

1

WELLINGTON CITY COUNCIL
Building Inspection Branch
- 6 NOV 1986
RECEIVED

Plumbing and Drainage Branch
Application
WORKING AND GRANTED

the City Engineer
is hereby permitted to carry out the works described in
the attached plans and specifications deposited herewith and in accordance with
the bylaws of the Wellington City Council.

PAGES 1 & 2 TO BE COMPLETED BY THE APPLICANT

ADDRESS OF PROPOSED WORK
Address Street No. and Name
Suburb

OWNER
Name
Address

LEGAL DESCRIPTION (from property rates demand if available)
Lot No. D.P. No. Area M²

BUILDER (if owner builder, tick ☐)
Name of Company
Postal Address
Phone No.

Description of Proposed Work
New Building ☒ Conversion ☐
Addition ☐ Demolition ☐
Alteration ☐ Repile ☐

Description of Use and Main Purpose of Building
ie Dwelling: Flats: Business: Other Building:
OTHER BUILDINGS

ESTIMATED VALUE OF WORK
Building \$25,000.
Mechanical Services \$ less materials balance
Drainage \$-\$-\$=\$
Plumbing \$-\$-\$=\$
Total \$25,000. 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.

FOR OFFICE USE
1-500 Sheet No. P28 Drainage Plan No.
Building District TC Aro 3

2

DETAILS OF PROPOSED BUILDING
Scope of Application ☐ Complete project ☒ Partial project
(state nature of partial work) Piling
Number of Dwelling Units 1 Number of Occupants 1

AREA OF BUILDING
Area of Addition Ground Floor M² 210
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 Jvd Lee
Address c/o Smith - Leuchars
Contact Phone No's 257-809 Signed 27-349
FOR OFFICE USE
DOCUMENTS ATTACHED AS PART OF THIS APPLICATION WHICH ARE APPLICABLE:
Drawings - two sets ☒ Specifications 2 ☐
Calculations ☒ Water Form ☐ Govt. Clearance ☒
Bracing Schedule ☒ Drainage Plan ☒ Architects Signature ☒
Parking Area ☒
Application Received By: Signed
Plans Show: Elevations ☒ Sections ☐ Construction ☐
Full Dimensional Site Plan ☒
Contour Plans & longitudinal section through vehicle access from kerb ☒
ACTION TAKEN ON ABOVE
SPECIAL LICENCES ETC. Refer to:
MISCELLANEOUS NOTES:

3

HISTORY SHEET
1. Water Supply
2. Town Planning
3. Plumbing & Drainage
4. Streetwork Design
5. Health Branch
6. Parks & Recreation
7. Structural
8. Other

APPROVED BY
DATE
6/11/86
12/11/86
20/11/86
6/11/86
7/11

REFER TO
TOP
Bloop
K. Taylor
P.H.

PLUMBING AND DRAINAGE REQUIREMENTS
N.P.R.
also planning on drainage work to be carried out under this filing only stage contract.

Drainage Branch Requirements
Proposal acceptable
Approved 19-11-86

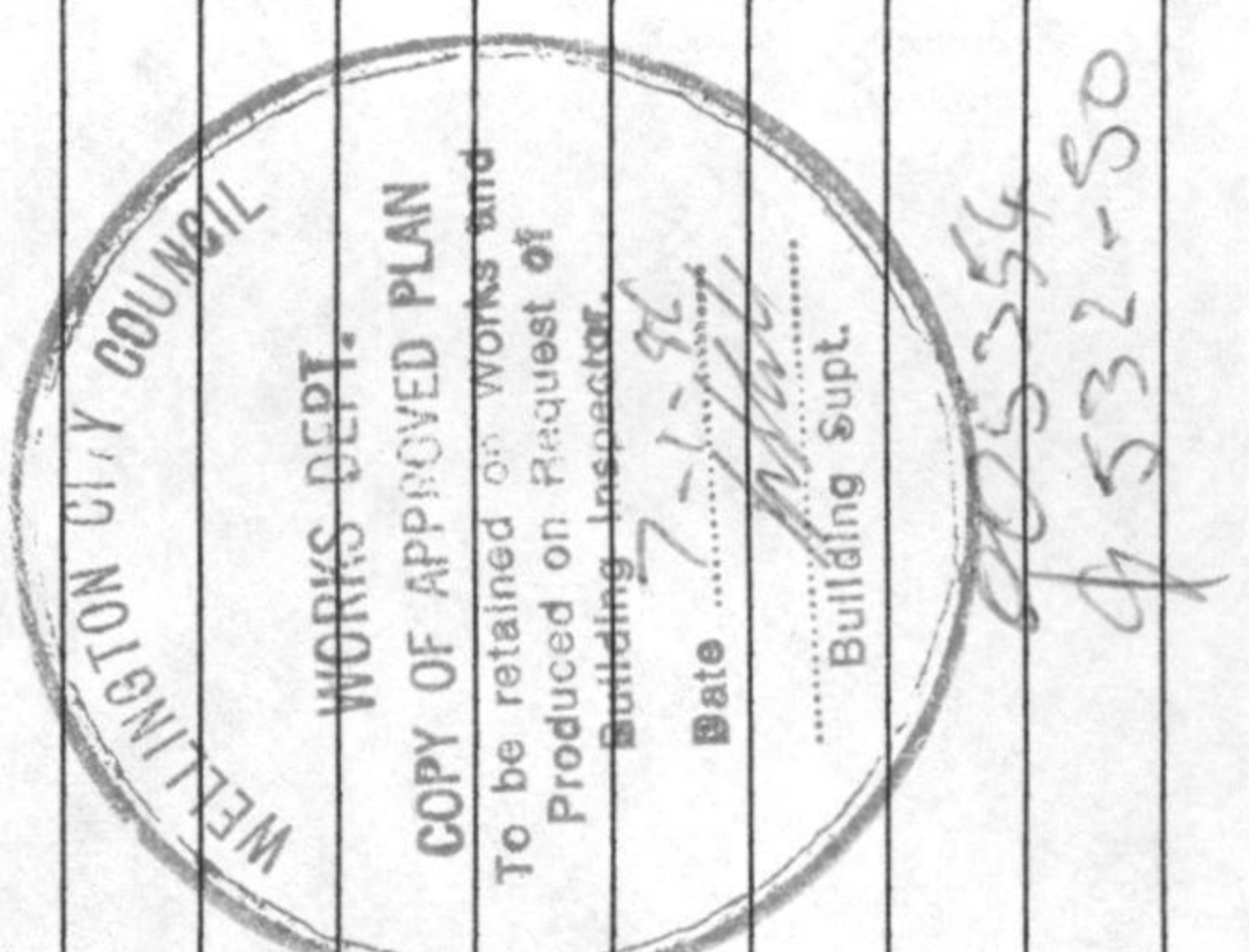
BUILDING REQUIREMENTS

STRUCTURAL
TOWN PLANNING
Complies with conditions of initial planning consent.
SIGNED
The water supply shall be metered. The meter is to be located externally in accordance with the position to the approval of the C.E. Engineer. O.K.
BUILDING EXTENSION 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 ☒ Disposal of Soil ☐
Ground Conditions Fill ☐ Natural ☒
Demolitions ☒ Hoardings ☒ Gantry ☒
Encroachments approved ☒ Building Line Restrictions ☒
Egress Refer to
Signed by District Inspector: M. Anderson
Date 28-11-86

APPLICATION APPROVED
Signed
Date





BUILDING PERMIT
(Office Copy)

**WELLINGTON CITY COUNCIL
WORKS DEPARTMENT**

No. D 005354

Date Issued **8 11 187**

OWNER

Name WELLINGTON WORKING MEN'S CLUB

Mailing Address 8 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 BUILDING)

| FLOOR AREA | | DWELLING UNITS | |
|------------------|------------|----------------|--|
| Whole Sq. Metres | <u>210</u> | Number Erected | |

| ESTIMATED VALUES \$ | Building | <u>25 000</u> | |
|---------------------------|----------|---------------|--|
| | Plumbing | <u>-</u> | |
| | Drainage | <u>-</u> | |
| | TOTAL | <u>25 000</u> | |

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 | | <u>25</u> | | 263-939 | Sewer Connections | | | |
| 065-955 | Inspection of Work/Documents | | <u>345</u> | | 263-939 | Stormwater Connections | | | |
| 061-902 | Plumbing Permit Fee | | <u>-</u> | | 263-941 | Manhole/LH CE Raise/Lower | | | |
| 061-902 | Drainage Permit Fee | | <u>-</u> | | Dep. No. | Demolition Deposit Rd/Path | | | |
| 704-902 | Building Research Levy | | <u>25</u> | | 263-940 | Sewer Disconnections | | | |
| 745-909 | Reserves Contribution | | <u>137</u> | <u>50</u> | 263-940 | Stormwater Disconnections | | | |
| Dep No. | Access Guarantee Deposit | | <u>-</u> | | 294-940 | Water Disconnections | | | |
| Dep No. | Footpath Damage Deposit | | <u>-</u> | | | | <u>EXC 65</u> | <u>484</u> | <u>39</u> |
| 225-971 | L.D. Crossing & Conc. Cutting | | <u>-</u> | | | | <u>BST =</u> | <u>48</u> | <u>41</u> |
| 225-971 | Stormwater Alteration | | | | | | TOTAL INC | <u>532</u> | <u>50</u> |
| 225-970 | H.D. Crossing | | | | Received From | <u>Benevolence</u> | | | |
| 225-972 | Builders Road Fee | | | | Address | <u>Box 40080</u> | | | |
| 225-972 | Drainlayers Footpath Fee | | | | Machine Receipt No. | <u>403 5538</u> | Date | <u>7.1.57.</u> | |
| 225-972 | Drainlayers Road Fee | | | | The above fees are payable in addition to the plan examination fee of \$ <u>185</u> - already paid. Refer receipt <u>403 4049</u> | | | | |
| Dep. No. | Drainlayers Deposit Road/Path | | | | Date <u>4.11.86</u> | | | | |

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 [Signature]

DATE 8.11.87



Brickell Moss Raines & Stevens Ltd

Consulting Engineers, Planners, Surveyors and Valuers

181-189 Thorndon Quay
Wellington, New Zealand
PO Box 1591
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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,

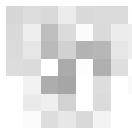
LIMITED SUBSURFACE INVESTIGATION
PROPOSED REDEVELOPMENT
WELLINGTON WORKING MENS CLUB
CUBA STREET, WELLINGTON

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.



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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:-

| | <u>Dead Plus Live Load</u> | <u>Factored Dead Plus Live Earthquake</u> |
|----------------|----------------------------|---|
| 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

1. The first step in the process of identifying a problem is to define the problem clearly. This involves identifying the symptoms, the scope of the problem, and the impact it is having on the organization. Once the problem is defined, the next step is to gather information about the problem. This can be done through interviews, surveys, and other research methods. The information gathered should be used to identify the causes of the problem and to develop a plan of action to address the problem.

2. The second step in the process of identifying a problem is to gather information about the problem. This can be done through interviews, surveys, and other research methods. The information gathered should be used to identify the causes of the problem and to develop a plan of action to address the problem.

3. The third step in the process of identifying a problem is to develop a plan of action to address the problem. This plan should be based on the information gathered in the previous steps and should outline the steps that will be taken to address the problem. The plan should also include a timeline for when the actions will be taken and a budget for the actions.

4. The fourth step in the process of identifying a problem is to implement the plan of action.

5. The fifth step in the process of identifying a problem is to evaluate the results of the plan of action. This involves comparing the results of the plan to the original problem and to the goals that were set in the plan. If the results are not as expected, the plan may need to be revised.

6. The sixth step in the process of identifying a problem is to communicate the results of the plan of action to the relevant stakeholders.

7. The seventh step in the process of identifying a problem is to monitor the results of the plan of action.

8. The eighth step in the process of identifying a problem is to report the results of the plan of action.

9. The ninth step in the process of identifying a problem is to review the results of the plan of action.

10. The tenth step in the process of identifying a problem is to document the results of the plan of action.

11. The eleventh step in the process of identifying a problem is to share the results of the plan of action with the relevant stakeholders.

12. The twelfth step in the process of identifying a problem is to evaluate the results of the plan of action. This involves comparing the results of the plan to the original problem and to the goals that were set in the plan. If the results are not as expected, the plan may need to be revised.

13. The thirteenth step in the process of identifying a problem is to communicate the results of the plan of action to the relevant stakeholders.

14. The fourteenth step in the process of identifying a problem is to monitor the results of the plan of action.

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 backhoe 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:-

| <u>Raft/Soil Interaction</u> | <u>Coefficient of Friction</u> |
|--|--------------------------------|
| 1. Raft concrete in direct contact with the naturally occurring site soils | 0.6 |
| 2. Raft concrete separated from soil by DPC etc. | 0.1 |

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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 footings 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:-

| <u>Design Procedure</u> | <u>Factor of Safety</u> |
|-------------------------|--|
| 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:-

| <u>Eccentricity of Load (c/b)</u> | <u>Reduced Ultimate Bearing Capacity (kPa)</u> |
|-----------------------------------|--|
| 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.

Section 1

The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in all financial dealings.

The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the statistical analysis performed.

The third part of the document presents the results of the study. It includes a series of tables and graphs that illustrate the findings. The data shows a clear trend of increasing activity over time, which is consistent with the hypothesis.

The final part of the document discusses the implications of the findings. It suggests that the results have significant implications for the field of research and may lead to further developments in the future.

The document concludes with a summary of the key points and a final statement on the importance of the research. It also includes a list of references and a bibliography.

Table 1: Summary of Data

| Year | Value |
|------|-------|
| 2010 | 100 |
| 2011 | 120 |
| 2012 | 150 |

Table 2: Summary of Data

| Year | Value |
|------|-------|
| 2010 | 100 |
| 2011 | 120 |
| 2012 | 150 |

The data shows a clear trend of increasing activity over time, which is consistent with the hypothesis. The results are presented in a series of tables and graphs.

The document concludes with a summary of the key points and a final statement on the importance of the research. It also includes a list of references and a bibliography.

Table 3: Summary of Data

| Year | Value |
|------|-------|
| 2010 | 100 |
| 2011 | 120 |
| 2012 | 150 |

Table 4: Summary of Data

| Year | Value |
|------|-------|
| 2010 | 100 |
| 2011 | 120 |
| 2012 | 150 |

The data shows a clear trend of increasing activity over time, which is consistent with the hypothesis. The results are presented in a series of tables and graphs.

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

100

The following table shows the results of the regression analysis for the dependent variable "Perceived Organizational Support" (POS). The independent variables are "Organizational Commitment" (OC) and "Organizational Identification" (OI). The table includes the regression coefficients, standard errors, t-statistics, and p-values for each variable.

| Variable | Regression Coefficient | Standard Error | t-Statistic | p-Value |
|------------------------------------|------------------------|----------------|-------------|---------|
| Organizational Commitment (OC) | 0.45 | 0.08 | 5.62 | 0.000 |
| Organizational Identification (OI) | 0.32 | 0.07 | 4.57 | 0.000 |
| Constant | 1.23 | 0.15 | 8.13 | 0.000 |
| Adjusted R-squared | 0.78 | | | |

The results indicate that both Organizational Commitment and Organizational Identification are significant predictors of Perceived Organizational Support. The regression coefficients are positive, suggesting that higher levels of OC and OI are associated with higher levels of POS. The t-statistics for both OC and OI are greater than the critical value (approximately 1.96), and the p-values are less than 0.05, indicating statistical significance. The adjusted R-squared value of 0.78 suggests that the model explains a large portion of the variance in POS.

1. *Journal of the American Medical Association*, 2000; 283: 2639-2645.

www.elsevier.com/locate/jmb

1. **Wiederholung** (Repetition) – Wiederholen des Textes, um das Gedächtnis zu stärken.

[illegible]

1. **Identify the main components of the system.**

1. **Introduction**
 2. **Background**
 3. **Methodology**
 4. **Results**
 5. **Conclusion**
 6. **References**
 7. **Appendix**
 8. **Figure 1**
 9. **Figure 2**
 10. **Figure 3**
 11. **Figure 4**
 12. **Figure 5**
 13. **Figure 6**
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Abstract

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1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

[illegible]

