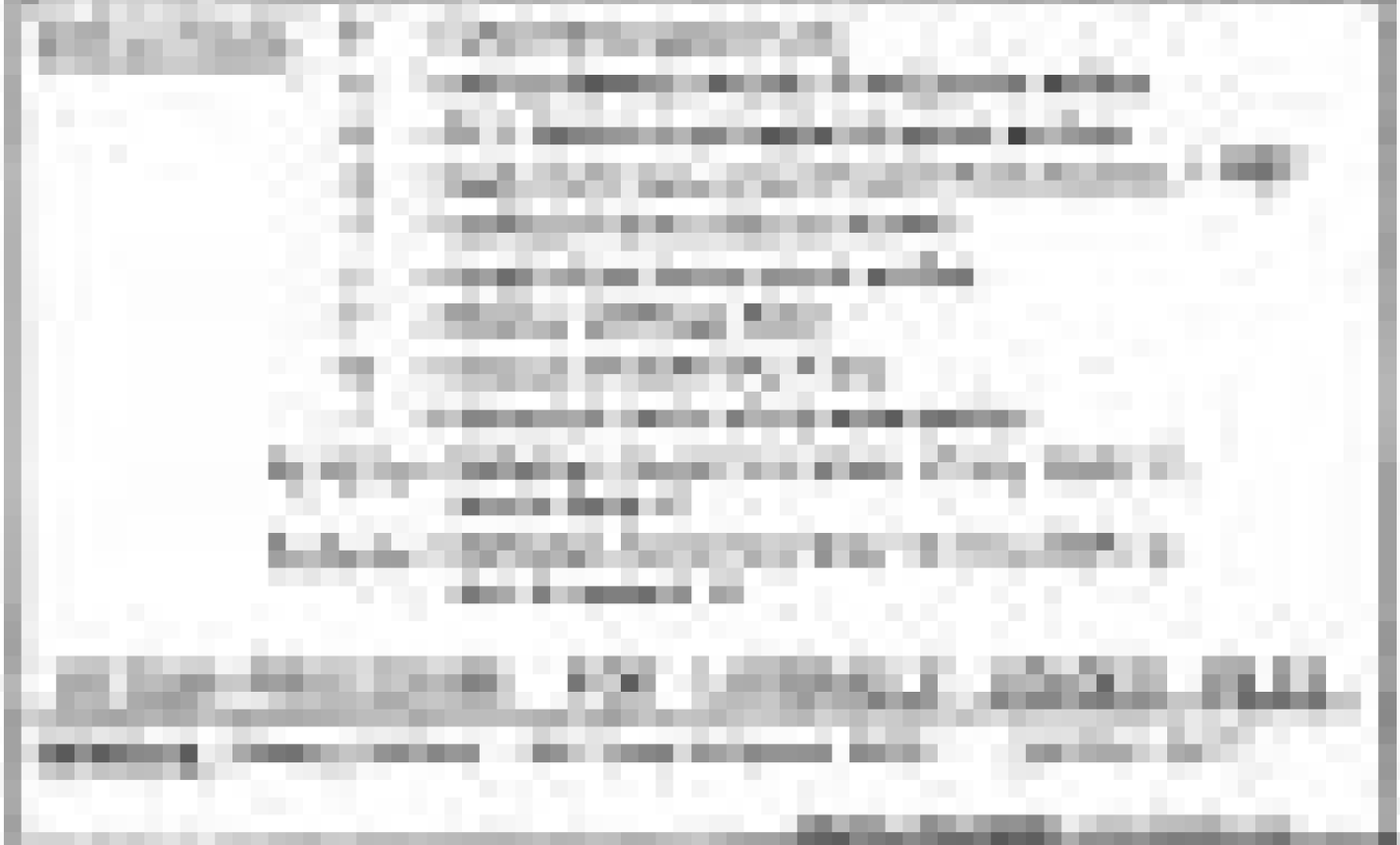
DESIGN PROCEDURE FOR LATERALLY LOADED PILES

REFERENCE: Reese & Matlock : 8th Texas Conference, SMFE. (NAVFAC DM7)

BRICKELL MOSS RAINES & STEVENS LTD.

PLATE 5D

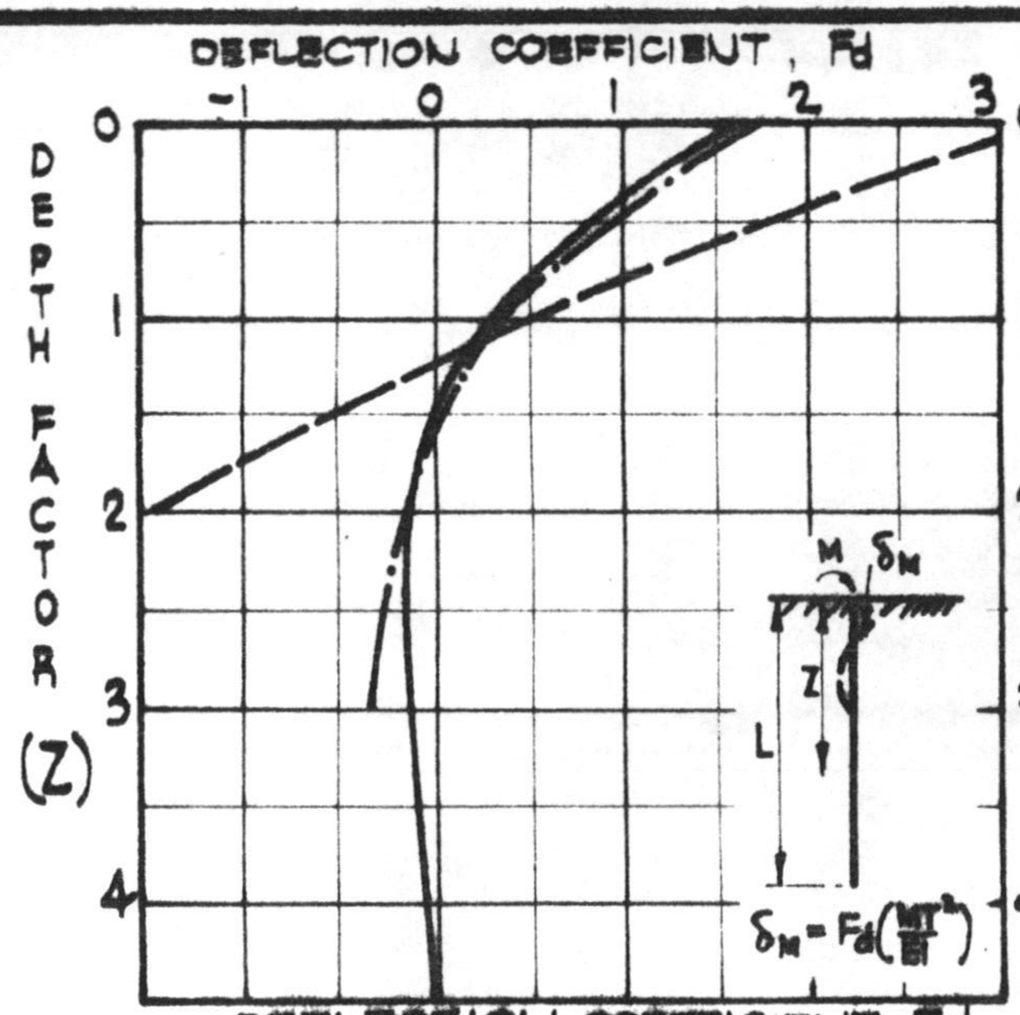
DATE ---- CHECKED ---- BY ---- LOCATION ---- CLIENT ---- JOB ----



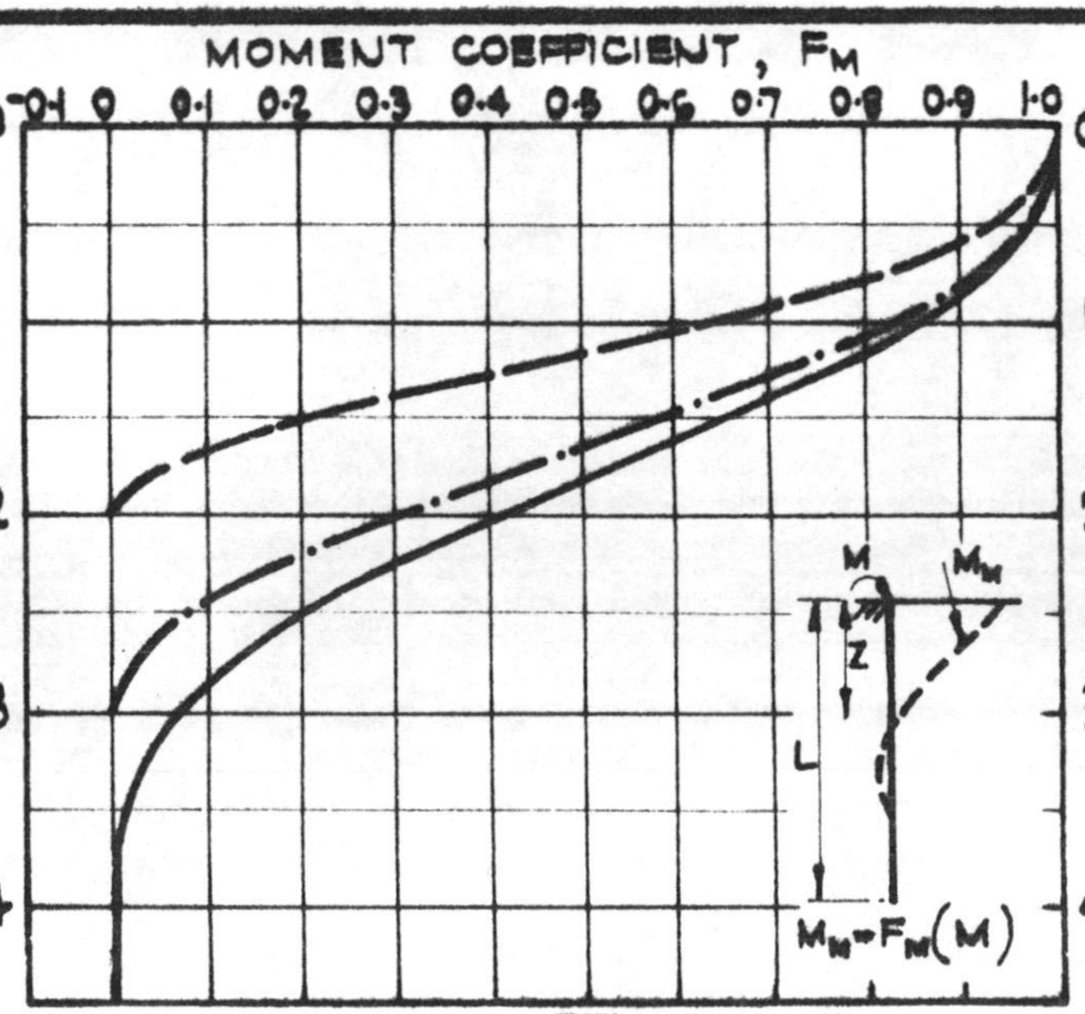
JOB _____ CLIENT _____ LOCATION _____ BY _____ CHECKED _____ DATE _____

DESIGN PROCEDURE FOR LATERALLY LOADED PILES

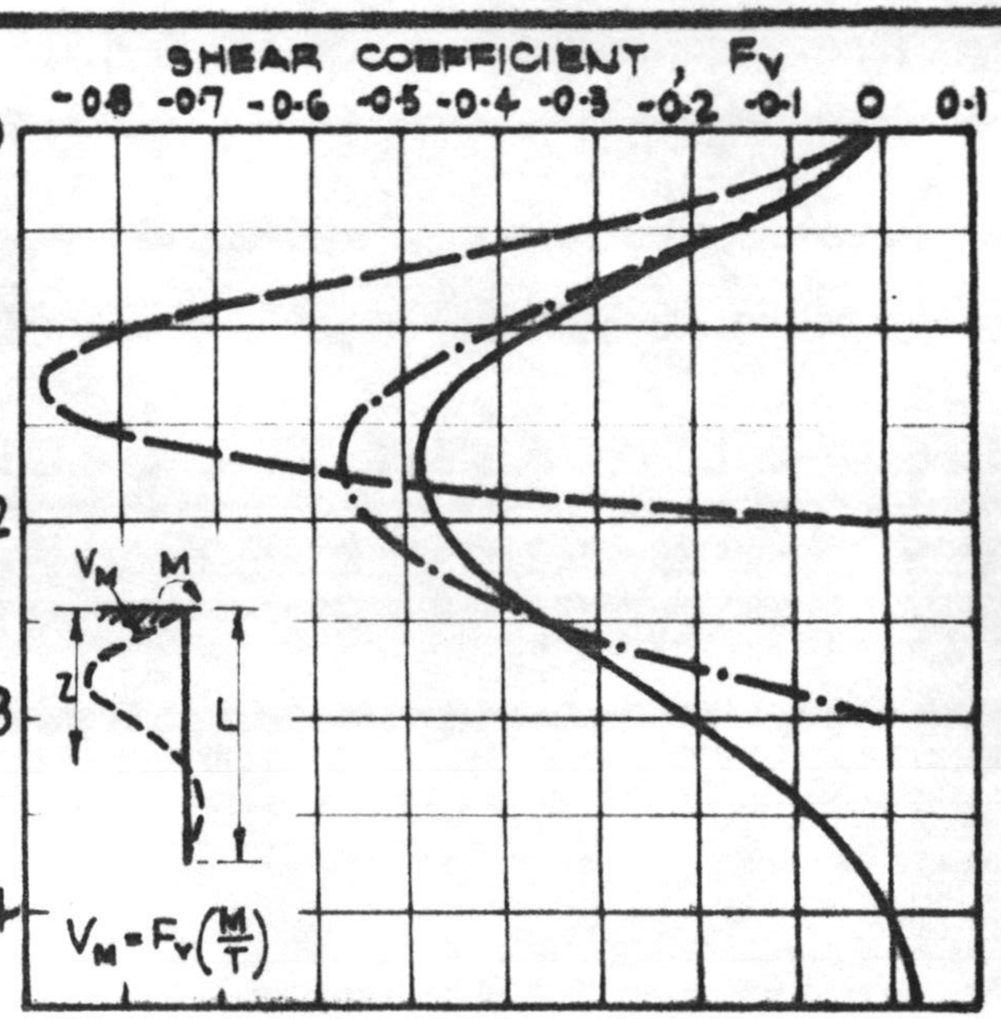
CASE I : FLEXIBLE CAP OR HINGED END CONDITION