and/or at irregular 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

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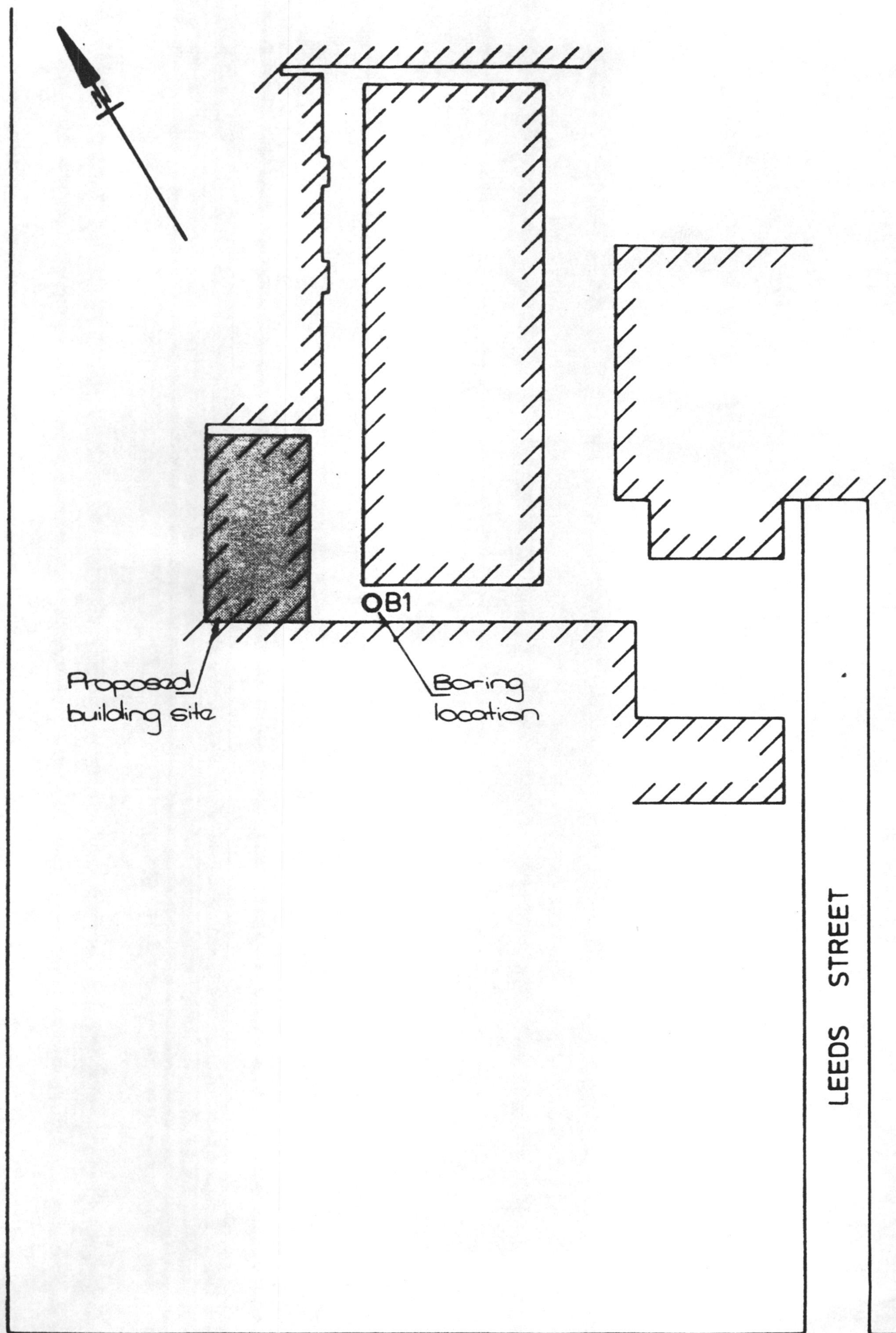
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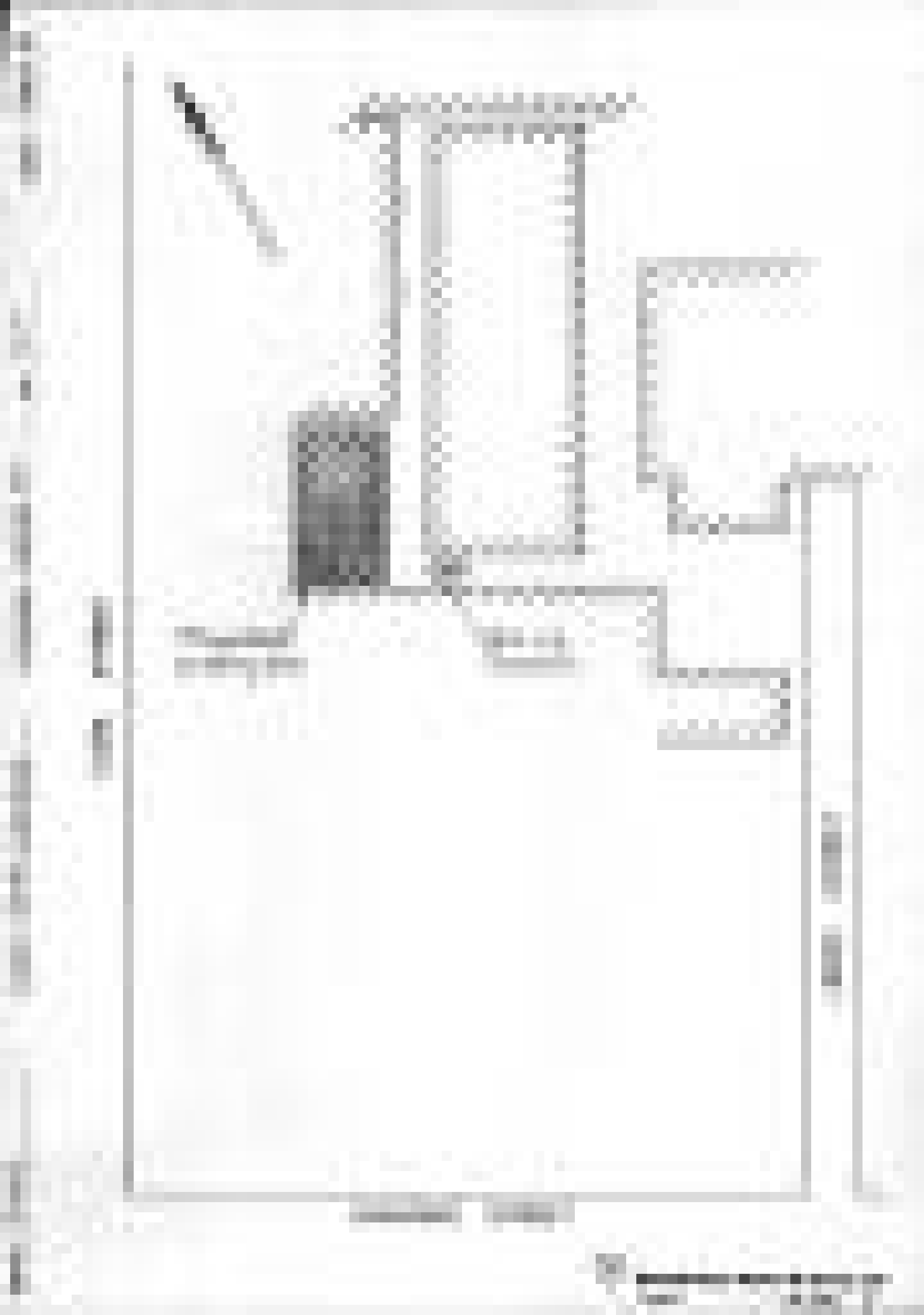
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CUBA STREET

LEEDS STREET

GHUZNEE STREET



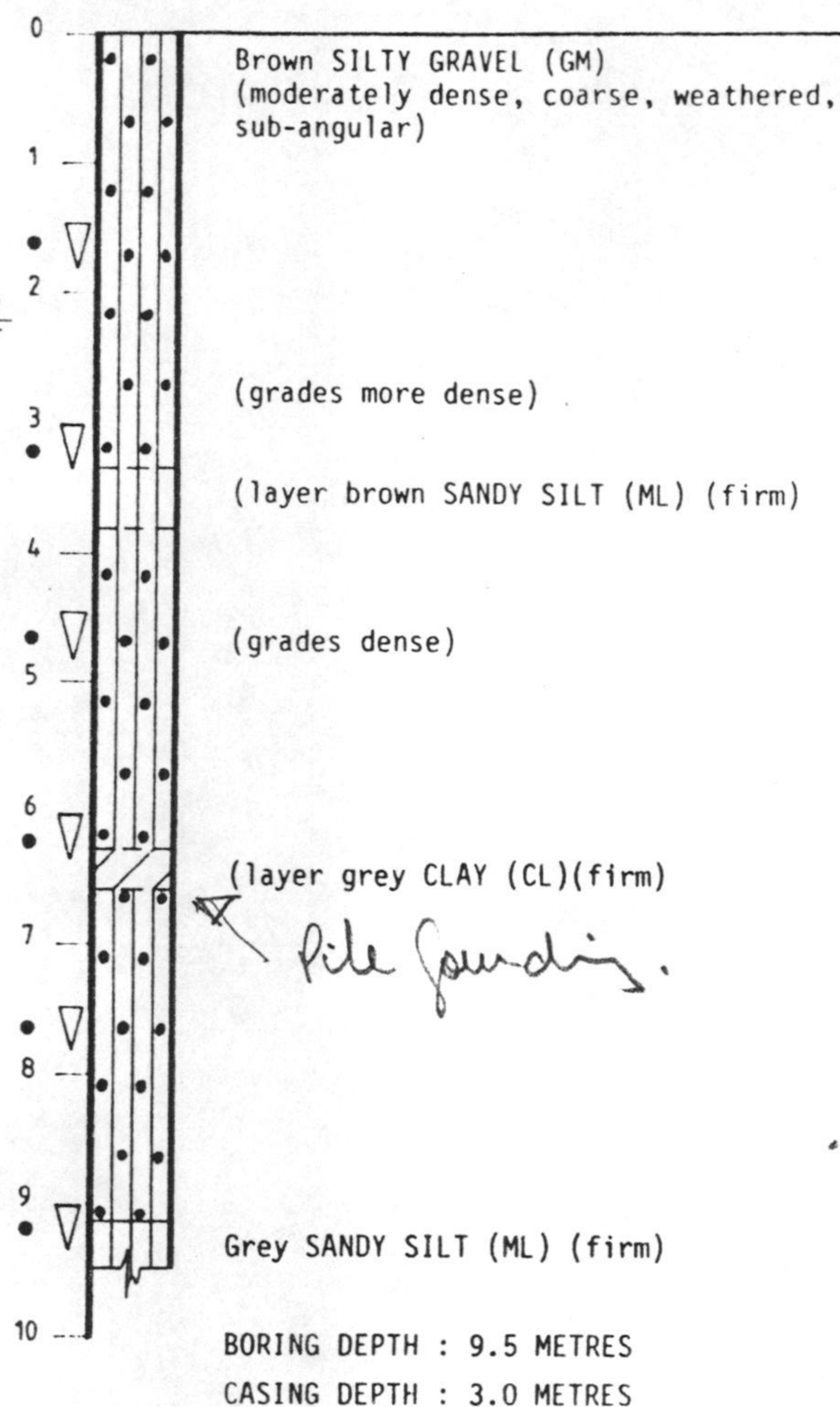


| CLASSIFICATION DATA | | | STRENGTH DATA | | | WATER - DENSITY DATA | | FIELD DATA |
|---------------------|-----------------|---------------------|-----------------|--------------------------------------|---------------------|----------------------------------|-------------------------------------|---------------------------|
| % FINES (-63µm) | LIQUID LIMIT | PLASTICITY INDEX | TYPE OF TEST | TEST SURCHARGE PRESSURE KPa | % SHEAR STRENGTH | NATURAL WATER CONTENT % | DRY DENSITY kg/m ³ | PENETRATION RESISTANCE |
| | | | | | | | | |
| | | | | | | | | N = 16 |
| | | | | | | | | |
| | | | | | | | | N = 21 |
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| | | | | | | | | N = 41 |
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| | | | | | | | | N = 21 |
| | | | | | | | | |

DEPTH IN
METRES

BORING B1

ELEVATION: 8.5 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

100

1. *Journal of the American Medical Association*, 2000; 284: 2689-2695.

100

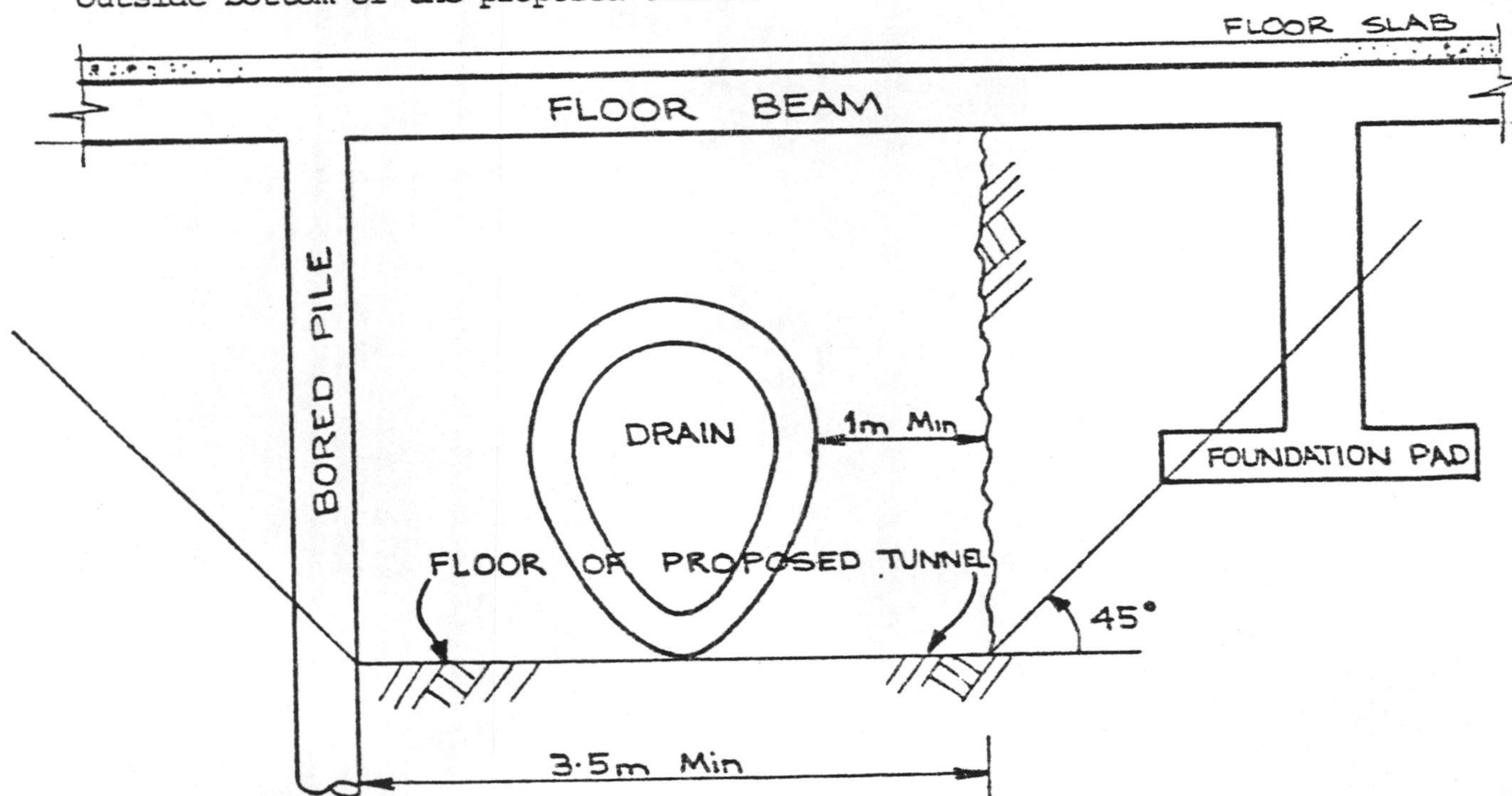
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REQUIREMENTS FOR BUILDING OVER LARGE DRAINS

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 transferred 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 $3\frac{1}{2}$ 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:

CA Wright

DATE:

7.1.87

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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.

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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 reinforcing 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.



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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

1. **NAME**

2. **ADDRESS**

3. **TELEPHONE**

4. **DATE**

5. **REMARKS**

6. **SIGNATURE**

7. **DATE**

8. **DESCRIPTION OF WORK**

9. **REMARKS**

10. **DATE**

11. **SIGNATURE**

12. **DATE**

13. **REMARKS**

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 drawings.
- (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 used 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.

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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.

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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 material 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,

The following table shows the results of the regression analysis for the dependent variable "Number of children in the household" (N = 1,000). The independent variables are "Age of the head of household" and "Gender of the head of household". The table includes the coefficient estimates, standard errors, t-statistics, and p-values for each variable.

| Variable | Coefficient | Standard Error | t-statistic | p-value |
|--|-------------|----------------|-------------|---------|
| Age of the head of household | 0.001 | 0.000 | 1.2 | 0.23 |
| Gender of the head of household (Male = 1, Female = 0) | -0.05 | 0.02 | -2.5 | 0.01 |
| Constant | 1.5 | 0.1 | 15.0 | 0.00 |

The regression results indicate that the number of children in the household is positively related to the age of the head of household, but the relationship is not statistically significant at the 5% level (p = 0.23). The gender of the head of household is negatively related to the number of children in the household, and this relationship is statistically significant at the 5% level (p = 0.01). The constant term is 1.5, indicating that the expected number of children in the household is 1.5 when the age of the head of household is zero and the gender is female.

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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.

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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

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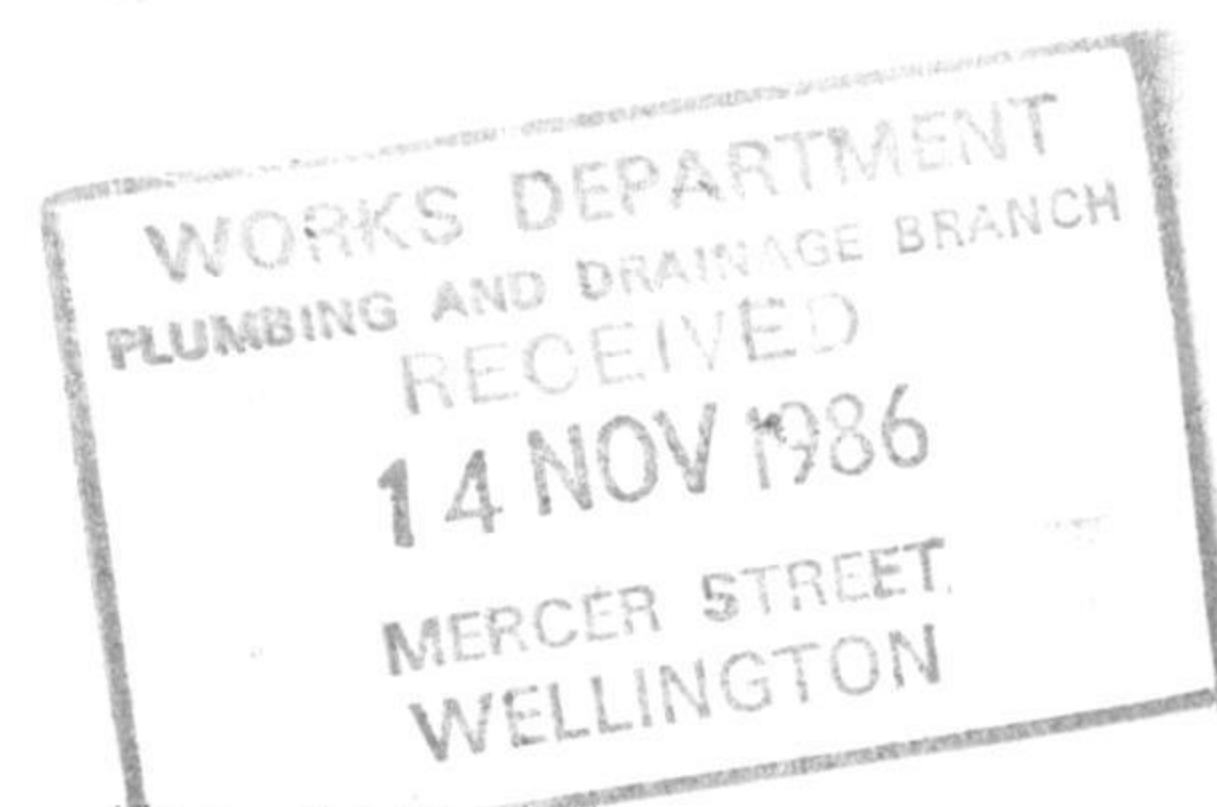
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undercutting and backfilling to the subgrade levels shown on the drawings shall be at the rates of the relevant provisional item in the Schedule.

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.

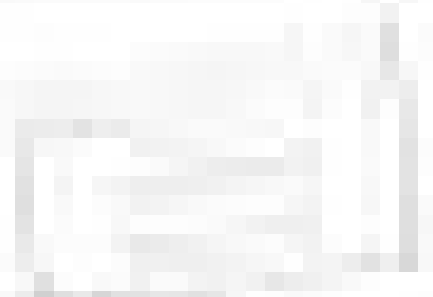
B1.12 FILLING

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.



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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 deleterious 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%.