DEFLECTION COEFFICIENT Fd
FOR APPLIED MOMENT, M



MOMENT COEFFICIENT, FM
FOR APPLIED MOMENT, M



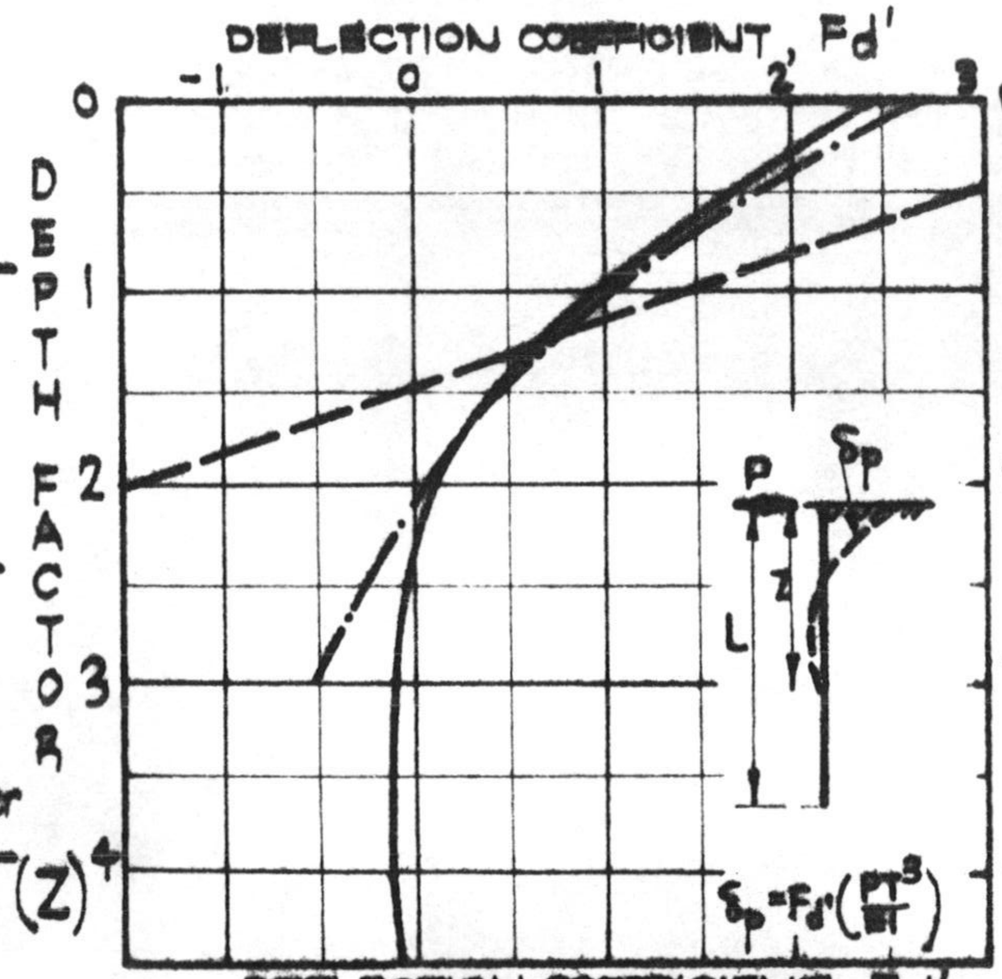
SHEAR COEFFICIENT, Fv
FOR APPLIED MOMENT, M

NOTE :