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SPECIFICATION

FOR

PILING AND EXCAVATION

FOR

STRENGTHENING & EXTENSIONS

AT

**111-117 CUBA STREET
WELLINGTON**

FOR

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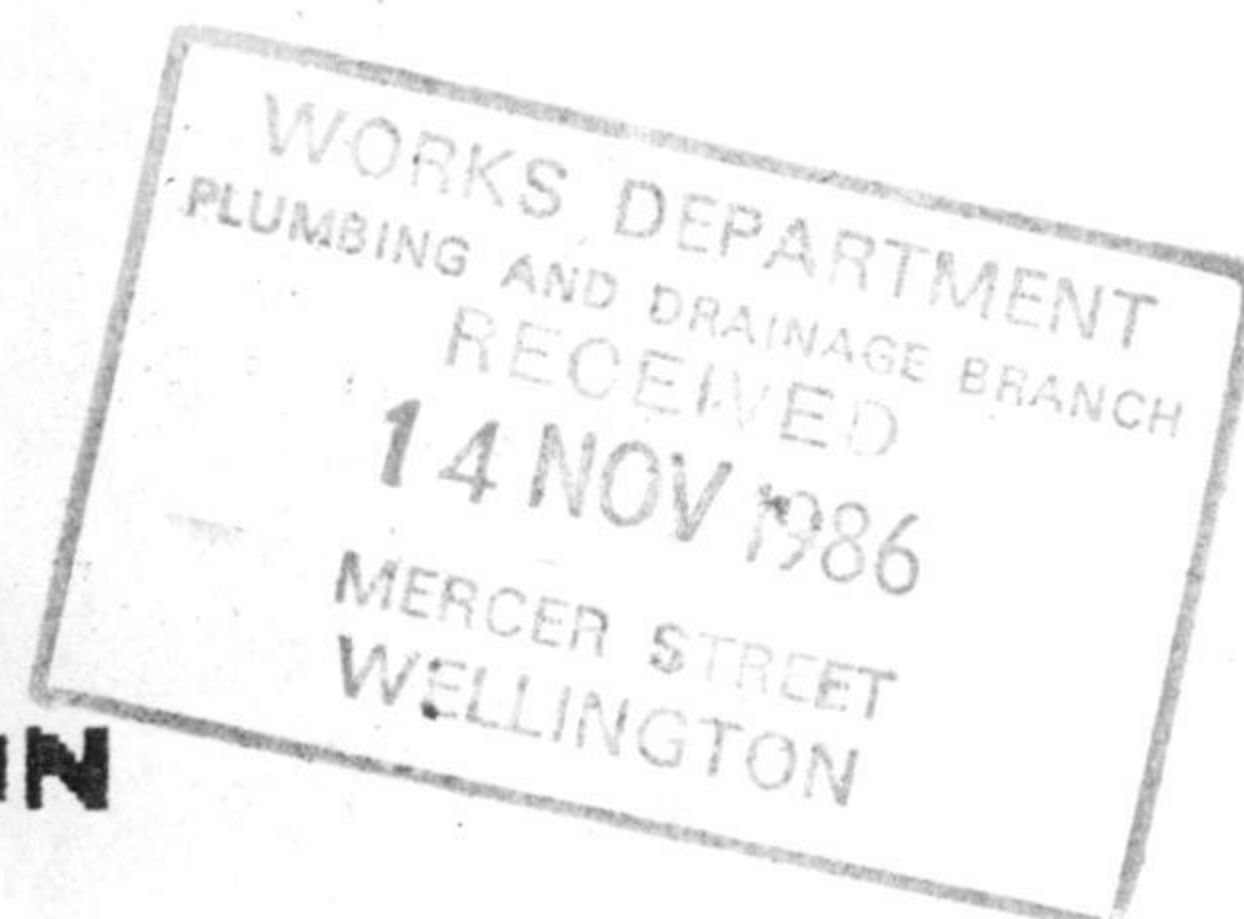
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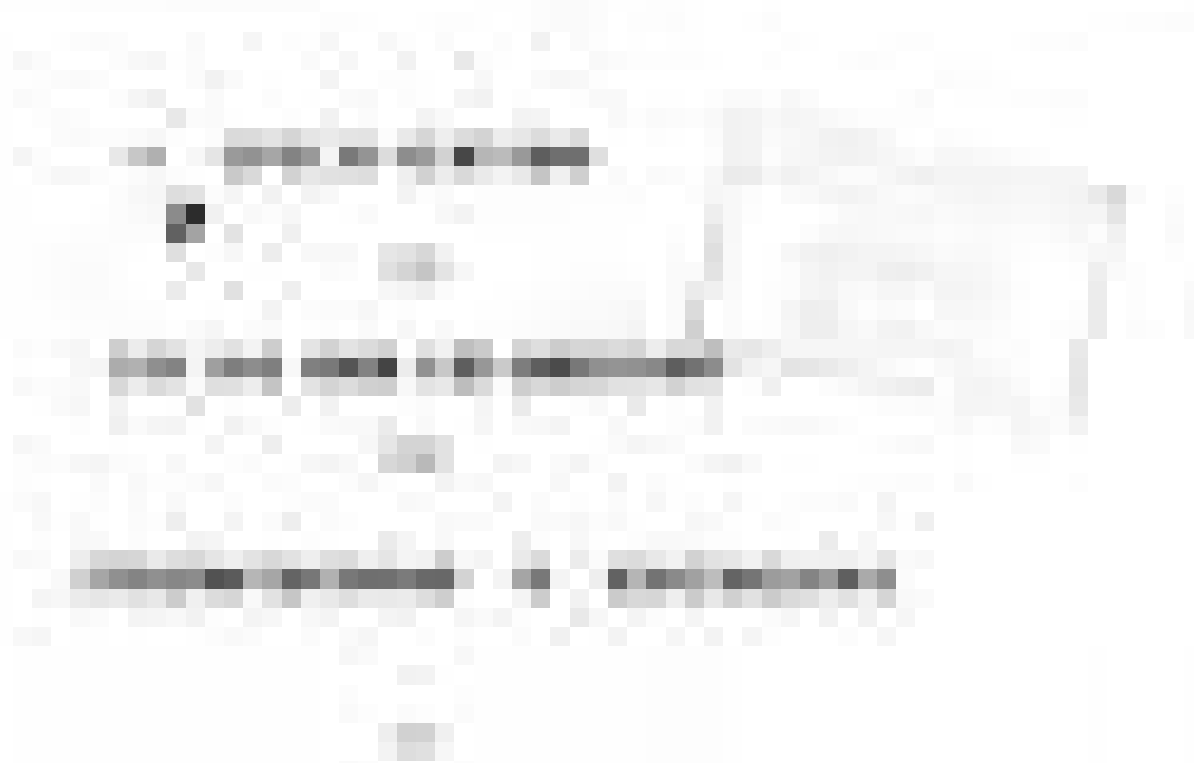
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THE GREAT BRIDGE
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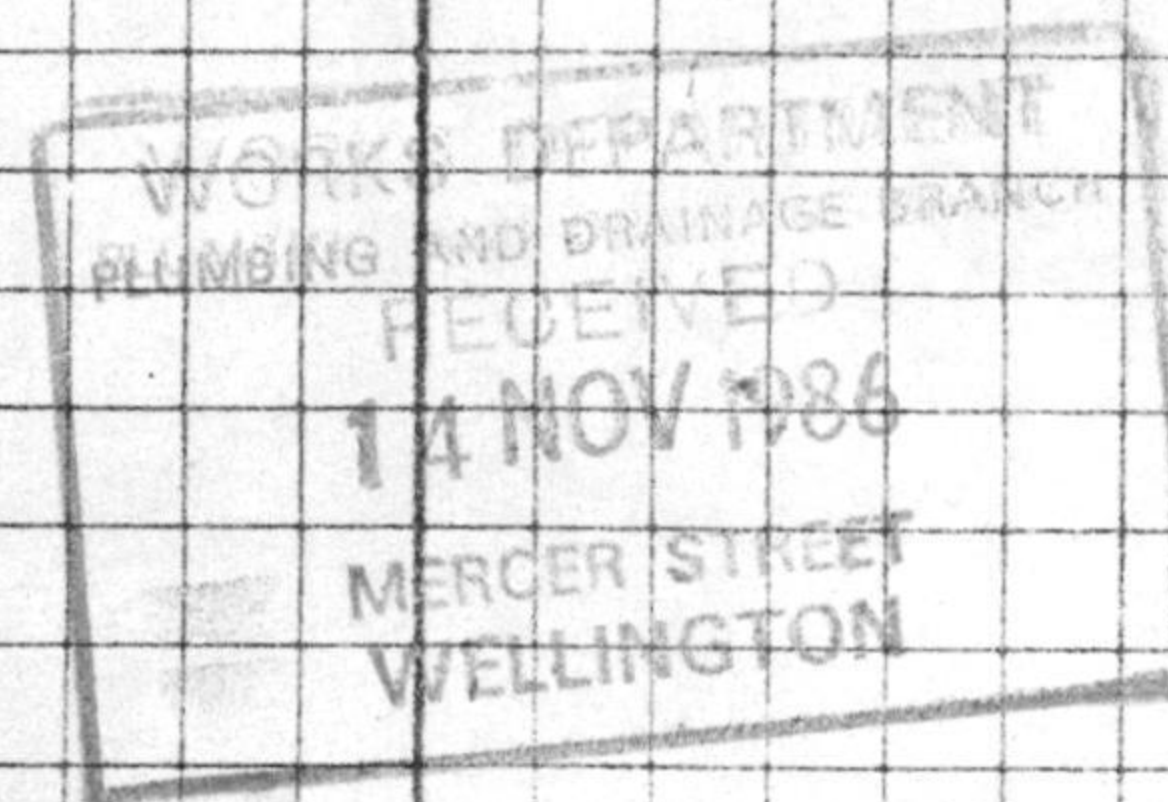
JOB STAGE II STRENGTHENING & EXTENSIONS
WELLINGTON WORKINGMEN'S CLUB



DATE 31/10/86

STRUCTURAL CALCULATIONS

INDEX



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Ground Beam Design.

P/0-18.

Strengthening to
Existing Building.
Foundation Investigation

1. The first part of the report is a general statement of the purpose and scope of the investigation. It is followed by a description of the methods used in the study.

2. The second part of the report is a detailed description of the results of the investigation. It is followed by a discussion of the results and their significance.

3. The third part of the report is a summary of the results and a conclusion. It is followed by a list of references.

4. The fourth part of the report is a list of references. It is followed by a list of figures and tables.

5. The fifth part of the report is a list of figures and tables. It is followed by a list of appendices.

6. The sixth part of the report is a list of appendices. It is followed by a list of footnotes.

7. The seventh part of the report is a list of footnotes. It is followed by a list of index.

INTRODUCTION (refer to sketch over)

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

The final pile position 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.

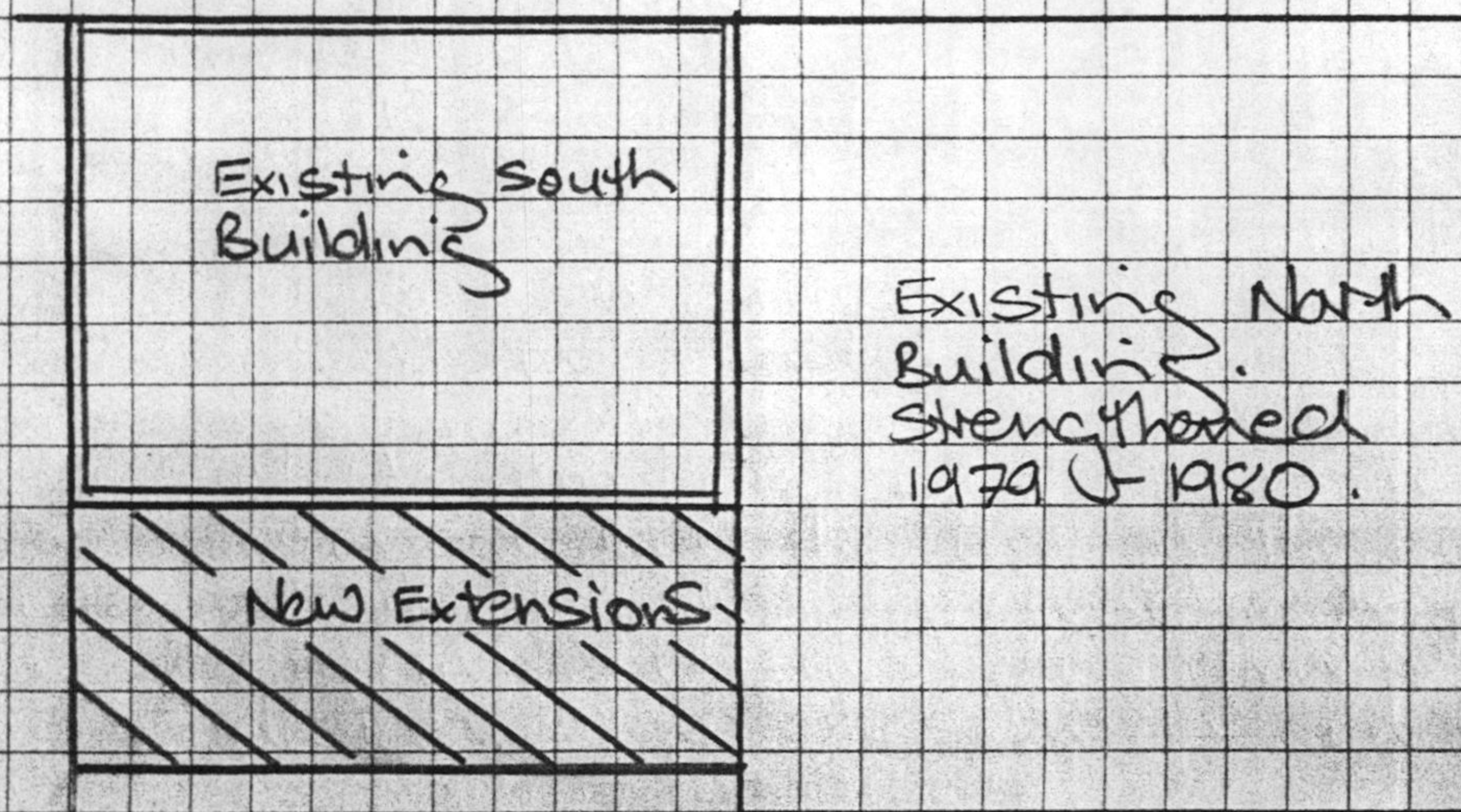
The project involves strengthening the existing 3 Storey brick masonry building (south side) by tying it to a new concrete framed 6 Storey extension to be erected in place of the 1 Storey building located at the rear of the site.

The new building consists of north-south perimeter frames & cast-in-place concrete shear walls at each end. The flooring is Stahilton timber infill.

The combined building has been designed to resist seismic loads to $\frac{2}{3}$ that required under NZS 1000 Chap 8: 1965, and also to deflect in unison with the already strengthened North Building. Limited ductility detailing has also been applied.

| Table 1: Summary of Data | |
|--------------------------|-------|
| Category | Value |
| Item 1 | 10 |
| Item 2 | 20 |
| Item 3 | 30 |
| Item 4 | 40 |
| Item 5 | 50 |
| Item 6 | 60 |
| Item 7 | 70 |
| Item 8 | 80 |
| Item 9 | 90 |
| Item 10 | 100 |

The new building is supported on bored cast-in-place belled piles & concrete ground 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


(M.J. ORSMAN MIPENZ).

1. *Journal of the American Medical Association*, 2000; 283: 2689-2695.

100

100




Figure 6

Figure 1

Abstract

[illegible]

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PAGE 1

JOB _____

BY WFM

DATE 18/8/86

| Section | Building | Masses | |
|------------------|----------------|---|-----|
| 1st floor | | | |
| D | Walls | N $24 \times .45 \times 4 \times 15 = 648$ | |
| | Corr. Interior | $4 \times 24 \times .23 \times 2.1 \times 15 = 696$ | |
| | S | 648 | |
| | Walls | $6 \times 24 \times 2.3 \times .8 \times .5 = 1132$ | |
| | W | $24 \times .6 \times 2 \times 21 = 605$ | |
| | Tr | $.5 \times 2.1 \times 40 = 42$ | |
| | Floor | $1 \times 21 \times 15 = 315$ | |
| | | <u>3086</u> | |
| L | L/3 = 1 kPa | | 315 |
| 2nd floor | | | |
| D | Walls | N&S $2 \times 24 \times .45 \times 2.0 \times 15 = 648$ | |
| | | N&S $2 \times 24 \times .35 \times 1.8 \times 15 = 454$ | |
| | W | $24 \times .6 \times 3.8 \times 21 = 1149$ | |
| | Tr | $.5 \times 2.1 \times 40 = 42$ | |
| | | $.5 \times 1.8 \times 40 = 36$ | |
| | Floor | <u>315</u> | |
| | | <u>2644</u> | |
| L | | | 315 |
| 3rd floor (roof) | | | |
| D | Walls | N&S $2 \times 24 \times .35 \times 1.8 \times 15 = 454$ | |
| | | N&S $2 \times 24 \times .23 \times 2.5 \times 15 = 414$ | |
| | W | $24 \times .6 \times 5 \times 21 = 1512$ | |
| | Tr | $.5 \times 1.8 \times 40 = 36$ | |
| | Roof | $.5 \times 21 \times 15 = 158$ | |
| | | <u>2573</u> | |

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(continued)

[illegible]

Figure 1

[illegible]

Abstract

[illegible][illegible]

Figure 1

100

Figure 1

Abstract

Abstract

Figure 1. The effect of the number of trials on the mean number of correct responses for the 100% condition. The number of correct responses was significantly higher than the number of incorrect responses for all conditions.

| | | | | |
|-----------------------------|----------|---------------------------|-------------|--|
| <u>New Bldg</u> | | | | |
| <u>Mezz Floor</u> | | | | |
| | S | 24 x .15 x 2.5 x 9 = | 81 | |
| D | walls | E 4 x 2.5 x 21 = | 210 | |
| | tr | .5 x 2.5 x 20 = | 25 | |
| | floor | 4 x 21 x 9 = | 756 | |
| | beams | 2 x 24 x 1.6 x 20 = | 576 | |
| | cols | 10 x 24 x 1.0 x 6 x 2.5 = | 288 | |
| | | | <u>1936</u> | |
| L | | 1.67 x 21 x 9 = | 316 | |
| <u>1st floor</u> | | | | |
| | S | 24 x .15 x 3 x 9 = | 97 | |
| D | walls | E 4 x 3 x 21 = | 252 | |
| | tr | .5 x 3 x 20 = | 30 | |
| | floor | | 756 | |
| | beams | | 576 | |
| | cols | | <u>288</u> | |
| | | | <u>1999</u> | |
| L | | 1 x 21 x 9 | 189 | |
| <u>2nd floor, 3rd floor</u> | | | | |
| D | walls | S 24 x .15 x 3.7 x 9 = | 120 | |
| | | E 4 x 3.7 x 21 = | 311 | |
| | tr | .5 x 3.7 x 20 = | 37 | |
| | floor | | = 756 | |
| | beams | | 576 | |
| | cols | | <u>288</u> | |
| | | | <u>2088</u> | |
| L | | | 189 | |
| <u>4th floor</u> | | | | |
| D | as above | | 2088 | |
| | roof | | 95 | |
| | walls | | <u>120</u> | |
| | | | <u>2303</u> | |
| L | | | 316 | |

} $\div 10\% \Rightarrow OK$

| Final | Seismic | Masses | | | |
|-------|---------|--------|------|------|-------|
| LEVEL | OLD | BLDG | NEW | BLDG | Wt |
| | D | L/3 | D | L/3 | |
| 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 reqmts

$$V = KCW_t$$

$$2/3 KC = 2/3 \times 1.25 \times 0.12 = 0.1$$

$$V = 0.1 W_t = 2055 \text{ kN}$$

| LEVEL | h _x | W _x | W _x h _x | F _x | V _x | FRAME DESIGN FORCES | |
|-------|----------------|----------------|-------------------------------|----------------|----------------|---------------------|----------------|
| | | | | | | F _x | V _x |
| 4 | 3.7 | 16.4 | 2619 | 42952 | 476 | 238 | 238 |
| 3 | 3.7 | 12.7 | 4850 | 61595 | 682 | 341 | 579 |
| 2 | 4.0 | 9.0 | 5236 | 47124 | 522 | 261 | 840 |
| 1 | 2.4 | 5.0 | 5589 | 27945 | 310 | 155 | 795 |
| M | 2.6 | 2.6 | 2252 | 5855 | 65 | 33 | 1028 |
| | | | | 185471 | | | |

$$F_x = \frac{V W_x h_x}{\sum W_x h_x}$$

$$R/L = 16.4/21 = 0.8 < 3$$

⇒ No 0.1V @ top.

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

⇒ Design forces for frame are 50% of total

Abstract

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[illegible]

Figure 1

[illegible]

1. *Journal of the American Medical Association*, 2000; 283: 2689-2693.

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Abstract

100

100

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[illegible]

1000

11. *Journal of the American Medical Association*, 277: 1005-1006, 1997.

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1. *Journal of the American Medical Association*, 2000; 283: 2689-2695.

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100

Figure 1

Table 1

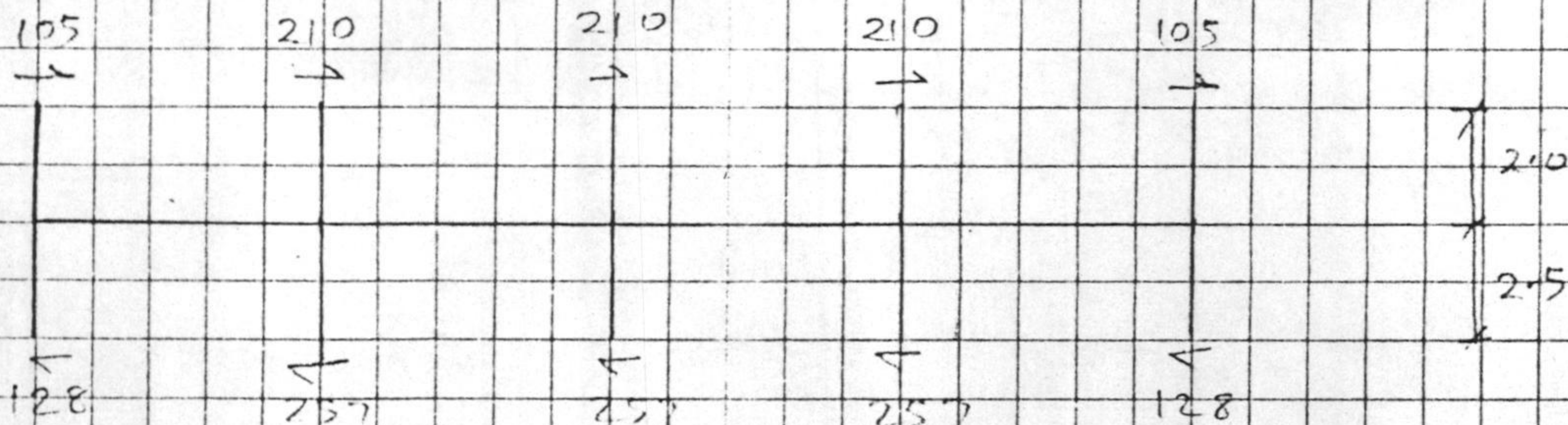
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Assume

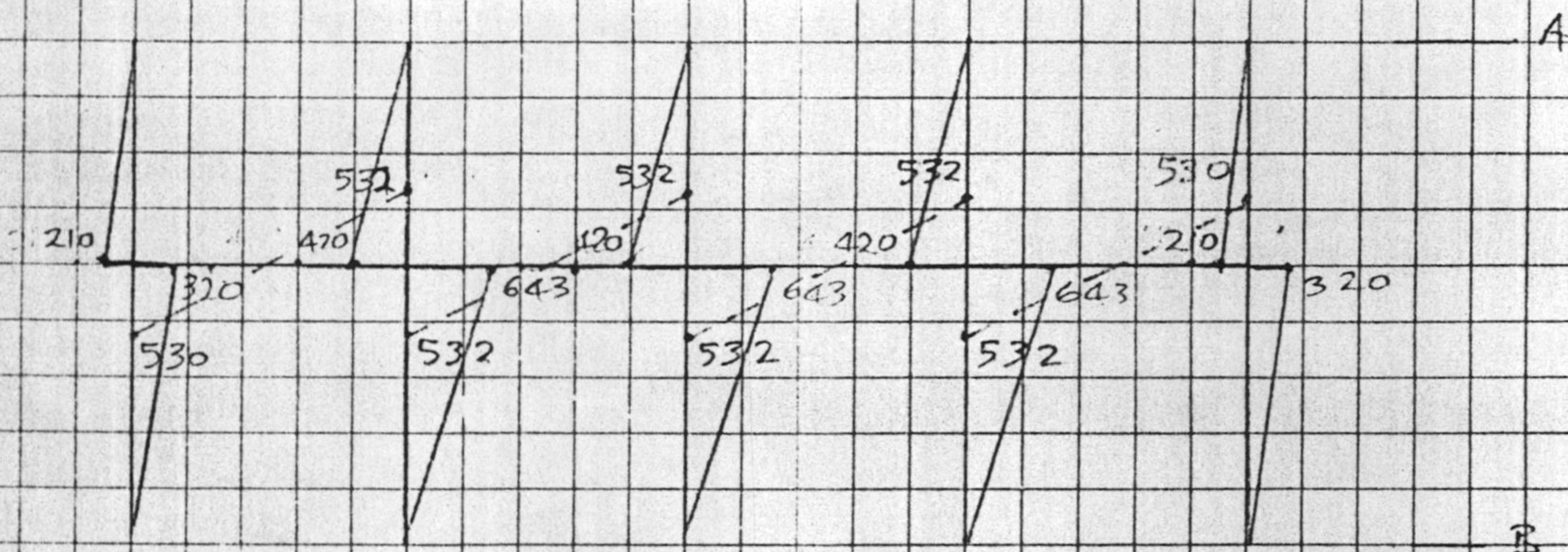
pt. of contraflexure @ mezzanine level
(ignore floor level for purpose of scheme)

Clear Floor Width: 6.1m

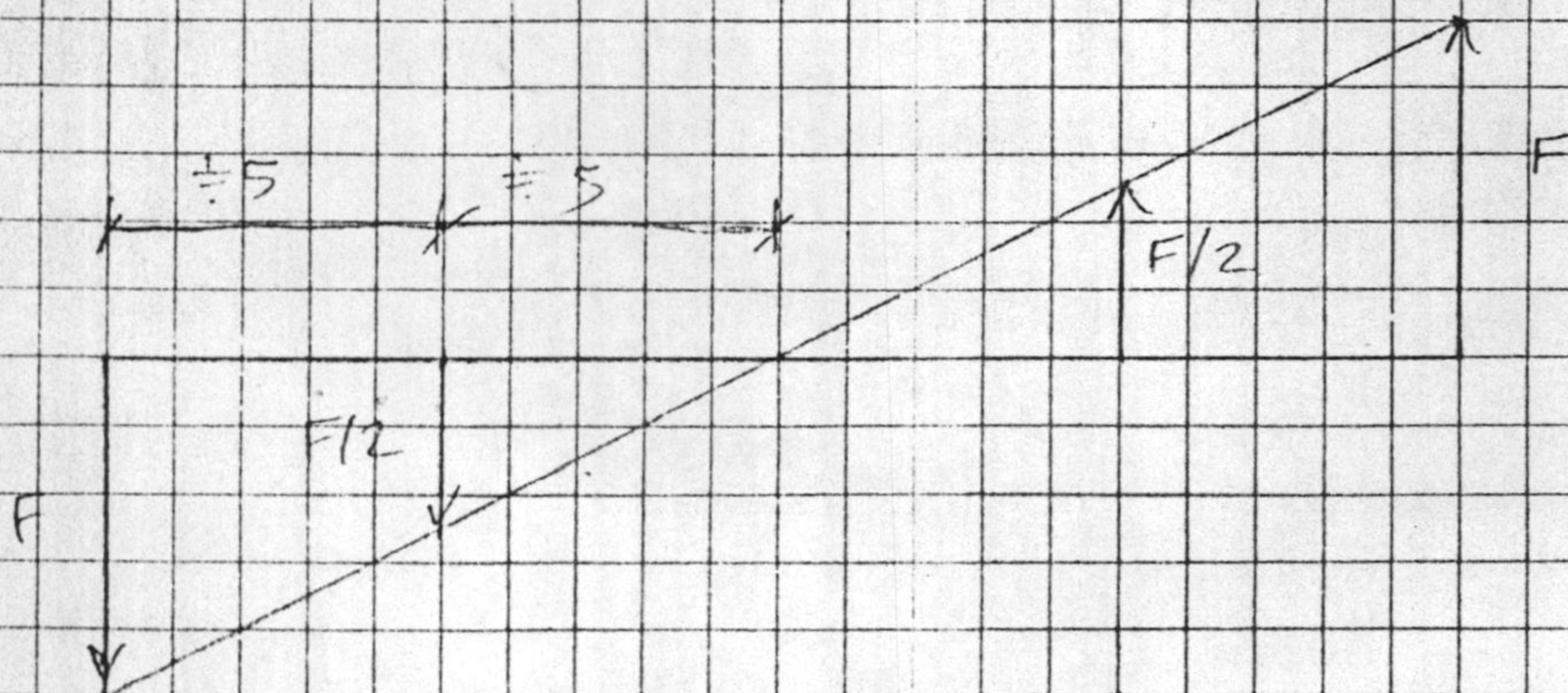
Assume end cols = Equivalent of
have $I = 0.5$ internal cols 8 cols



BMD



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



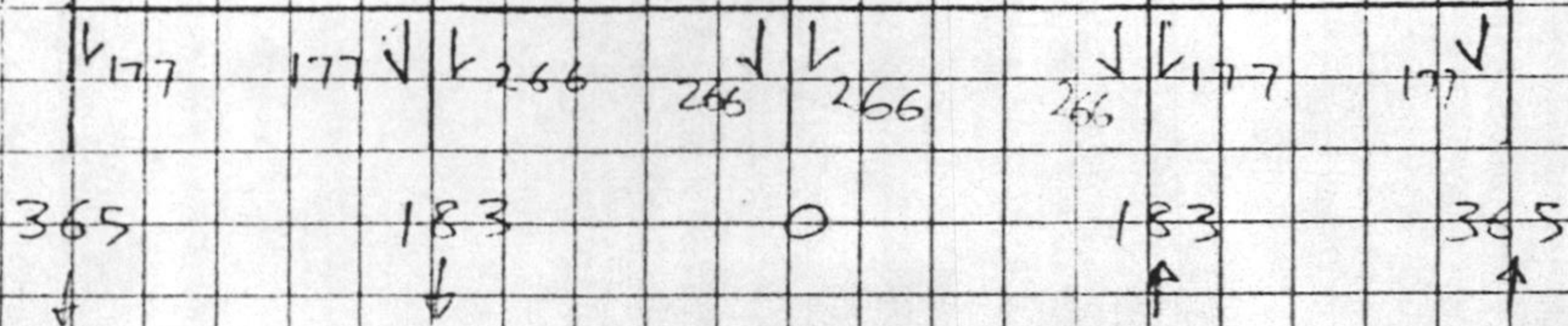
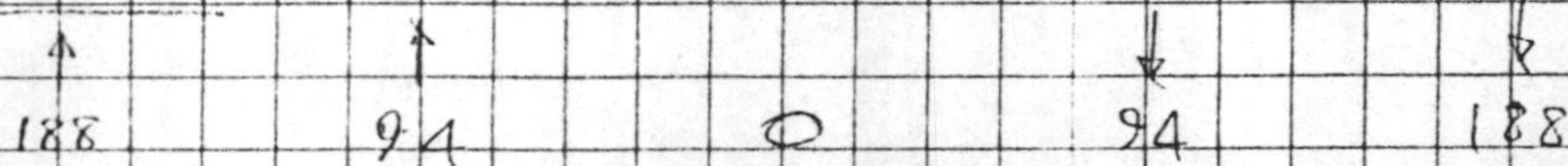
$$[(F \times 10) + (F/2 \times 5)] \times 2 = 25 F$$

$$\text{Moment @ A} = 238 \times 9.4 + 341 \times 5.7 + 261 \times 2 = 4703 \text{ kNm/frame}$$

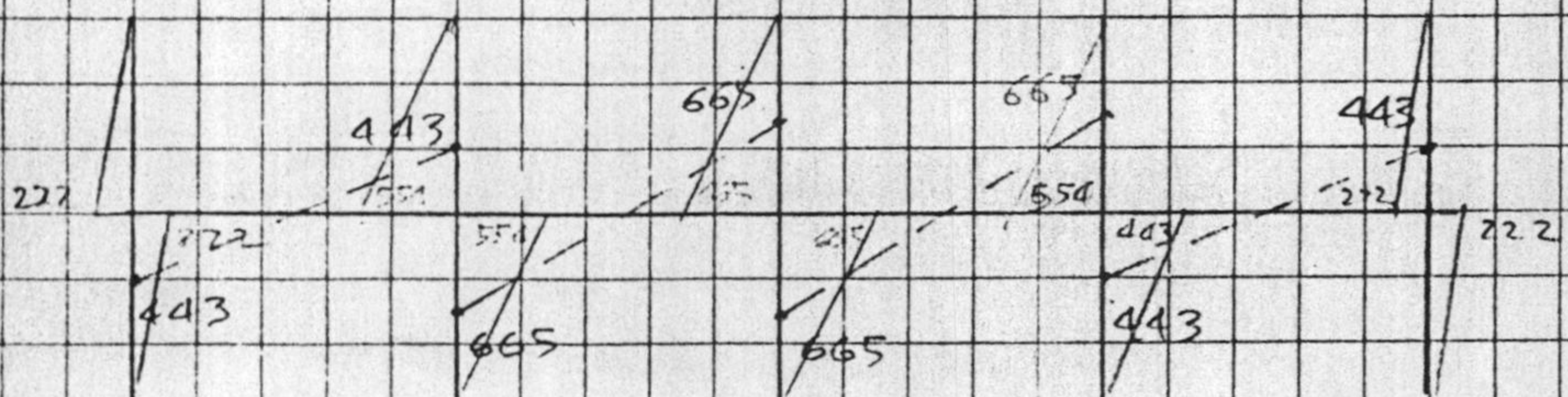
$$\text{Moment @ B} = 238 \times 13.9 + 341 \times 10.2 + 261 \times 7.5 + 155 \times 2.5 = 9131 \text{ kNm/frame}$$

$$\Rightarrow \text{At A: } \begin{matrix} 25F = 4703 \\ 9131 \end{matrix} \Rightarrow \begin{matrix} F = 188 \\ 365 \end{matrix} \quad F/2 = \begin{matrix} 94 \\ 183 \end{matrix} \text{ kN}$$

At A: Forces



BMD (check only)



\Rightarrow Consider worst cases - cols

$$\left. \begin{matrix} M_E = 320 \text{ kNm} \\ P_E = 365 \text{ kN tension} \end{matrix} \right\}$$

$$\left. \begin{matrix} M_E = 665 \text{ kNm} \\ P_E = 183 \text{ kN tension} \end{matrix} \right\}$$

Frame - $M_E = 665 \text{ kNm}$

Try 250×500 $R_u = 2.77$ $\rho = 0.008$ $A_s = 2930$
 $\rho = 0.010$ ($R_u = 2.00$) $A_s = 3540$

\Rightarrow 4H32 or 5D32

\Rightarrow Probably O.K.

Seismic

Internal beam - level 2

Span = 11.0 m

Includes slab 0.5 kPa

$$\begin{array}{lcl}
 \text{D floor (500 Ti 250)} & 3.2 \times 4.5 \times 11 = & 158 \\
 \text{beam} & 24 \times 1.2 \times 1.5 \times 11 = & 158 \\
 & & \hline
 & & 316
 \end{array}$$

$$\begin{array}{lcl}
 \text{D PL - floor} & 1 \times 1.8 \times 5.7 = & 10 \\
 & 24 \times 1.5 \times 3 \times 1.8 = & 6 \\
 & & \hline
 & & 16
 \end{array}$$

$$\begin{array}{lcl}
 \text{L UDL} & 3 \times 5 \times 1 = & 15 \\
 \text{PL} & 3 \times 1.8 \times 5.7 = & 31 \\
 & & \hline
 & & 46
 \end{array}
 \quad
 \begin{array}{lcl}
 A = 55 & R = 1.67 & L_e = 111 \\
 A = 10 & & L_e = 21
 \end{array}$$

$$\begin{array}{lcl}
 \text{D} & 166 & \text{D} & 166 \\
 \text{LL} & 98 & \text{LL} & 98 \\
 \text{Lr} & 66 & \text{Lr} & 66 \\
 1.4D + 1.7L_r & 345 & 1.4D + 1.7L_r & 345
 \end{array}$$

FEM

MSM

$$\begin{array}{lcl}
 \text{D} & 290 + 22 = & 312 \\
 \text{Lr} & 102 + 29 = & 131 \\
 1.4D + 1.7L_r & & 660
 \end{array}
 \quad
 \begin{array}{lcl}
 145 + 22 = & 167 \\
 51 + 29 = & 80 \\
 & 370
 \end{array}$$

$$\begin{aligned}
 \text{Reduct. } M_u^- &= 0.7 \times 660 = 462 \text{ kNm} \\
 M_u^+ &= 568 \text{ kNm}
 \end{aligned}$$

$$P_u = 568 \times 10^6 / (0.9 \times 500 \times 730^2) = 2.37$$

⇒ 800x500 OK as for seismic



Cals

Try 250x500 col

$$\left. \begin{aligned} M_i / f_c' b h^2 &= 665 \times 10^6 / .9 \times 25 \times 500 \times 800^2 = .092 \\ P_i / f_c' b h &= -183 \times 10^3 / .9 \times 25 \times 500 \times 800 = -.02 \\ g &= 660/800 = .8 \end{aligned} \right\} \rho_m = .30$$

$$\left. \begin{aligned} M_i / f_c' b h^2 &= 320 \times 10^6 / .9 \times 25 \times 500 \times 800^2 = .046 \\ P_i / f_c' b h &= -365 \times 10^3 / .9 \times 25 \times 500 \times 800 = -.04 \end{aligned} \right\} \rho_m = .16$$

$$\rho_t = .0168 \quad A_s = 6720 \text{ mm}^2 \Rightarrow 10 \text{ HD } 32$$

 $\Rightarrow 800 \times 500 \text{ col OK}$



Gravity loadings

West frame

Lev 4

| | | | | |
|---|-------|---------------------------|---|------------------|
| D | roof | $.5 \times 4.5$ | = | 2.3 |
| | walls | $.5 \times 4$ | = | 2.0 |
| | floor | 3.2×4.5 | = | 14.4 |
| | beam | $2.4 \times .8 \times .5$ | = | 9.6 |
| | | | | <u>28.3</u> kN/m |

L $3.25 \times 5 = 16.3$

Lev 3

| | | | |
|---|-------|-----------------|-------------|
| D | floor | | 14.4 |
| | beam | | 9.6 |
| | roof | $.5 \times 7$ | = 3.5 |
| | walls | $.5 \times 3.7$ | = 1.9 |
| | | | <u>29.4</u> |