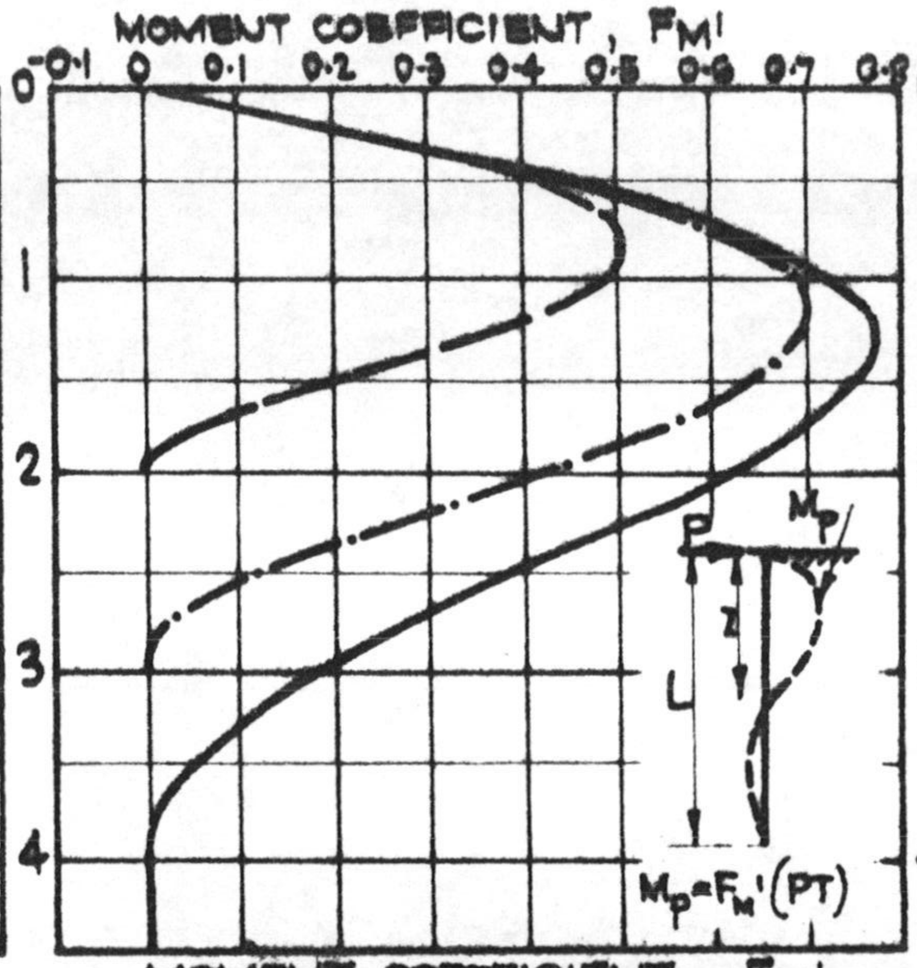
J/T = 2

J/T = 3

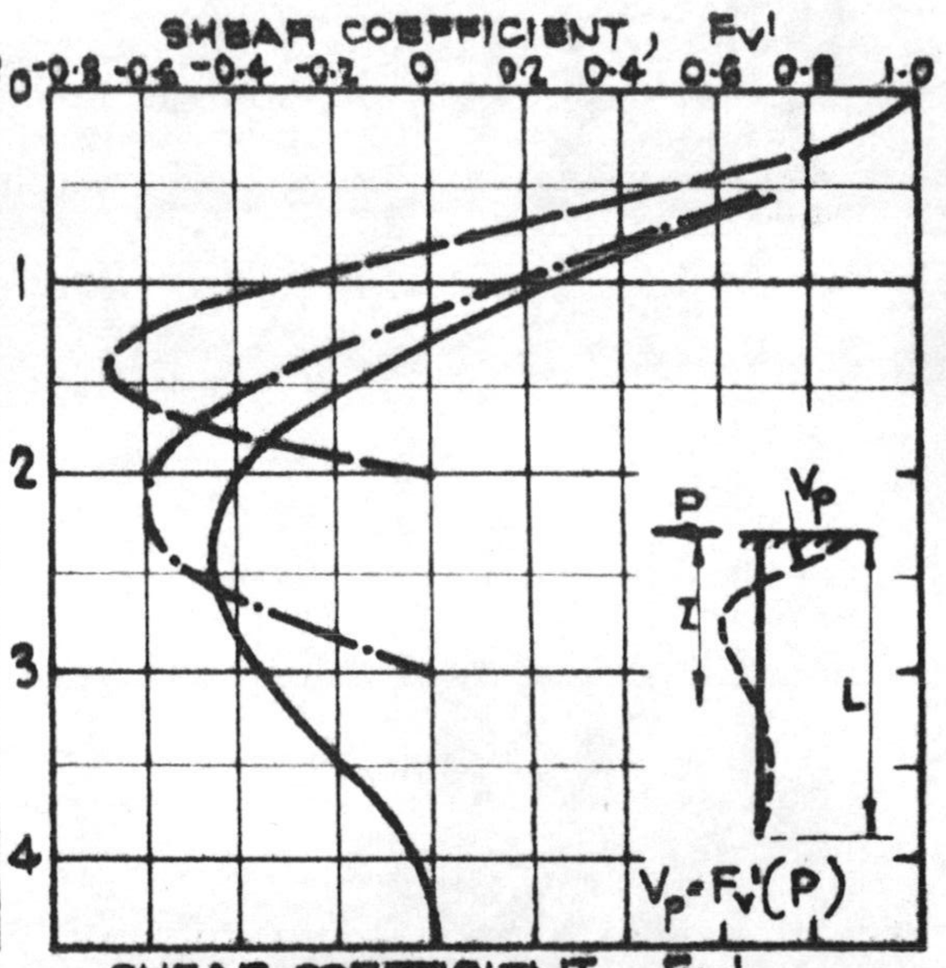
J/T = 4 & greater



DEFLECTION COEFFICIENT, Fd'
FOR APPLIED LATERAL FORCE, P



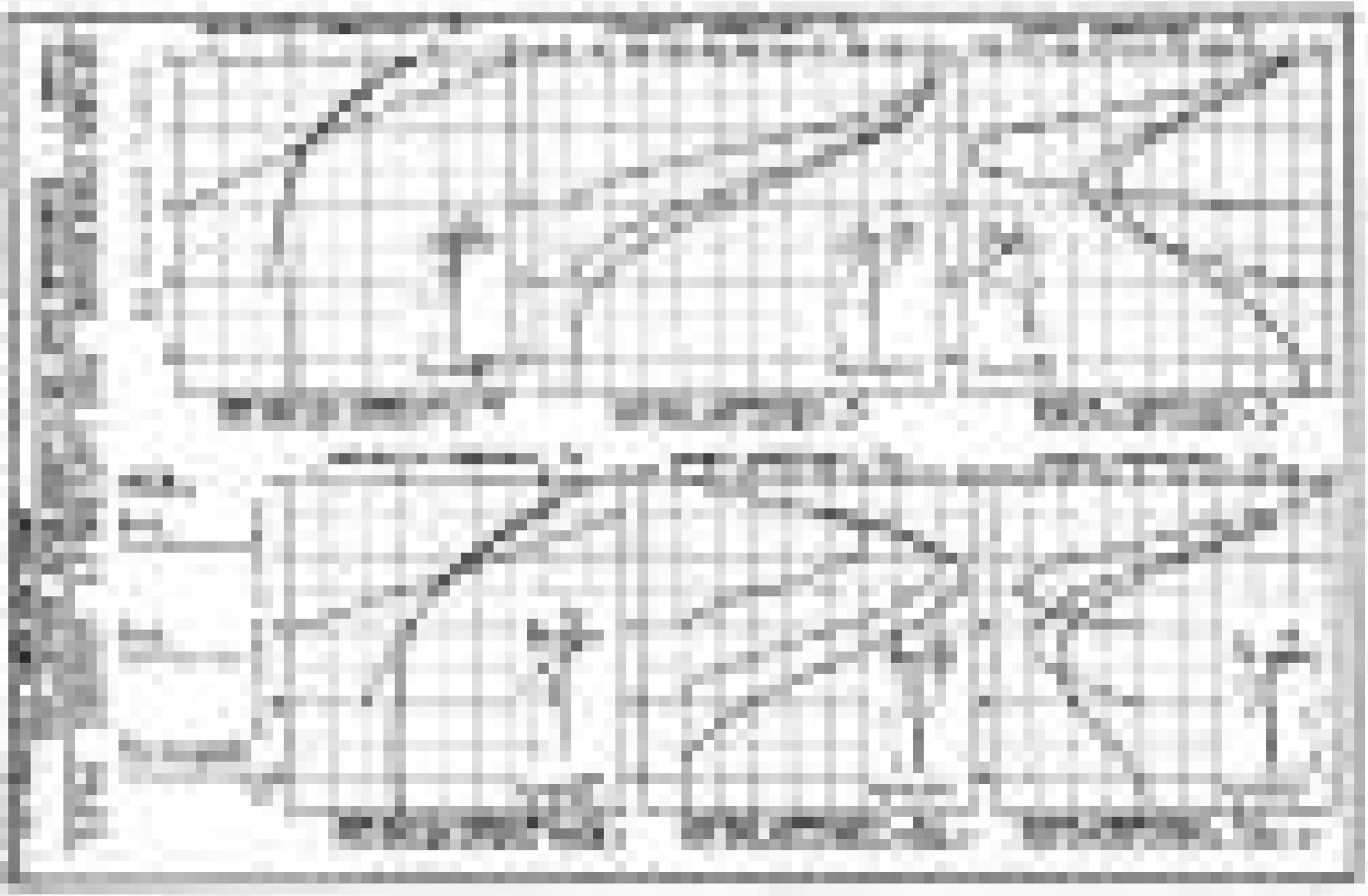
MOMENT COEFFICIENT, FM'
FOR APPLIED LATERAL FORCE, P



SHEAR COEFFICIENT, Fv'
FOR APPLIED LATERAL LOAD, P

BRICKELL MOSS RAINES & STEVENS LTD.