L $3 \times 5 = 15.0$
 $.25 \times 7 = 1.8$
16.8

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

Levs 2 & 1

| | | | | |
|---|-------|------------------|---|------------------|
| D | floor | 3.2×4.5 | = | 14.4 |
| | beam | | = | 9.6 |
| | | | | <u>24.0</u> kN/m |

PL 16.0 kN

L $3 \times 5 = 15$ kN/m

PL 31 kN

*Note

PL \div midspan
 @ lev 2 but @
 lev. 1 PL is
 just away from
 col. pos = under

Lev M

| | | | | | |
|---|-------|-------------------|---|-------------|--------------|
| D | floor | 3.42×4.5 | = | 15.4 | (950 T, 300) |
| | beam | | = | 9.6 | |
| | walls | $.5 \times 2.4$ | = | 1.2 | |
| | | | | <u>26.2</u> | say 27 |

L $5 \times 5 = 25$ kN/m

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East Frame

Lev 4.

| | | | |
|---|----------------------|-------------|-------------|
| D | roof | 2.3 | |
| | walls $4 \times 4 =$ | 16.0 | |
| | floor | 14.4 | |
| | beam | 9.6 | |
| | | <u>42.3</u> | say 43 kN/m |
| L | | 16.3 | say 17 kN/m |

Levs 3, 2 & 1

| | | | |
|---|------------------------|-------------|-------------|
| D | floor | 14.4 | |
| | beam | 9.6 | |
| | walls $4 \times 3.2 =$ | 12.8 | |
| | | <u>36.8</u> | say 37 kN/m |
| L | | 15.0 | |

Lev M

| | | | |
|---|------------------------|-------------|-------------|
| D | floor | 15.4 | |
| | beam | 9.6 | |
| | walls $4 \times 1.6 =$ | 6.4 | |
| | | <u>31.4</u> | say 32 kN/m |
| L | $5 \times 5 =$ | 25 | kN/m |



Shear Walls

Torsion $e_{max} = .16 = .1 \times 25 = 2.5 \text{ m}$ from COM

Centre of stiffness = midway b/w frames $x = 20 \text{ m}$

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 | Meq (MNm) | Veq (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
 $H/6 = 2733$

T_y 150 RC

Effective Section

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

$$= 4800$$

300 150

800

8000

800



Flex. Capacity

$$\text{Assume } P_i = DIL_w / \phi = 0$$

$$\Rightarrow C = T$$

$$C_{max} = .3l_w = 2880 \quad 1052$$

$$\text{Try } c = 800$$

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

$$C_s = 3968 \times .380 = 1.51$$

$$T_{col} = 1.51$$

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

$$(\text{Use HD16 @ } 300)$$

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

$$C = 6.50 + 1.51 = 7.51$$

$$T = 1.51 + 1.59 = 3.10$$

$$\text{Try } c = 400$$

$$C_c = 3.25$$

$$\text{Assume } C_s = T_s \quad (C_{col})$$

$$T_{web} = 1.59 \quad \left. \begin{array}{l} \\ \end{array} \right\} 3.10$$

$$T_{col} = 1.51 \quad \left. \begin{array}{l} \\ \end{array} \right\}$$

$$\text{Try } c = 380$$

$$C_c = 3.09 \quad \left. \begin{array}{l} \\ \end{array} \right\} \text{OK}$$

$$T = 3.10 \quad \left. \begin{array}{l} \\ \end{array} \right\}$$

Take moments about centroid

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

$$1.59 \times 0 =$$

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

$$20.97$$

Shear Walls

$$M_u = \phi M_i = 18.9 \text{ kNm}$$

150 RC

HD16 @ 300 vert

$$M_u \text{ reqd} = 12.59 \text{ kNm} \Rightarrow \text{OK}$$

Shear

$$v_c = 11.31 \times 10^3 / (.85 \times 150 \times (.8 \times 9600)) = 1.16 \text{ MPa}$$

$$2f'_c = 5 \text{ MPa} \rightarrow \text{OK}$$

$$.3 \sqrt{f'_c} = 1.5 \text{ MPa}$$

$$v_c > 1.5 \Rightarrow 2 \text{ layers of } \text{rod}$$

$$v_c = 0.6 \sqrt{\frac{P_o}{N \frac{P_o}{A_g}}}$$

$$A_g = 1.92 \text{ m}^2$$

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

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

$$v_s = 1.16 - .38 = 0.78$$

$$A_v = v_s bws / f_y$$

$$A_{vmin} = .7 bws / f_y$$

$$s_{max} = 201.5 \times 380 / 0.78 \times 150 = 653$$

\Rightarrow HD16 @ 300 horiz. OK

Shear Walls

150 R.C

HD16 @ 300 horiz.

Total r.c for walls

HD16 @ 300 BW

11 kg/m²

(Total 1500 kg)

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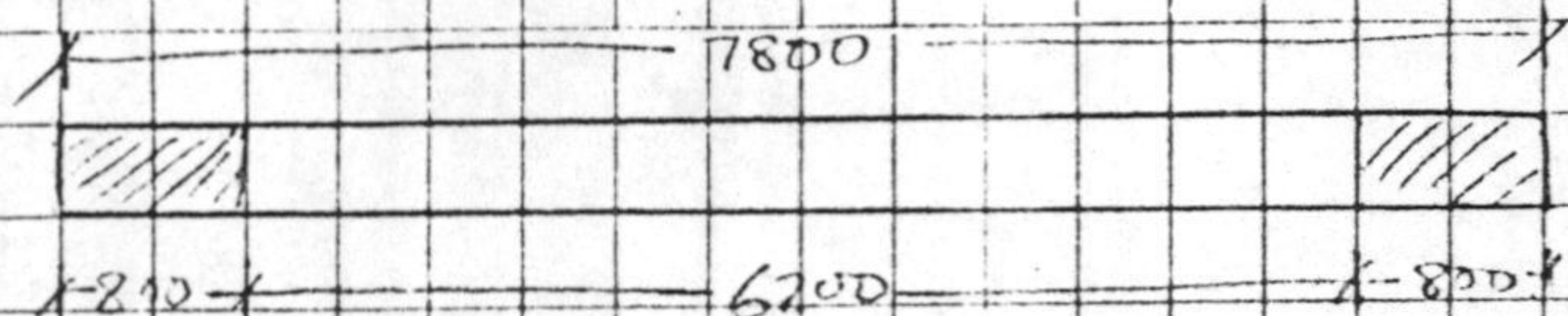
57. The fifty-seventh part of the document is a list of names and titles.

58. The fifty-eighth part of the document is a list of names and titles.

59. The fifty-ninth part of the document is a list of names and titles.

60. The sixtieth part of the document is a list of names and titles.

Effective section



Flex. Capacity

Try $c = 500$

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

$$\begin{aligned} T_w &= 1.58 \\ T_{col} &= 1.51 \end{aligned} \quad \left. \begin{array}{l} \\ \end{array} \right\} 3.09$$

Try $c = 600$

$$\begin{aligned} C_c &= 1.63 \\ C_s &= 1.03 \end{aligned} \quad \left. \begin{array}{l} \\ \end{array} \right\} 2.66$$

HD24 @ 100

$$\begin{aligned} T_s &= .34 \\ T_w &= 1.58 \\ T_{col} &= 1.37 \end{aligned} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} 3.29$$

Try $c = 700$

$$\begin{aligned} C_c &= 1.90 \\ C_s &= 1.20 \\ T_s &= .14 \\ T_w &= 1.58 \\ T_{col} &= 1.37 \end{aligned} \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} 3.1$$

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

$$M_u = \phi M_i = 13.91$$

$$M_u \text{ reqd} = 13.73 \text{ MNm} \Rightarrow \text{OK}$$



Try 8HD20, HD 12 @ 300

Try $c = 500$

$$\left. \begin{array}{l} C_c = 1.63 \\ C_s = .72 \end{array} \right\} 2.35$$

$$\left. \begin{array}{l} T_s = .24 \\ T_w = .89 \\ T_{ext} = .96 \end{array} \right\} 2.09$$

Try $c = 550$

$$\left. \begin{array}{l} C_c = 1.49 \\ C_s = .66 \end{array} \right\} 2.15$$

$$\left. \begin{array}{l} T_s = .30 \\ T_w = .89 \\ T_{ext} = .96 \end{array} \right\} 2.15$$

$$\begin{array}{rcl} M_i & 1.49 \times (3.9 - .85 \times .55/2) & = 5.46 \\ & .66 \times (3.9 - .275) & = 2.39 \\ & -.30 \times (3.9 - .675) & = -0.97 \\ & .89 \times 0 & = \\ & .96 \times (3.9 - .4) & = 3.36 \\ & & \hline & & 10.24 \end{array}$$

$$M_u = 9.22$$

$$M_u \text{ reqd} = 7.662 \Rightarrow \text{OK}$$

North Wall

150 RC
25 MPa
Vert Reo
Levs G-1
8HD20 @ 100
beside door
HD16 @ 300 web
Levs 1-2
8HD20 @ 100
beside door
HD12 @ 300 web
Horiz Reo
Levs G-1
HD16 @ 300
Levs 1-2
HD12 @ 300

lev 6-M

$$v_i = 11.31 \times 10^3 / .85 \times 150 \times .8 \times 7800 = 1.42$$

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

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

$$P_e = D = 461 \text{ kN} \quad v_c = .6 \sqrt{\frac{P_e}{A_g}} = .6 \sqrt{\frac{461000}{1.17 \times 10^6}}$$

$$v_c = .38$$

$$v_s = 1.04$$

$$A_{v \text{ min}} = .7 \text{ bars / sy}$$

$$s_{\text{max}} = 2' = 300$$

$$\#16 \quad s_{\text{max}} = 201 \times 380 / 1.04 \times 150 = 490$$

lev 1-2

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

$$\#12 \quad s_{\text{max}} = 315$$

South Wall.

$$A_{\text{min horiz}} = .002 \times 1.5 \times 1000 = 350 \text{ mm}^2/\text{m}$$

⇒ Detail as for North Wall

Door Opening

Trim with #16 bars

South Wall

175 RC
25 MPa

Levs G-1

#16 @ 300 BW

Levs 1-2

#12 @ 300 BW

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BY

WJM

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26/8/86

Frame Analysis

Gravity Loadings

A-10)

North End

South End

West Frame

4

B5

B6

B7

3

2

1

M

B8

B9

3.4

3.4

4.0

2.4

2.6

& dimensions

E

F

G

H

I

4.3

5.3

1.5

4.8

4.6

East Frame

4

B1

B2

B3

B4

3

2

1

M

A

B

C

D

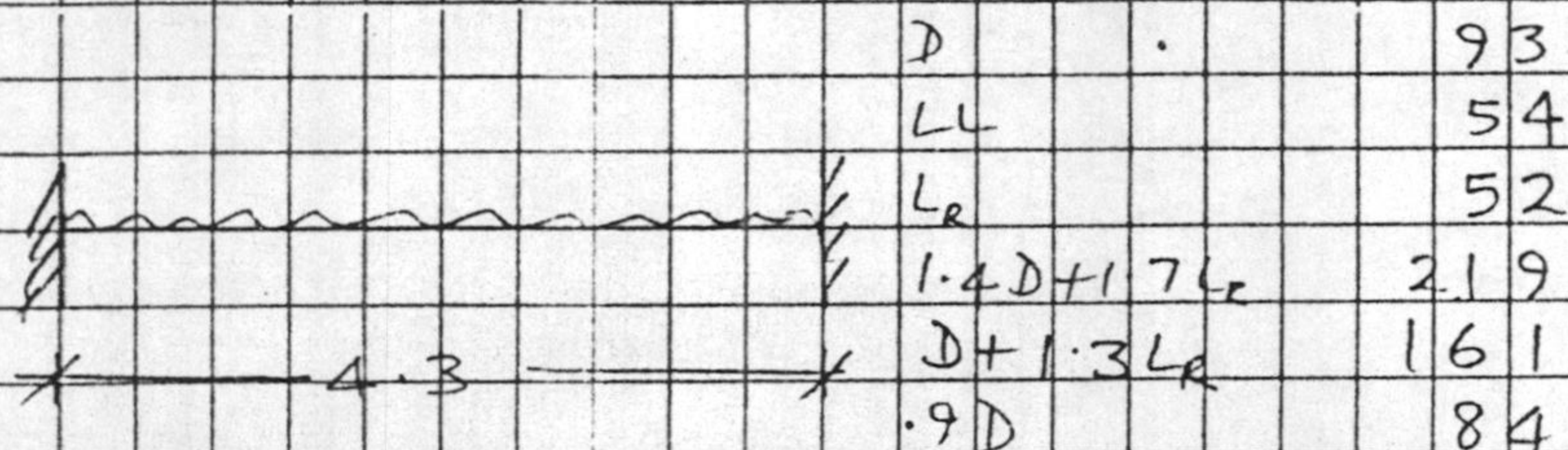
4.3

5.3

6.3

4.6



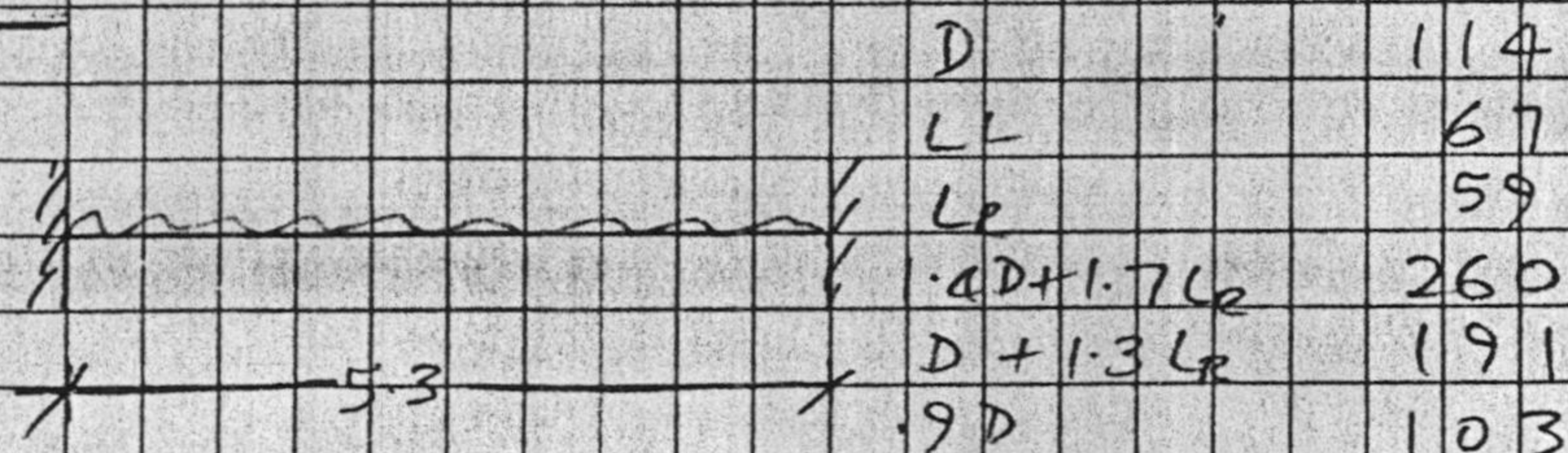
Beams 4-1B1, 1-MB5

$$D \quad 43 \times 4.3 = 185 \text{ kN}$$

$$LL \quad 25 \times 4.3 = 108 \quad A = 21.5 \quad R = .95 \quad L_r = 103 \text{ kN}$$

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

$$D \quad 43 \times 5.3 = 228$$

$$LL \quad 25 \times 5.3 = 133 \quad A = 26.5 \quad R = .88 \quad L_r = 117$$

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 |



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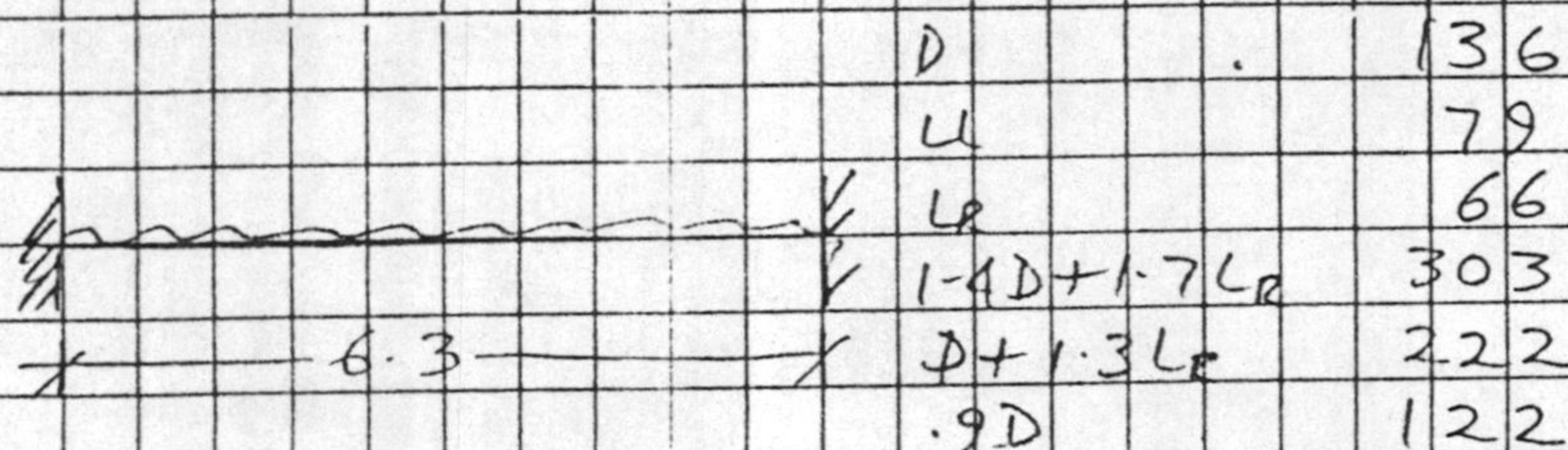
PAGE 18