PLATE 5.8



Job No

Location :

Client :

Date :

RELATIVE DENSITY OF COHESIONLESS SOILS

	Corrected SPT 'N' value (blows/300 mm)
Very Loose	0 to 4
Loose	4 to 10
Moderately Dense	10 to 30
Dense	30 to 50
Very Dense	> 50

GRAIN SIZE

BOULDERS	> 200 mm
GRAVEL	
Very coarse	200 mm to 60 mm
Coarse	60 mm to 20 mm
Medium	20 mm to 6 mm
Fine	6 mm to 2 mm
SAND	
Coarse	2 mm to .6 mm
Medium	.6 mm to .2 mm
Fine	.2 mm to .06 mm
SILT & CLAY	< .06 mm

GRAIN SHAPE

Angular	Showing little or no evidence of wear; edges and corners sharp, secondary edges present.
Subangular	Showing some effect of wear; faces virtually untouched but edges and corners slightly worn.
Subrounded	Showing considerable wear; edges and corners rounded off to smooth curves, original faces considerably reduced.
Rounded	Original faces almost completely destroyed, but some comparatively flat surfaces present. All original corners smoothed off to broad curves.
Well rounded	No original faces, corners or edges left. The entire surface consists of broad curves; flat areas absent - virtually spherical.

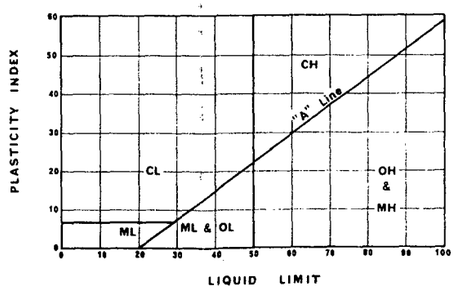
CONSISTENCY OF COHESIVE SOILS

Very Soft	-	squeezes between fingers
Soft	-	easily moulded by fingers
Firm	-	moulded by strong finger pressure
Stiff	-	dented " " " "
Very Stiff	-	dented only slightly by finger pressure
Hard	-	dented only slightly by pencil point.

STRUCTURE

Layer	A relatively continuous planar unit of soil, limited by difference in composition, texture or structure.
Lens	A discontinuous unit of soil, usually of limited area and generally less than 300 mm thick.
Bed	One distinct soil unit of sedimentary origin, confined within distinct bedding planes.
Homogeneous	Uniform properties within a soil unit.
Interbedded	Alternate beds of soil within a major soil unit.
Laminated	Distinct, fine layers each generally less than 3 mm thick.
Banded	Alternate layers of soil with distinct colour differences.
Mottled	Irregularly marked with spots or zones of different colours.
Slikenside	Smooth, polished sometimes striated planar structures resulting from insitu movement.

DEFINITIONS OF DESCRIPTIVE TERMS



PLASTICITY CHART

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE GRAINED SOILS (More than 1/2 of soil > 0.06 mm)	GRAVELS (More than 1/2 of coarse fraction > 2 mm)	GW	Well graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 1/2 of coarse fraction < 2 mm)	SW	Well graded sands or gravelly sands, little or no fines.
		SP	Poorly graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 1/2 of soil < 0.06 mm)	SILTS & CLAYS (LL < 50)	ML	Inorganic silts and very find sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS (LL > 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts.
HIGHLY ORGANIC SOIL		Pt	Peat and other highly organic soils.

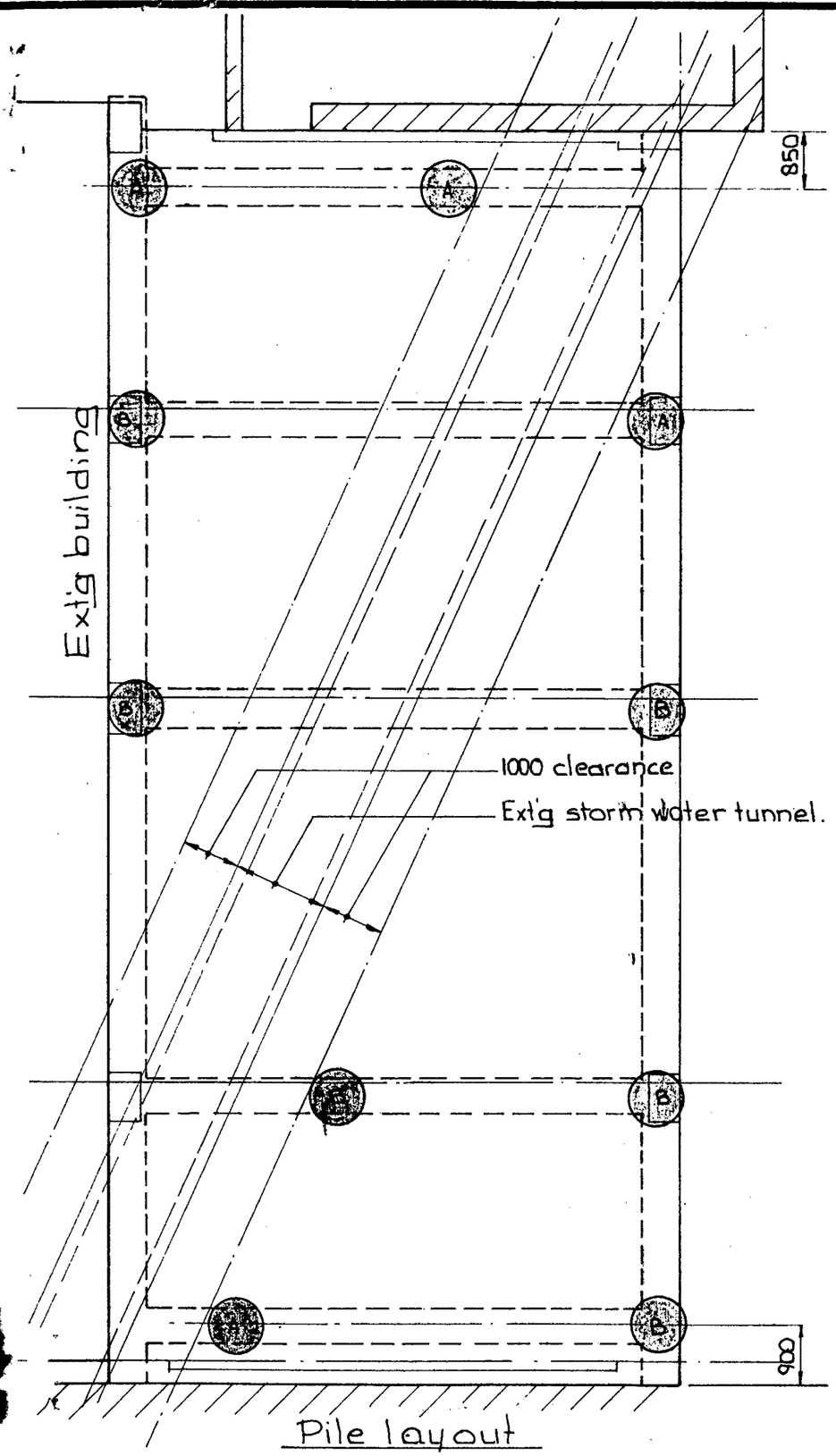
CLASSIFICATION CHART

(Unified Soil Classification System)

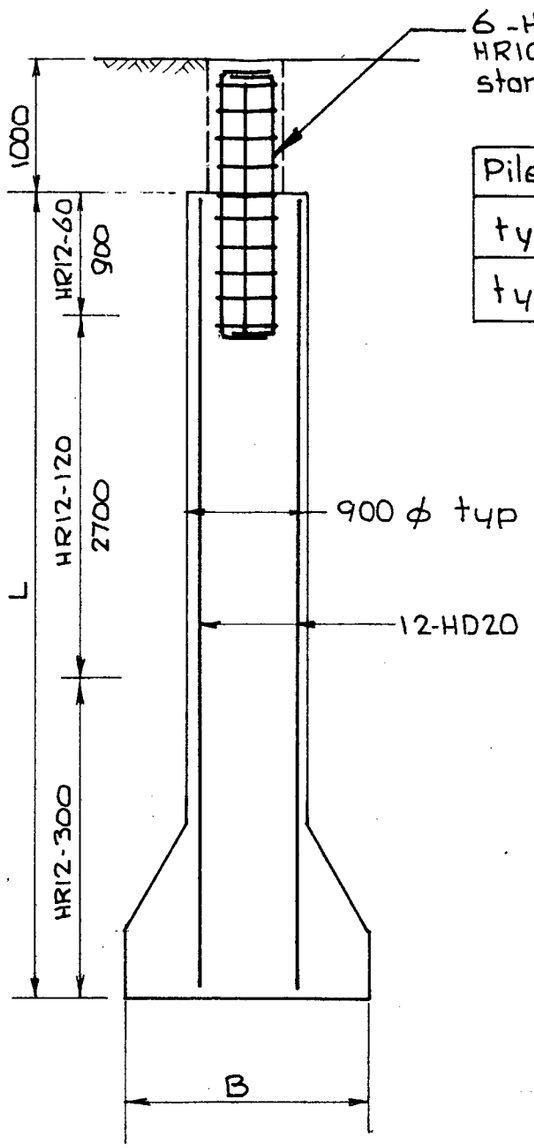
METHOD OF SOIL CLASSIFICATION

BRICKELL, MOSS & PARTNERS

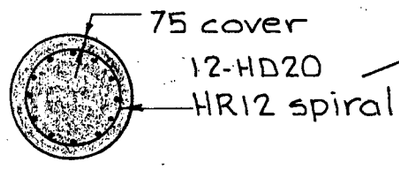
PLATE



Pile layout



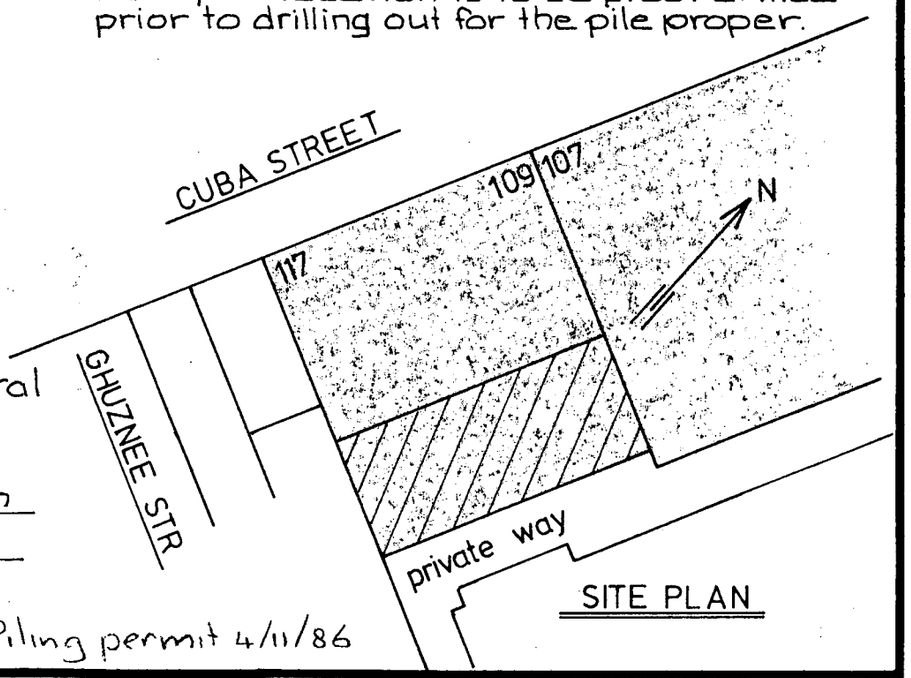
Pile type	L.(mm)	B Bell ϕ
type A	6200	1800
type B	5500	1500



Typ pile section
All piles 900 ϕ

Notes.

1. Concrete strength to be 25 MPa @ 28 days
2. The location of the piles adjacent to the stormwater tunnel may be adjusted following demolition and a more accurate assessment of the tunnel position.
3. Each pile location is to be proof drilled prior to drilling out for the pile proper.



SITE PLAN

Piling permit 4/11/86

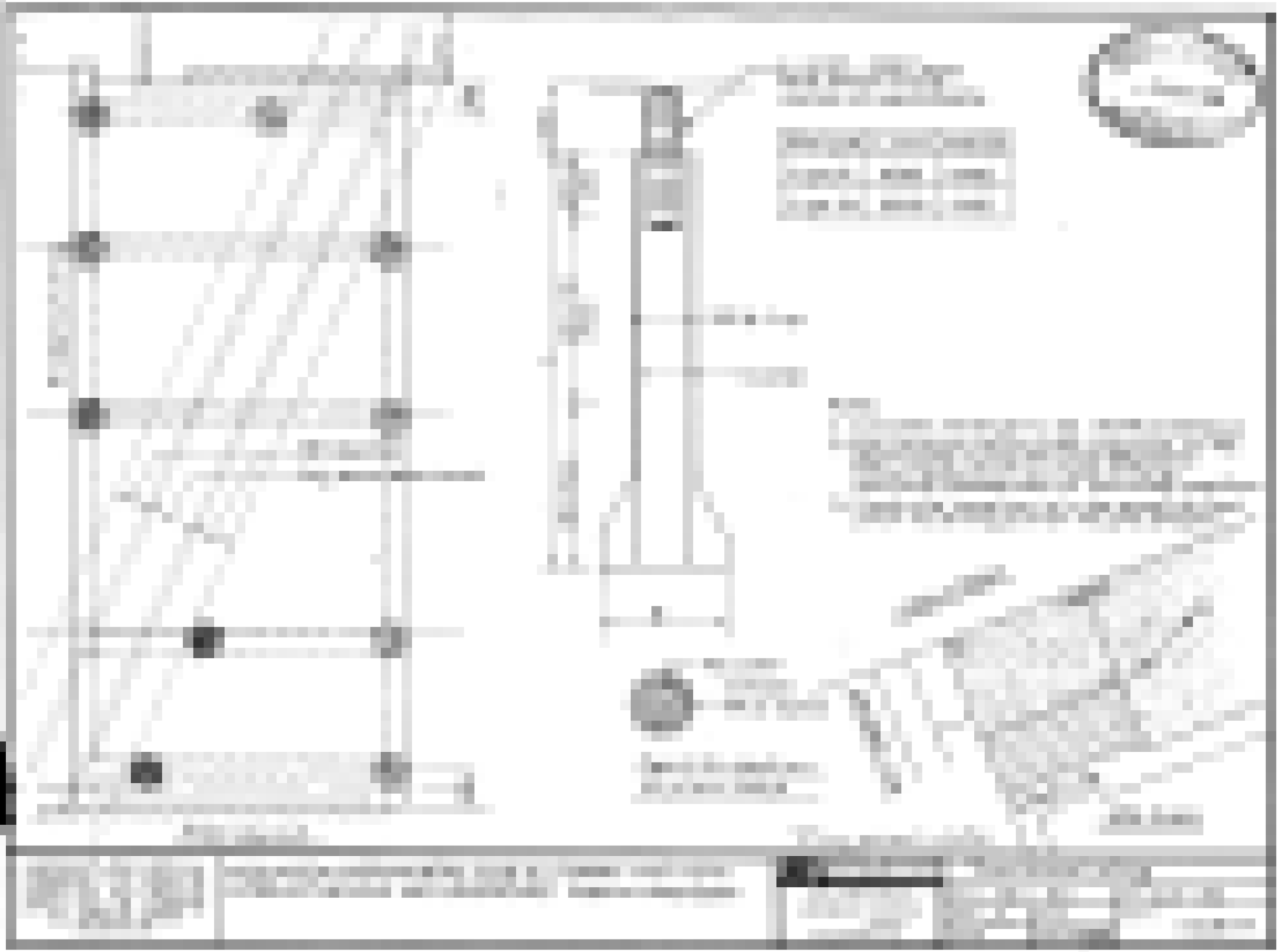
- CONTRACTORS MUST VERIFY ALL DIMENSIONS AT THE JOB BEFORE COMMENCING ANY WORK OR MAKING ANY SHOP DRAWINGS WHICH MUST BE SUBMITTED AND APPROVED BEFORE MANUFACTURE.