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DATE 26/8/86

4-MB3 MB9



D 43 x 6.3 = 271

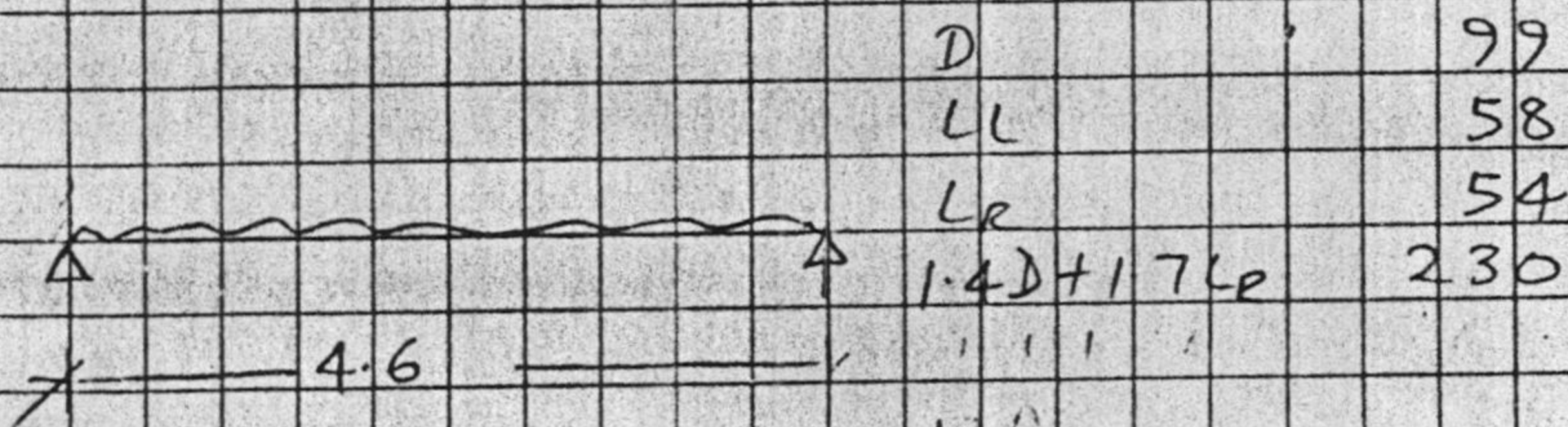
LL 25 x 6.3 = 158 A = 31.5 R = .83 LR = 131

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

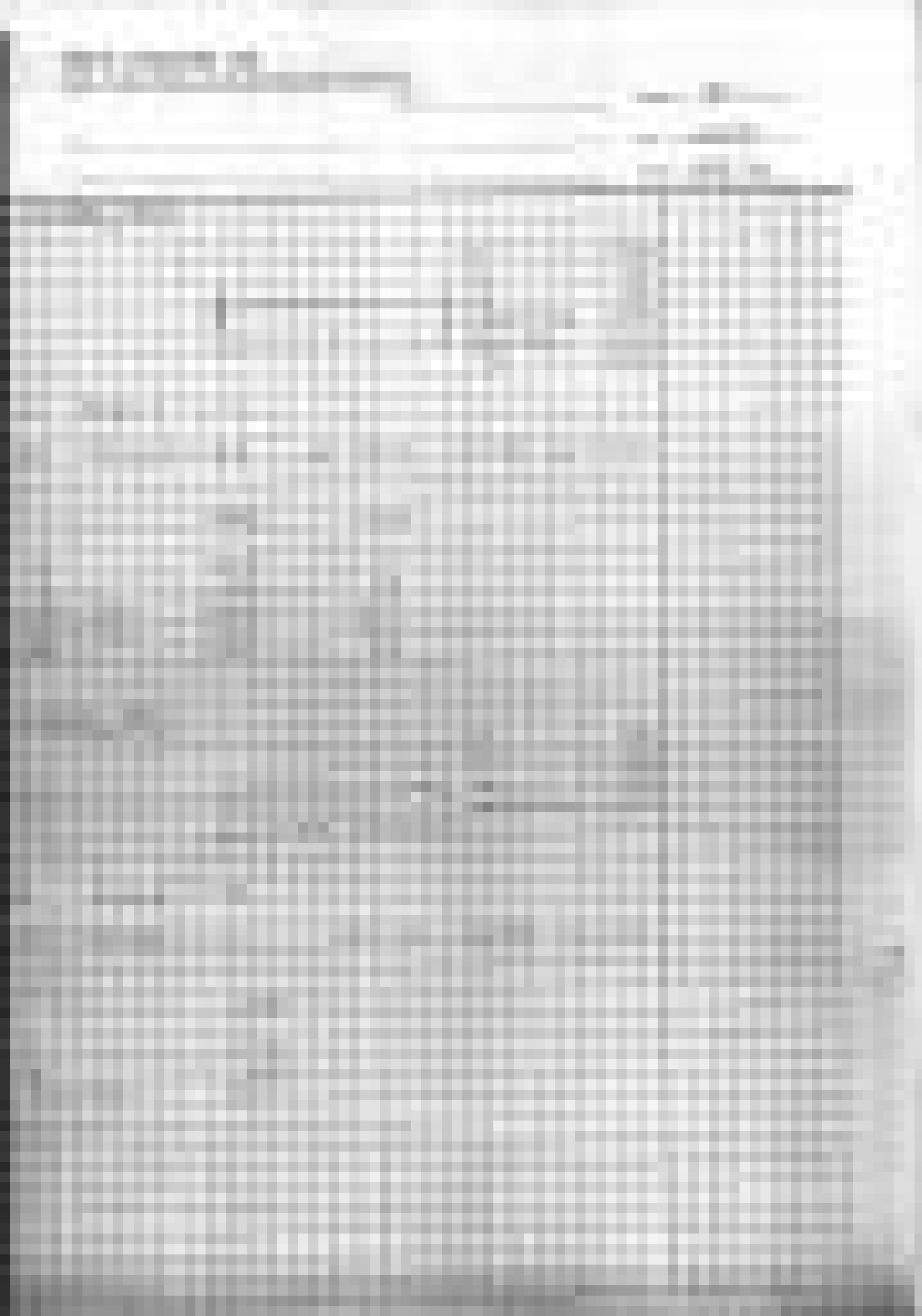


DL 43 x 4.6 = 198

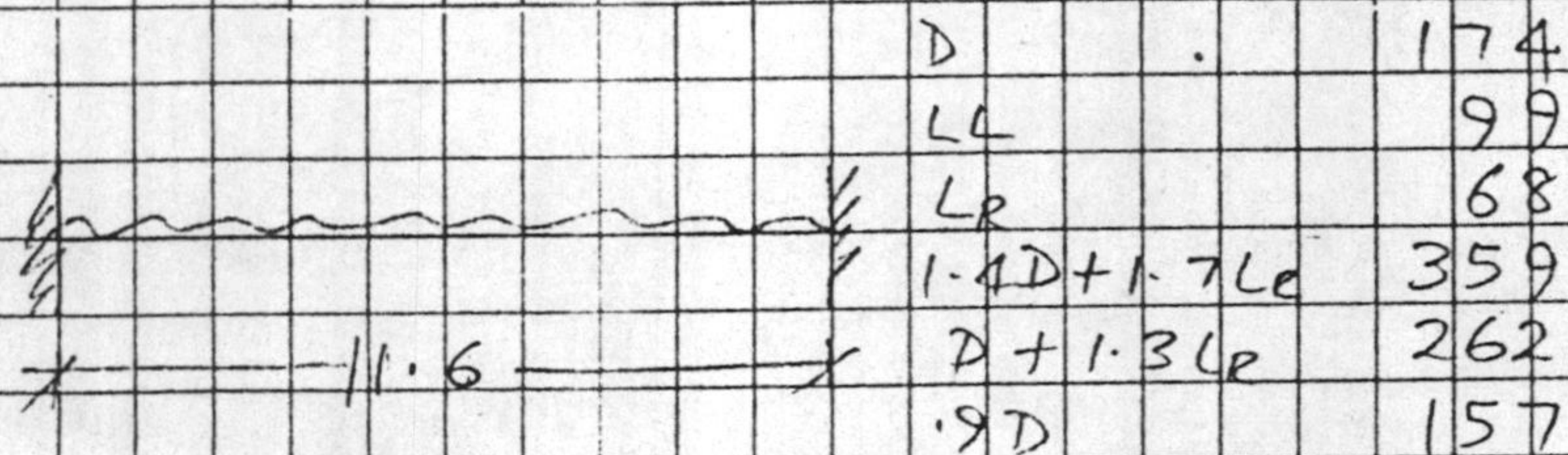
LL 25 x 4.6 = 115 A = 23 R = .93 LR = 107

SSM

| | |
|--------------|-----|
| D | 114 |
| LR | 62 |
| 1.4D + 1.7LR | 265 |



Beams A-3 B6



DL $30 \times 11.6 = 348 \text{ kN}$

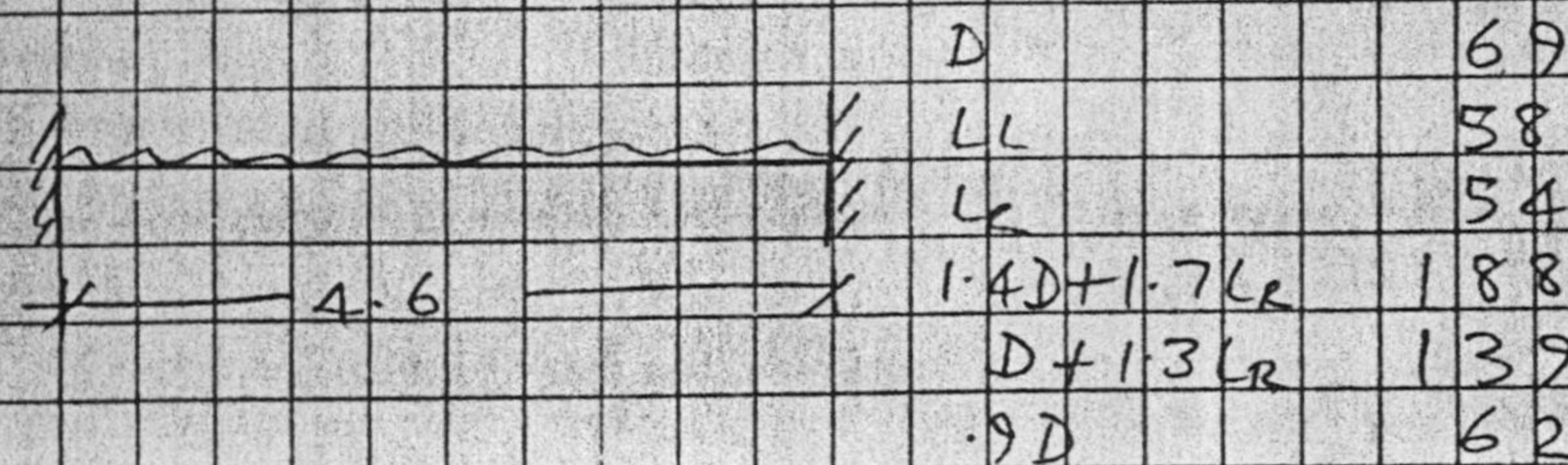
LL $17 \times 11.6 = 197$ $A = 58$ $R = .69$ $LR = 136$

FEM

MSM

| | | |
|----------------|-----|-----|
| D | 336 | 168 |
| LR | 131 | 66 |
| $1.4D + 1.7LR$ | 693 | 347 |
| $D + 1.3LR$ | 506 | 254 |
| .9D | 302 | 151 |

Beams 4-MB7



DL $30 \times 4.6 = 138$

LL $25 \times 4.6 = 115$ $A = 23$ $R = .93$ $LR = 107$

FEM

MSM

| | | |
|----------------|-----|----|
| D | 53 | 26 |
| LR | 41 | 21 |
| $1.4D + 1.7LR$ | 144 | 72 |
| $D + 1.3LR$ | 106 | 53 |
| .9D | 48 | 23 |

Beam 286

| | | | | |
|------------------------|-----|--|------------------------|-----|
| 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 |

$$DL-UDL \quad 24 \times 11.6 = 278$$

$$- PL \quad 16$$

$$294$$

$$LL-UDL \quad 15 \times 11.6 = 174$$

$$L_e = 115$$

$$- PL \quad 31$$

$$205$$

$$A = 68 \quad R = .66$$

FEM_AFEM_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 189

| | | | | |
|------------------------|-----|--|------------------------|-----|
| 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 |

$$DL \quad UDL \quad 24 \times 6.3 = 151$$

$$PL \quad 16$$

$$167$$

$$LL \quad UDL \quad 15 \times 6.3 = 95$$

$$PL \quad 31$$

$$126$$

$$A = 42 \quad R = .76 \quad L_e = 96$$

FEM_AFEM_B

MSM

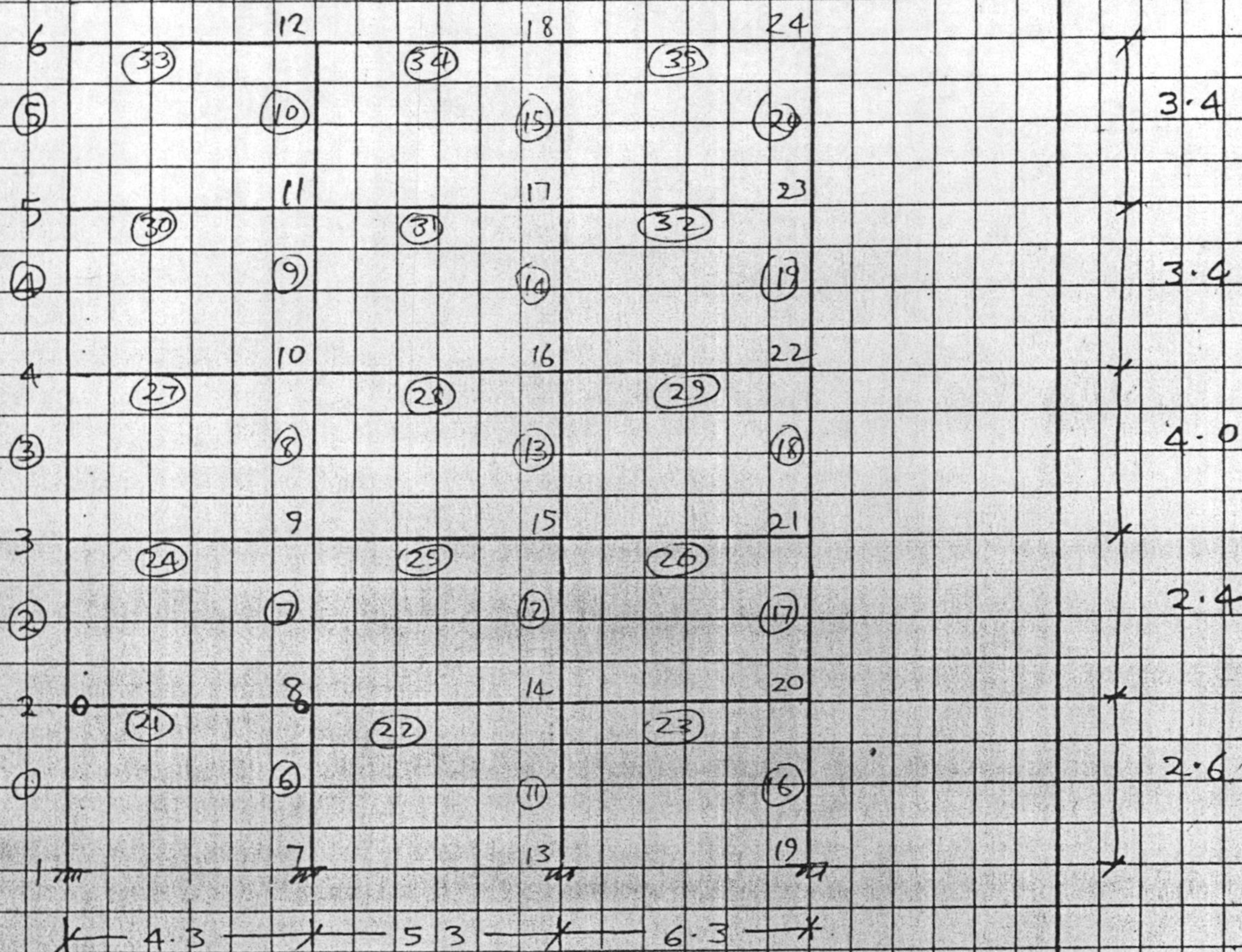
MSM

| | | | | |
|------------------------|--------------|-------------|-------------|-------------|
| 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 | 154 | 111 |
| D+1.3L _r | 178 | 143 | 40 | 81 |
| .9D | 84 | 75 | 45 | 41 |



Computer Model - Frame 80

East Frame



24 joints
35 mbrs
4 supports

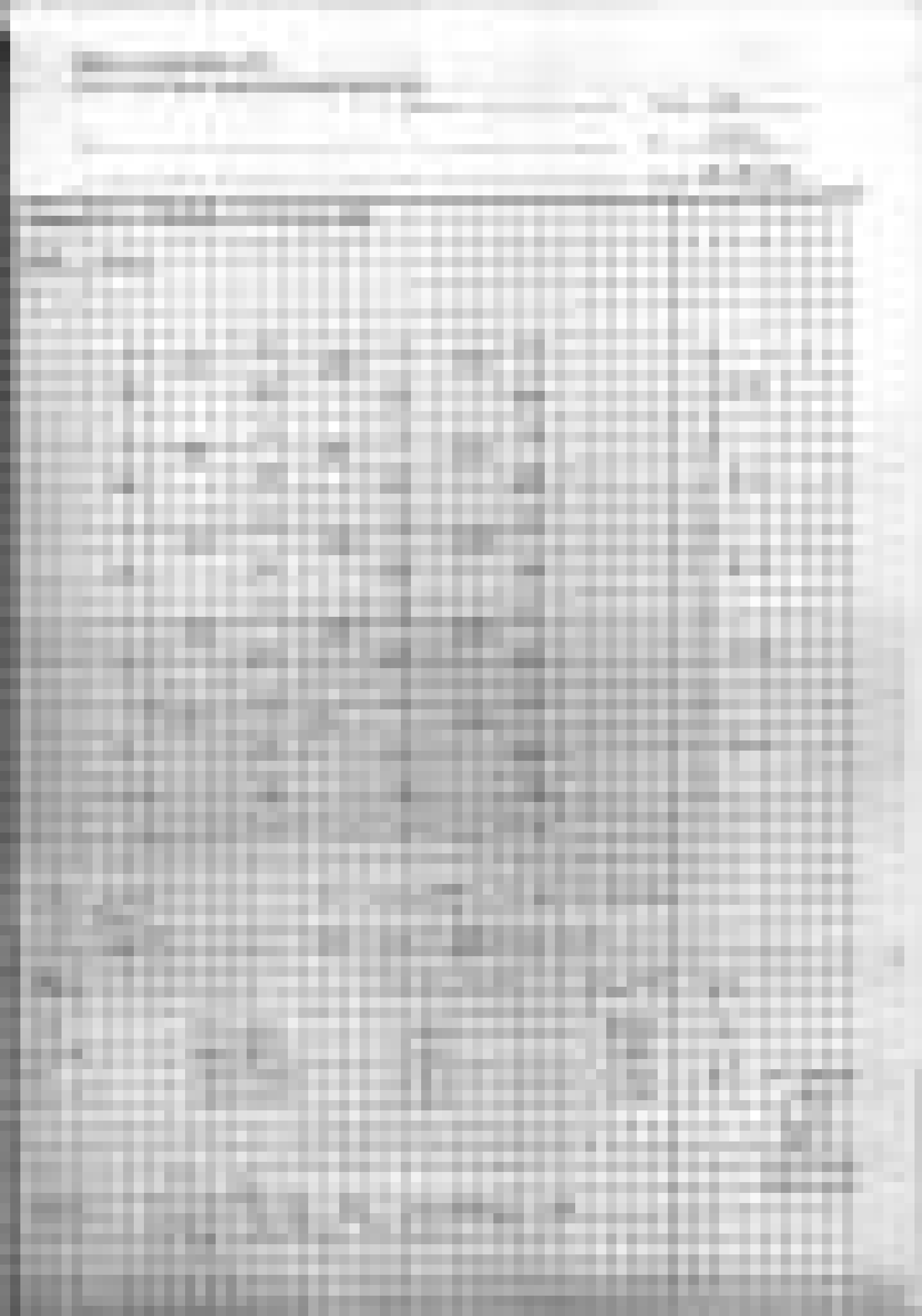
$$E = 4700 \sqrt{f_c'} = 2.35 \times 10^7 \text{ kg}$$