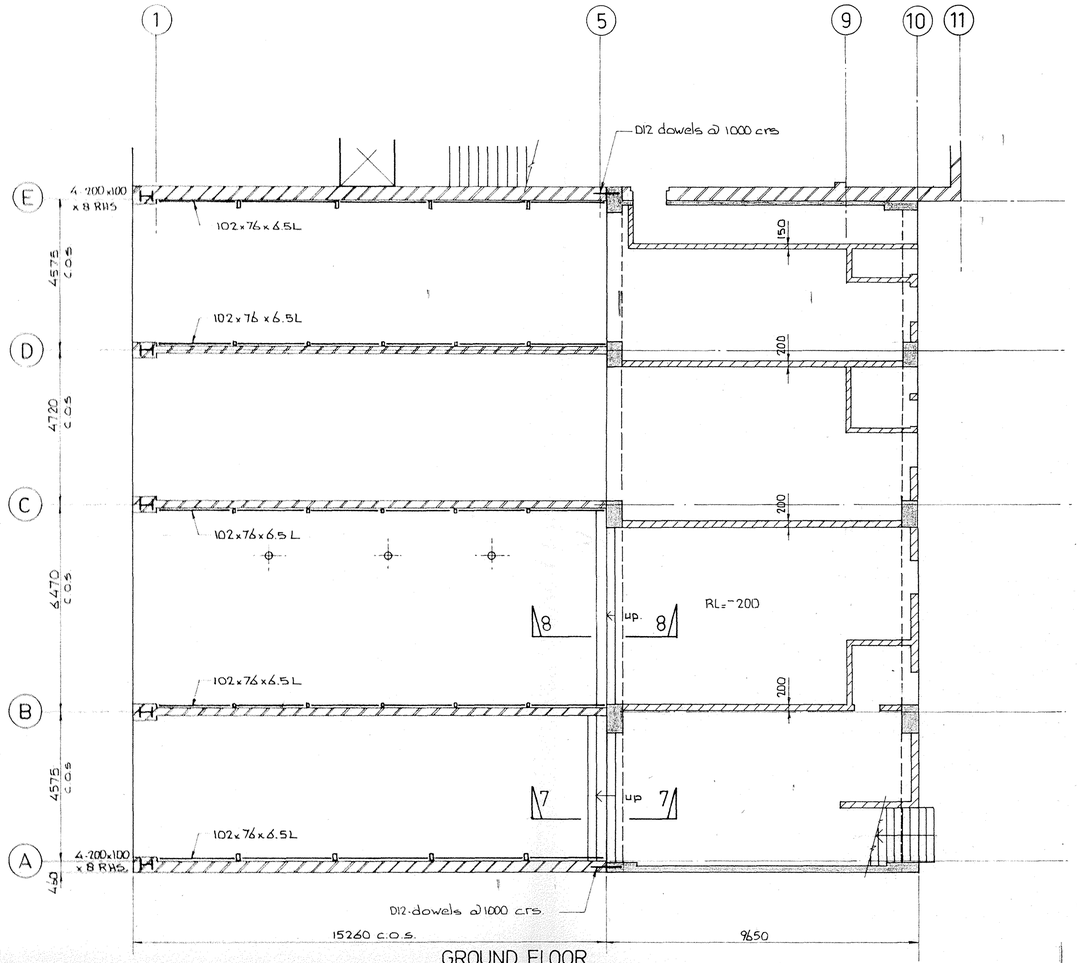
WELLINGTON WORKINGMENS CLUB & LITERARY INSTITUTE
STRENGTHENING AND UPGRADING CUBA ST PREMISSES.