Max node difference = 6

| Mbrs | x/s Area (m ²) | I _{xx} (m ⁴) | Type |
|-------|----------------------------|-----------------------------------|-------------------|
| 1-5 | 350 x 800 | 0.28 | 1 |
| 6-20 | 800 x 500 | 0.40 | 1 |
| 21 | 500 x 500 | 0.25 | 4? - Look up book |
| 22-35 | 800 x 500 | 0.40 | 1 |

(p. 25 also)
mbr pinned both ends

Assume $A = A_g$
 $I_{cr} = 75 I_g$ for consistency with existing building analysis



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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 |
| | | | | | |



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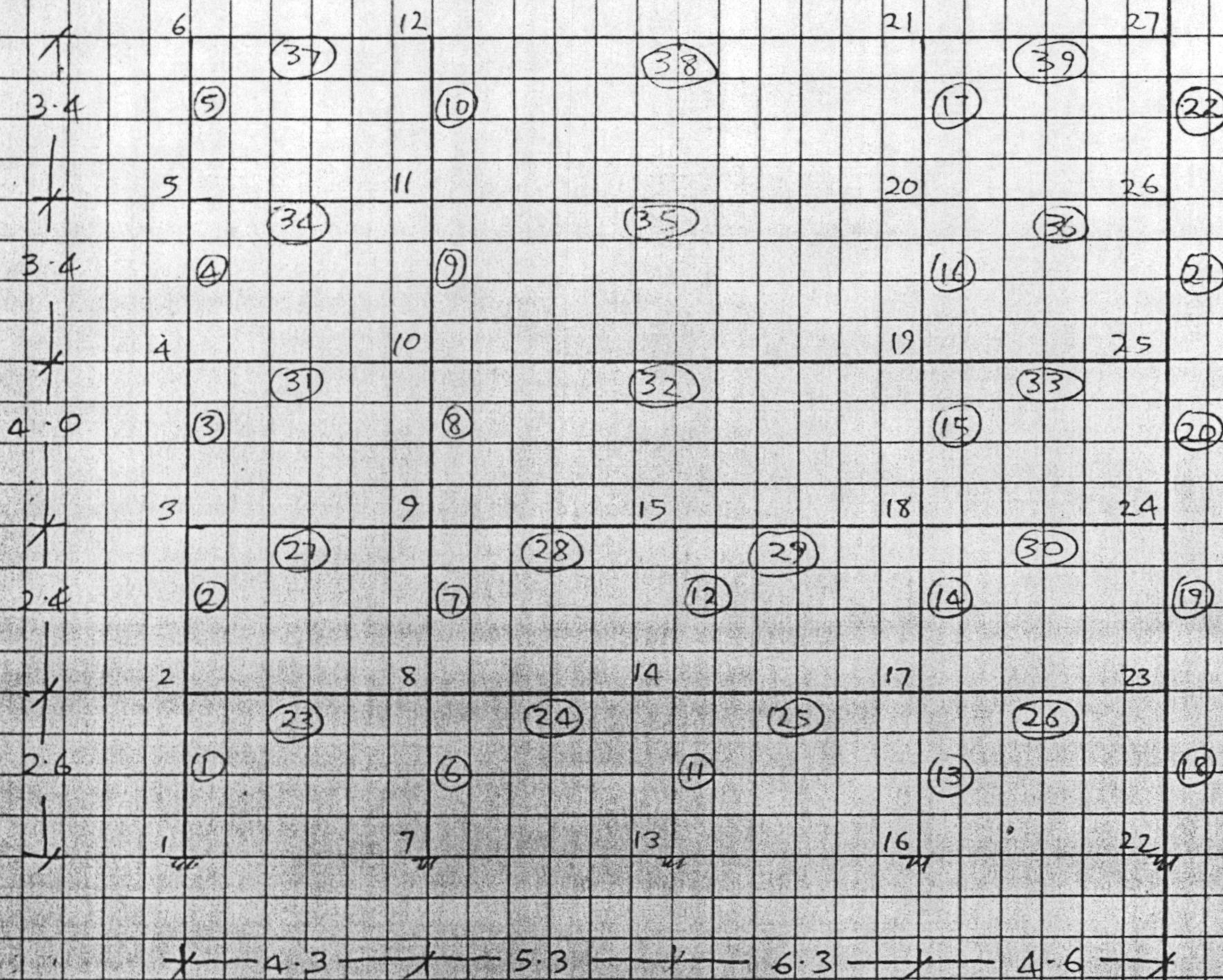
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JOB _____

BY WJM

DATE 28/8/86

West Frame



27 joints
39 mbrs
5 supports

$$E = 2.35 \times 10^7 \text{ kN}$$

Max node $\Delta = 9$

| Mbrs | X/S Area (m ²) | I _{xx} (m ⁴) | Type |
|-------|----------------------------|-----------------------------------|------|
| 1-17 | 800x500 | 0.40 | 1 |
| 18-22 | 350x800 | 0.28 | 1 |
| 23-39 | 800x500 | 0.40 | 1 |

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JOB _____

BY WFM

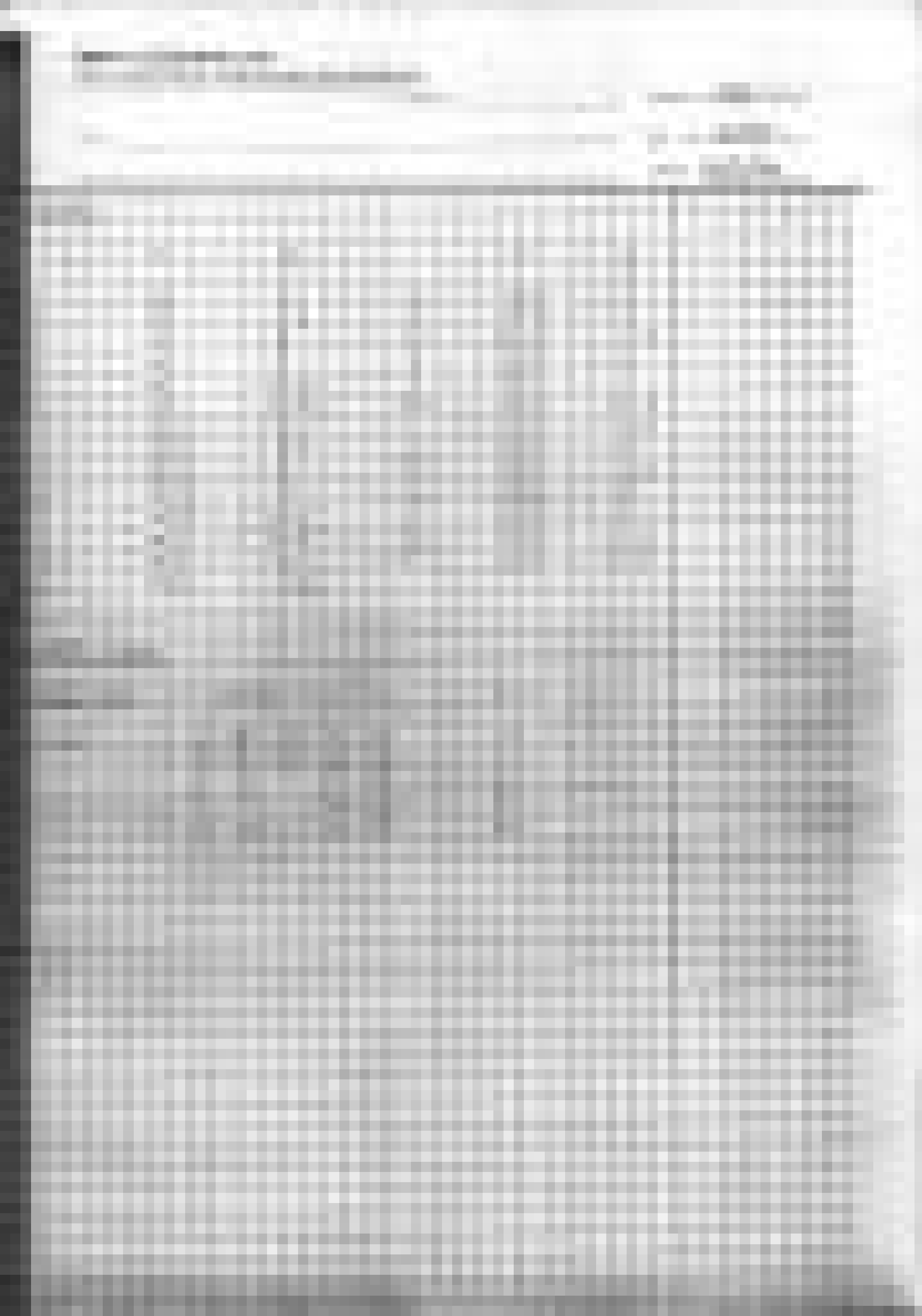
DATE 28/8/86

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 | | | |

Modal 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
FRAME 80 V1.0

STRUCTURE TITLE : WMCE

LOAD CASE TITLE : 1A(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 |

MMBR J-J

<----- J A ----->

<----- J B ----->

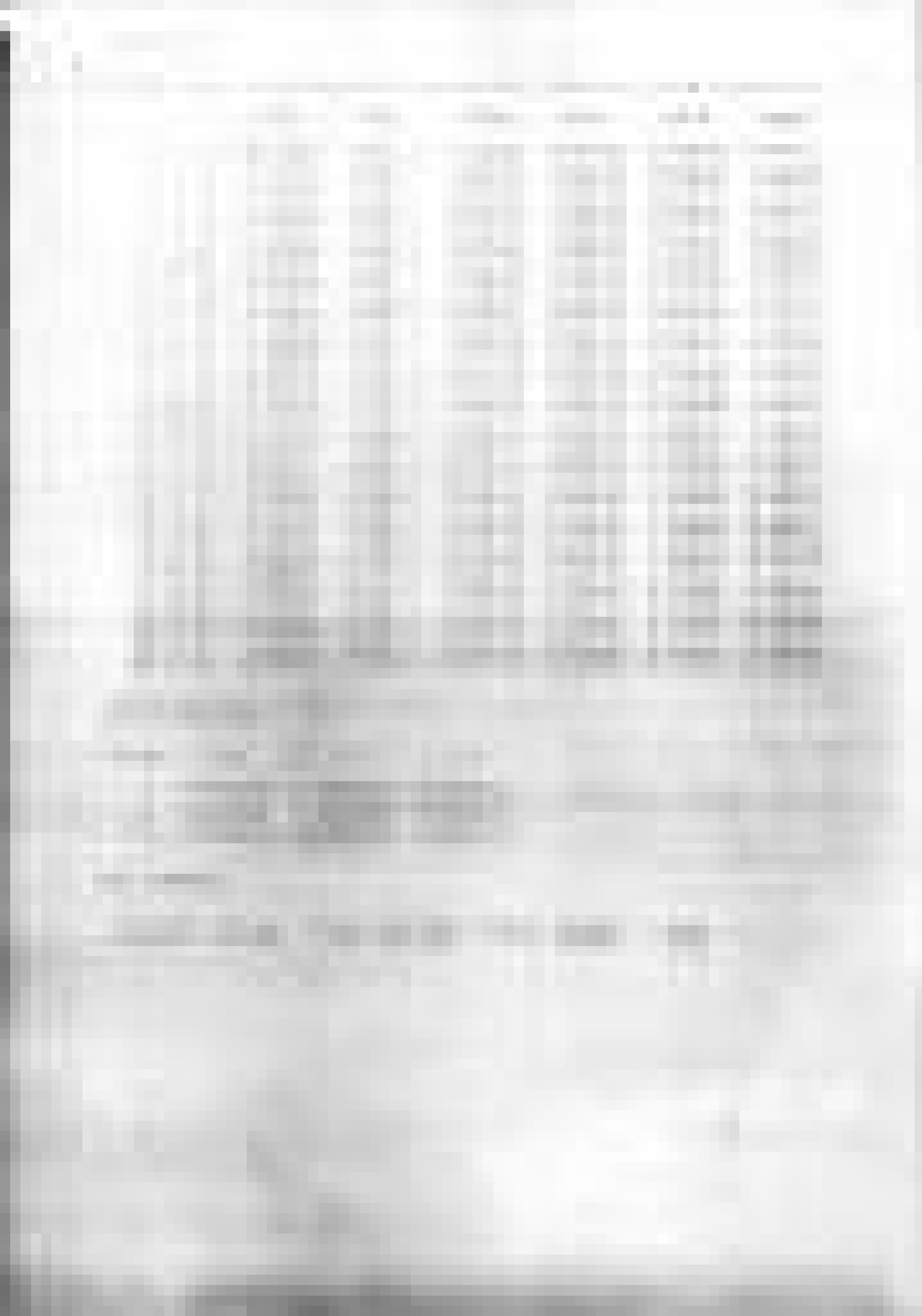
| | | | AXIAL | SHEAR | MOMENT | AXIAL | SHEAR | MOMENT |
|----|----|----|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | 1 | 2 | -4.31E+02 | 3.83E+00 | 5.09E+01 | 4.31E+02 | -8.83E+00 | -2.80E+01 |
| 2 | 2 | 3 | -4.31E+02 | 5.62E+01 | 2.80E+01 | 4.31E+02 | -5.62E+01 | 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 | 6 | 8 | -2.93E+02 | 3.11E+02 | 6.11E+02 | 2.93E+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 | 2.93E+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 | 12 | 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 | 3 | 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 | 3.23E+01 | -1.52E+02 | -2.45E+02 | -3.23E+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 |



461838

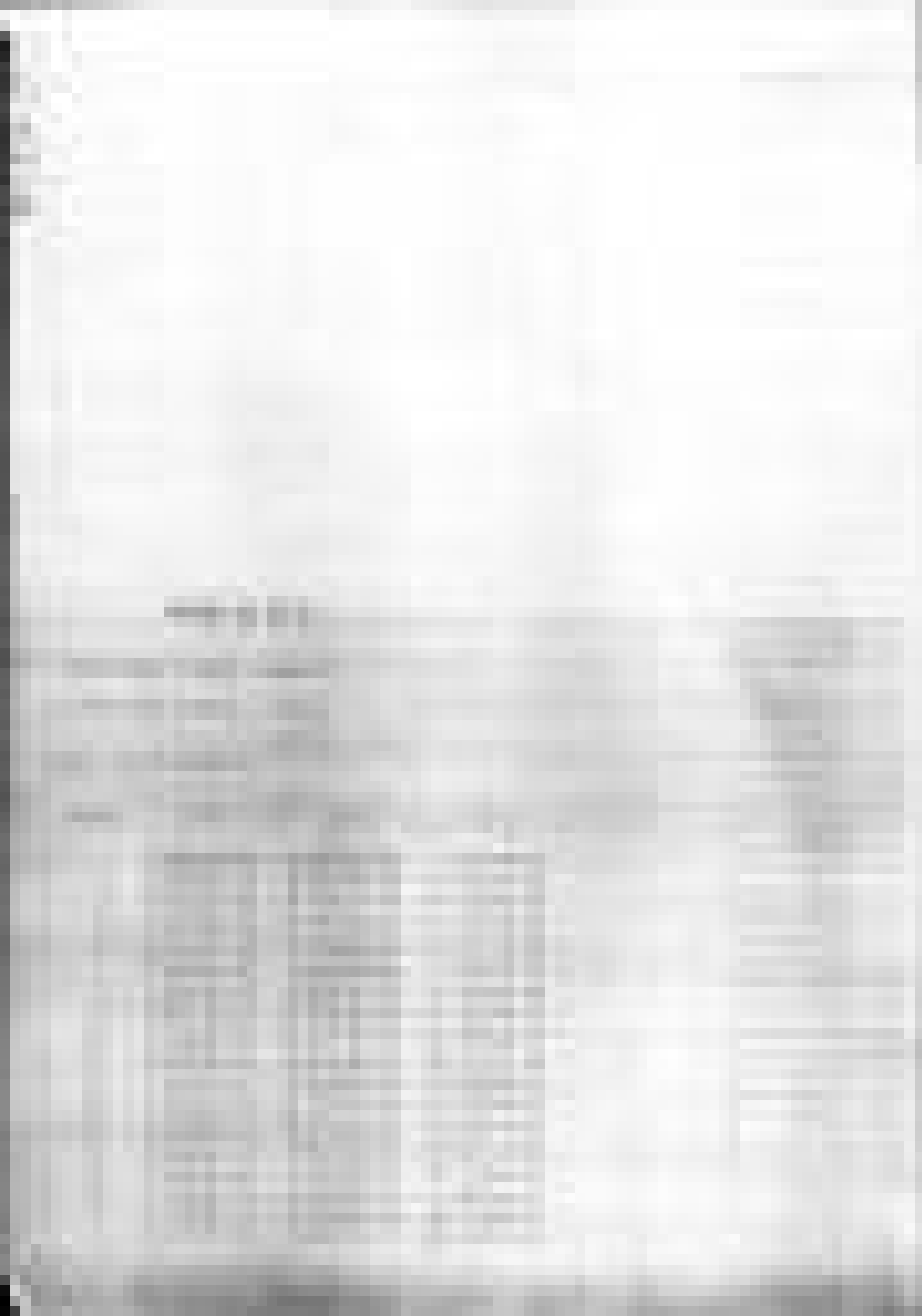
FRAME 88 01:0

STRUCTURE TITLE : WMCW

LOAD CASE TITLE : 1A(E)

JOINT DISPLACEMENTS

| JOINT | D-X | D-Y | R-Z |
|-------|------------|-------------|-------------|
| 1 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| 2 | 1.8524E-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 | 1.2393E-02 | 1.8806E-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 | 1.6220E-02 | -3.8535E-04 | -3.0322E-01 |
| 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

MEMBER 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 | 12 | 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 | 18 | 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 | 1.83E+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 | -9.36E+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