SMITH LEUCHARS LIMITED
CIVIL STRUCTURAL & EARTHQUAKE ENGINEERS
Wellington.
Ph 739-175, PO Box 10-153

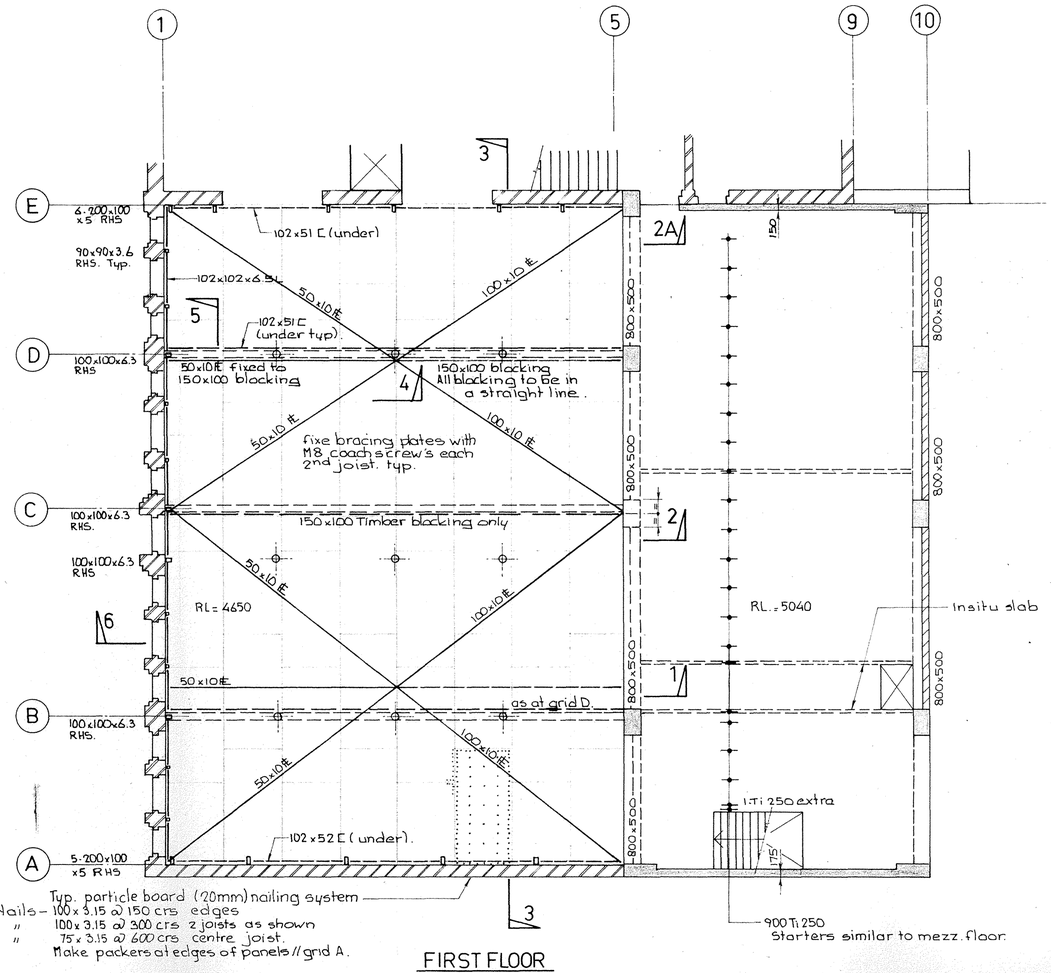
Provisional piling

SCALE 1:100 1:50		DATE Oct' 86.
DRAWN JL	TRACED	DWG No 1868/P1.
CHECKED	APPROVED MJO.	



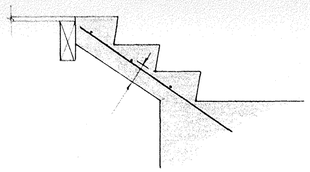


GROUND FLOOR

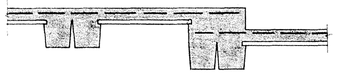


Typ. particle board (20mm) nailing system
Nails – 100x3.15 @ 150 crs edges
" 100x3.15 @ 300 crs 2 joists as shown
" 75x3.15 @ 600 crs centre joist.
Make packers at edges of panels // grid A.

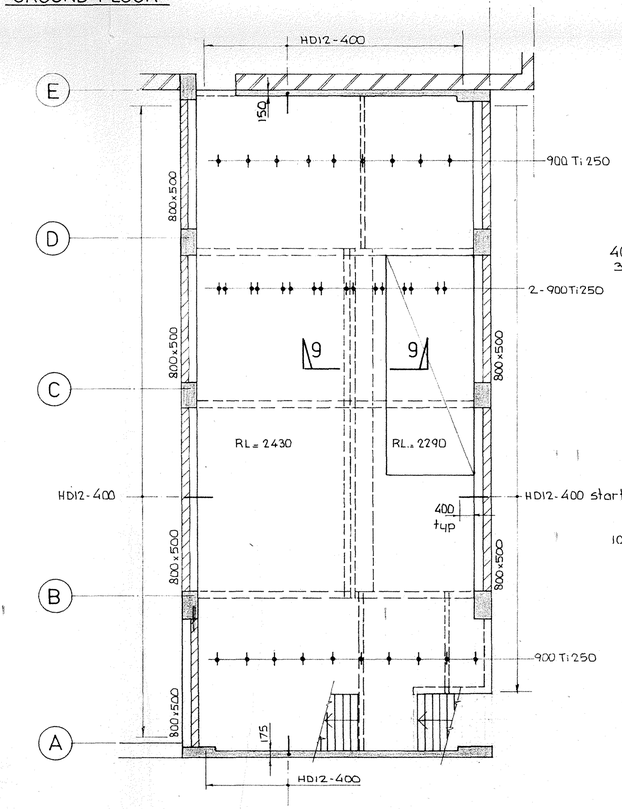
FIRST FLOOR



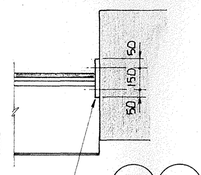
7–7 8–8 similar 2 risers only.



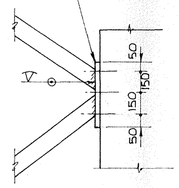
9–9



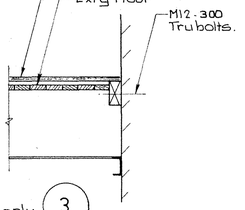
MEZZANINE FLOOR



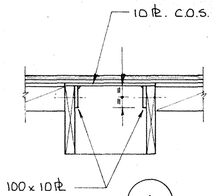
400x200x10 ℄ with 3x2-M20 anchor bolts



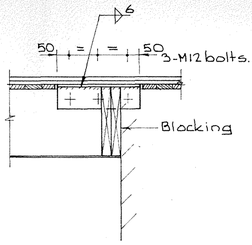
2 2A 2A similar. one bracing only

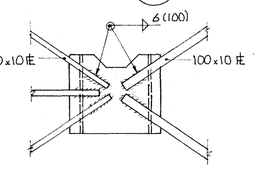


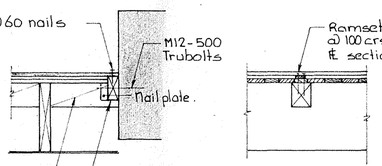
3



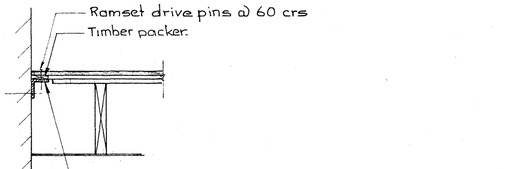
4







1 5 Similar.



6

CONTRACTORS MUST VERIFY ALL DIMENSIONS AT THE JOB BEFORE COMMENCING ANY WORK OR MAKING ANY SHOP DRAWINGS WHICH MUST BE SUBMITTED AND APPROVED BEFORE MANUFACTURE.

ISSUE	AMENDMENT	BY	DATE

WORKS DEPARTMENT BUILDING INSPECTION DISTRICT - 6 NOV 1986 MERCER STREET, WELLINGTON

	Piling permit	4/11/86
COPIES	ISSUED TO	DATE

SMITH LEUCHARS LIMITED

CIVIL STRUCTURAL & EARTHQUAKE ENGINEERS

Wellington: Ph. 857-809 P.O. Box 27349

Auckland: Ph. 399-614 P.O. Box 6324

Hamilton: Ph. 82760 P.O. Box 753

JOB TITLE
WELLINGTON WORKINGMENS CLUB & LITERARY INSTITUTE STRENGTHENING AND UPGRADING CUBA ST PREMISES

DWG TITLE
GROUND, MEZZANINE & FIRST FLOOR PLANS

DRAWN J.v.d.L.	SCALES 1:100
CHECKED	
APP'D	DWG Nº 1868/2
DATE Nov. '86