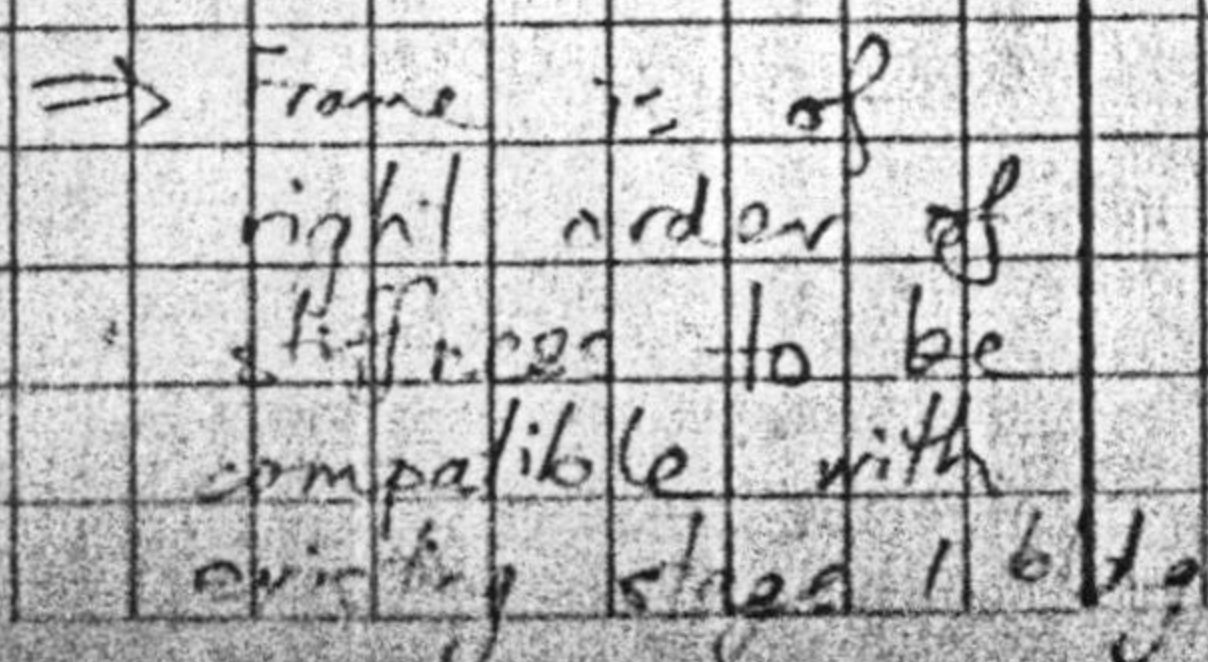
| JOINT | R-X | R-Y | R-Z |
|-------|-------------|-------------|------------|
| 1 | -2.0327E+02 | -8.7249E+02 | 3.8290E+02 |
| 7 | -2.7338E+02 | 5.3914E+02 | 4.4787E+02 |
| 13 | -2.4131E+02 | 6.4478E+01 | 4.2622E+02 |
| 16 | -2.5974E+02 | -2.1683E+02 | 4.3877E+02 |
| 22 | -5.2360E+01 | 4.8571E+02 | 7.2343E+01 |

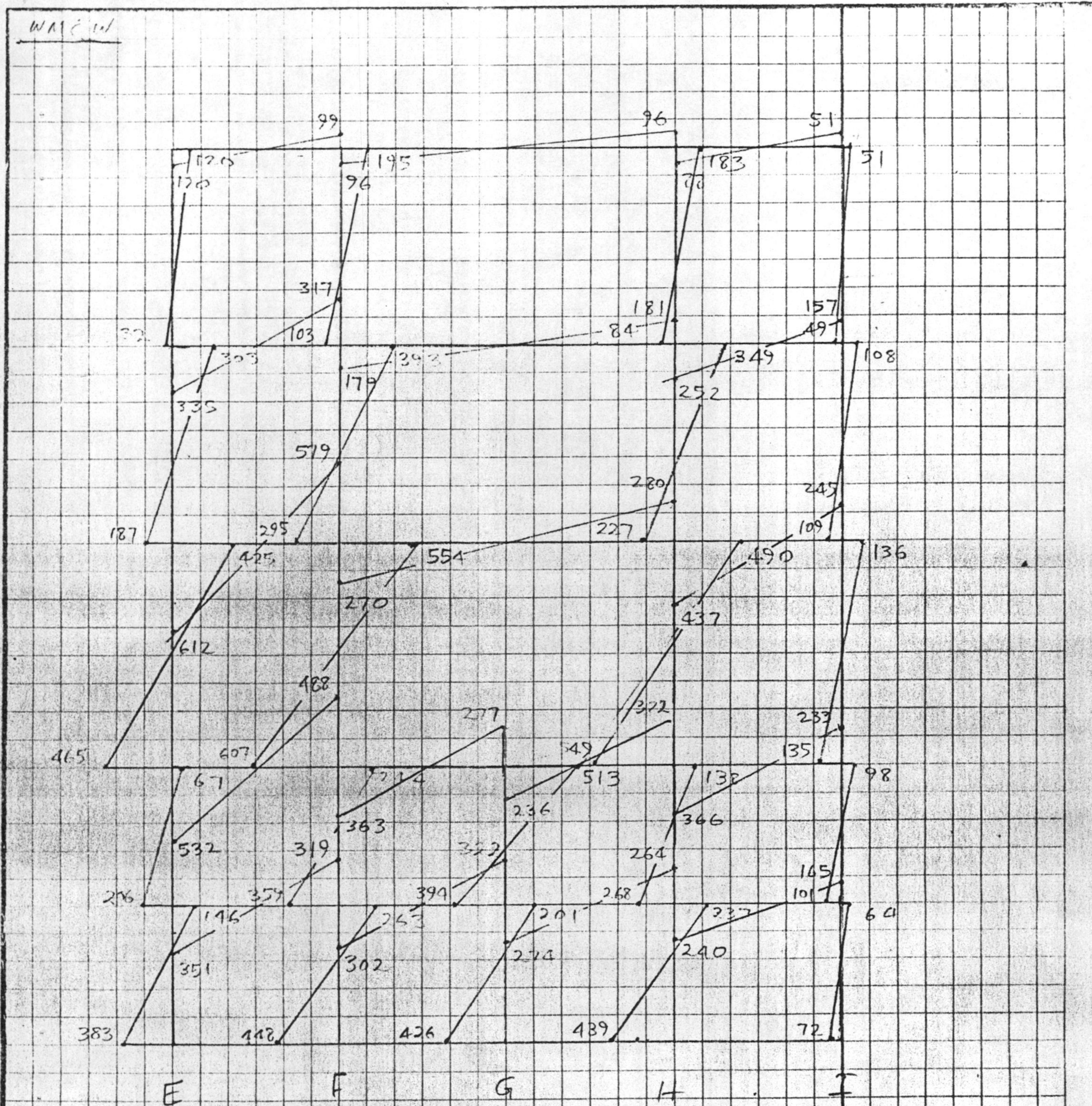
LOAD SUMMATION

AF1810

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

AF1810 1030.00 1030.06 0.00 0.00





| Low | Δ_{new} | $\Delta(\text{of } \text{age } 1)$ |
|-----|----------------|------------------------------------|
| 4 | 21.7 | |
| 3 | 18.7 | 26 |
| 2 | 13.3 | 21 |
| 1 | 4.7 | 11 |
| M | 1.9 | |

⇒ OK



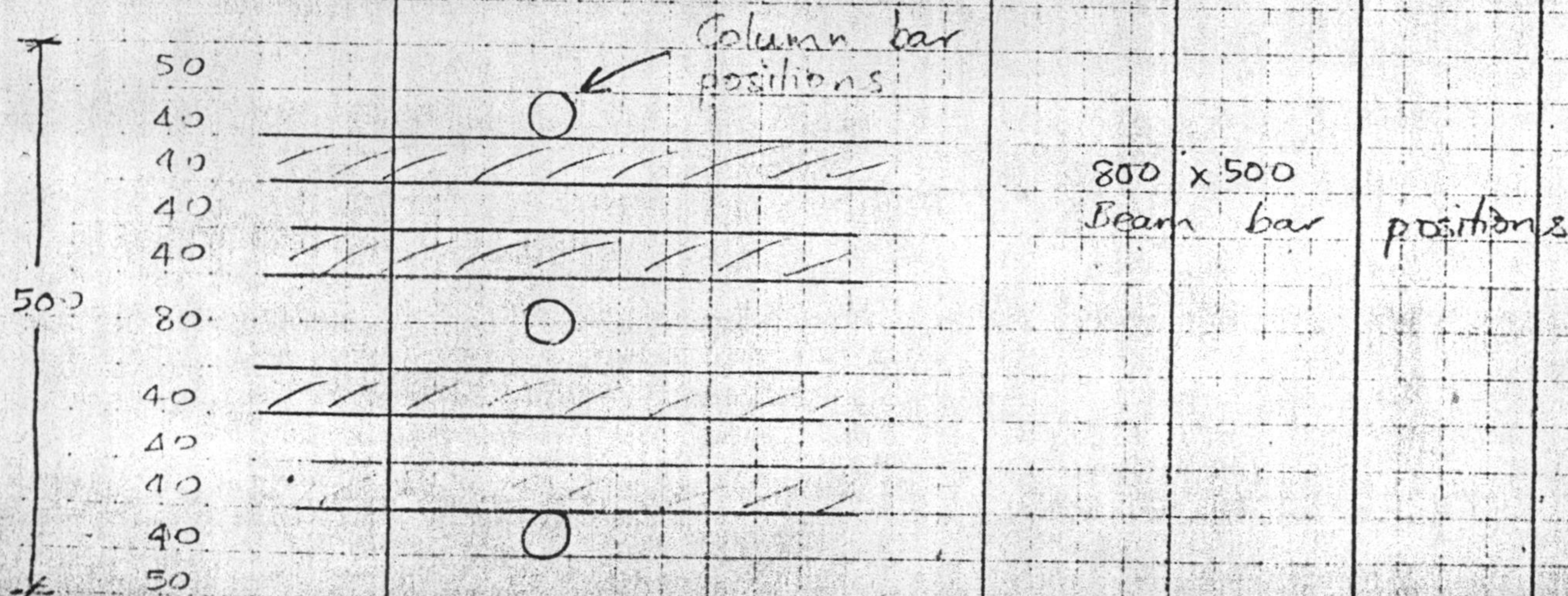
Beam Section 800 x 500

$$f'_c = 25 \text{ MPa}$$

$$f_{max} = 0.75 f_b$$

$$= 0.0218$$

| Bars | $A_s \text{ (mm}^2\text{)}$ | $d \text{ (mm)}$ | ρ | R_u | $M_u \text{ (kNm)}$ | $M_o \text{ (kNm)}$ |
|---------------|-----------------------------|------------------|--------|-------|---------------------|---------------------|
| 3HD24 | 1357 | 730 | 0.0037 | 1.34 | 321 | |
| 2HD24 + 2HD20 | 1533 | 730 | 0.0042 | 1.50 | 360 | |
| 4HD24 | 1810 | 730 | 0.0050 | 1.80 | 432 | |
| 4HD28 | 2463 | 730 | 0.0067 | 2.38 | 571 | |
| 4HD32 | 3217 | 730 | 0.0088 | 3.12 | 748 | |



1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

[illegible]

Abstract

[illegible]

1000

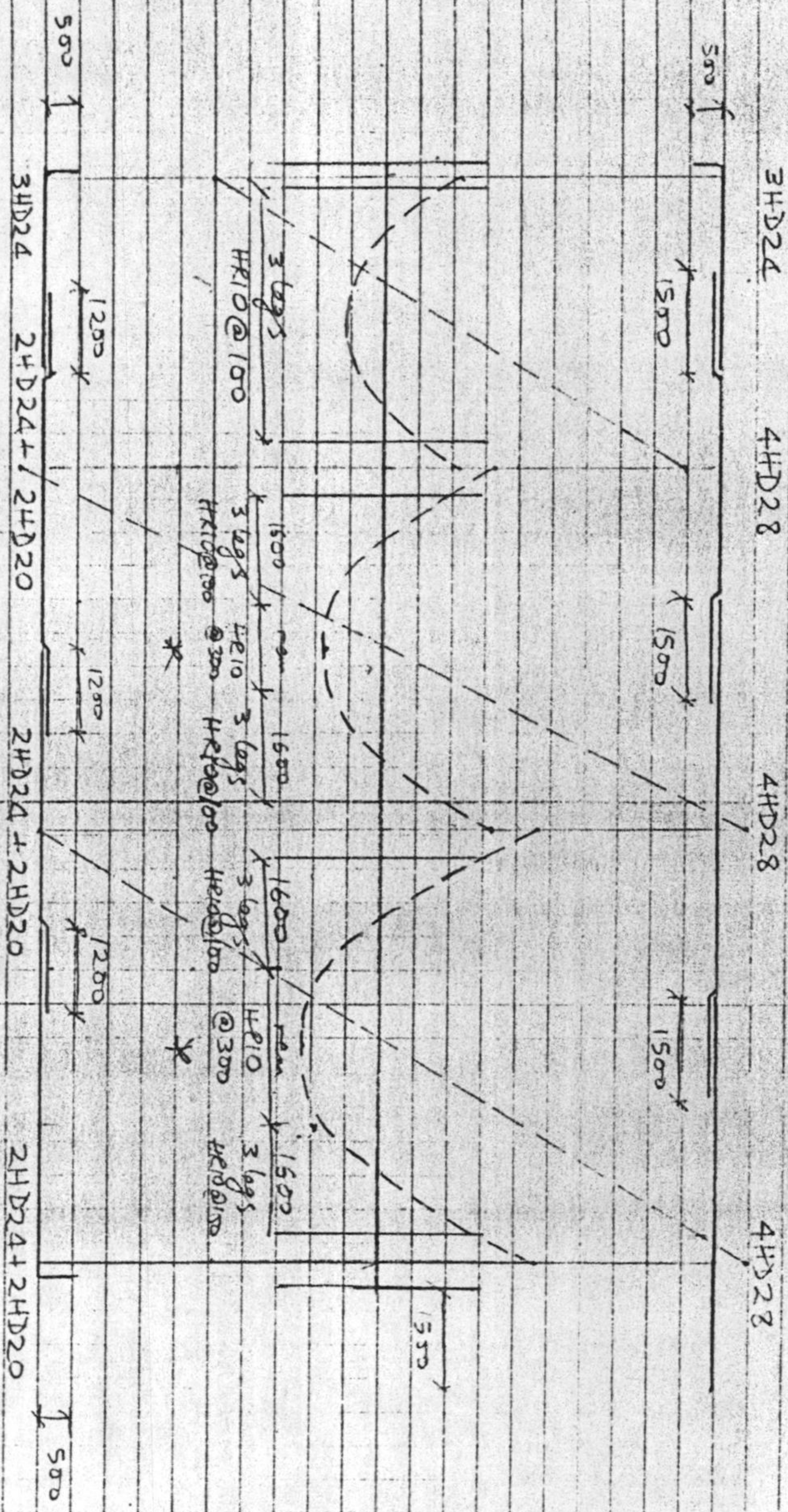
Figure 1

100

[illegible]

Table 1

East Farm - 800 x 500 bars - all birds can exact for food found

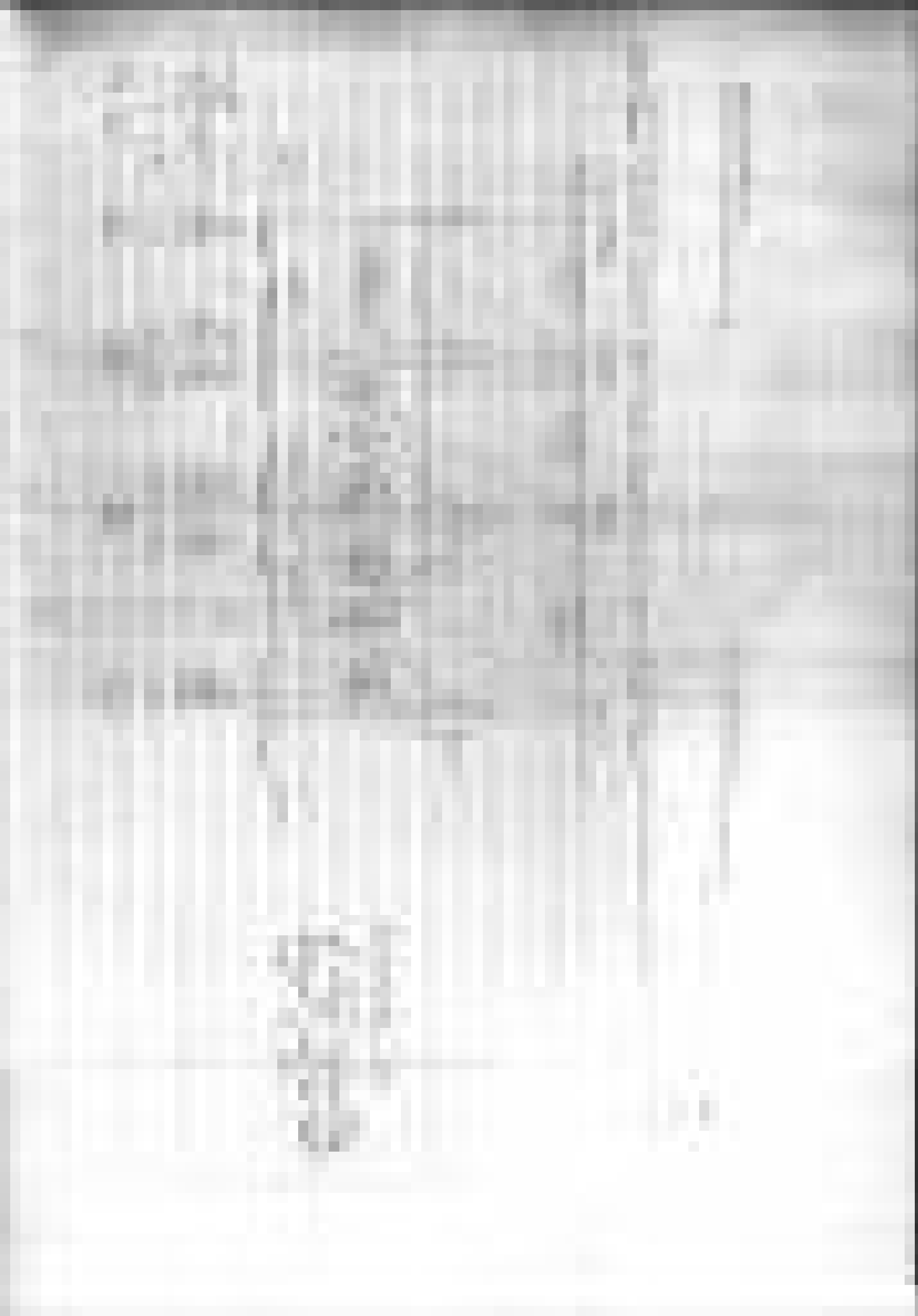


* Transverse Rao 11/5/60

If transverse no region
@ midspan becomes of less
than 1000, extend ord region
transverse, no. for full
length of beam

| | | | | | | | | | |
|----------------------------------|---------|----|------|------|----|------|------|-----|------|
| $\Delta = 1.36$ | 80 | 60 | 60 | 150 | 90 | 150 | 140 | 120 | 140 |
| $E(\%)$ | 220 | | 370 | 450 | | 460 | 420 | | 480 |
| $\Delta + 1.36 + E$ | -360 | | +310 | -550 | | +360 | -560 | | +340 |
| $\Delta + 1.36 - E$ | +140 | | -430 | +350 | | -540 | +280 | | -620 |
| $\Delta + 1.36 - E \text{ max.}$ | +210 | | -360 | +350 | | -560 | +330 | | -570 |
| Δ_{avg} | $M_u -$ | | | | | | | | |
| $M_u +$ | -300 | | -350 | | | -560 | | | -570 |
| | +210 | | +350 | | | +360 | | | +340 |

| | | |
|-----|-----|-----|
| 163 | 203 | 167 |
| 219 | 260 | 200 |
| 161 | 191 | 203 |
| 161 | 191 | 207 |
| 161 | 191 | 207 |



West End - Level 11, 1

JOB

BY

DATE

2/10/85

500

44D24

44D24

44D24

1500

44D24

34D24

500

500

44D24

44D24

44D24

1500

44D24

34D24

500

3 legs
H10 @ 100

1600
H10 @ 300

1600
H10 @ 300

3 legs
H10 @ 100

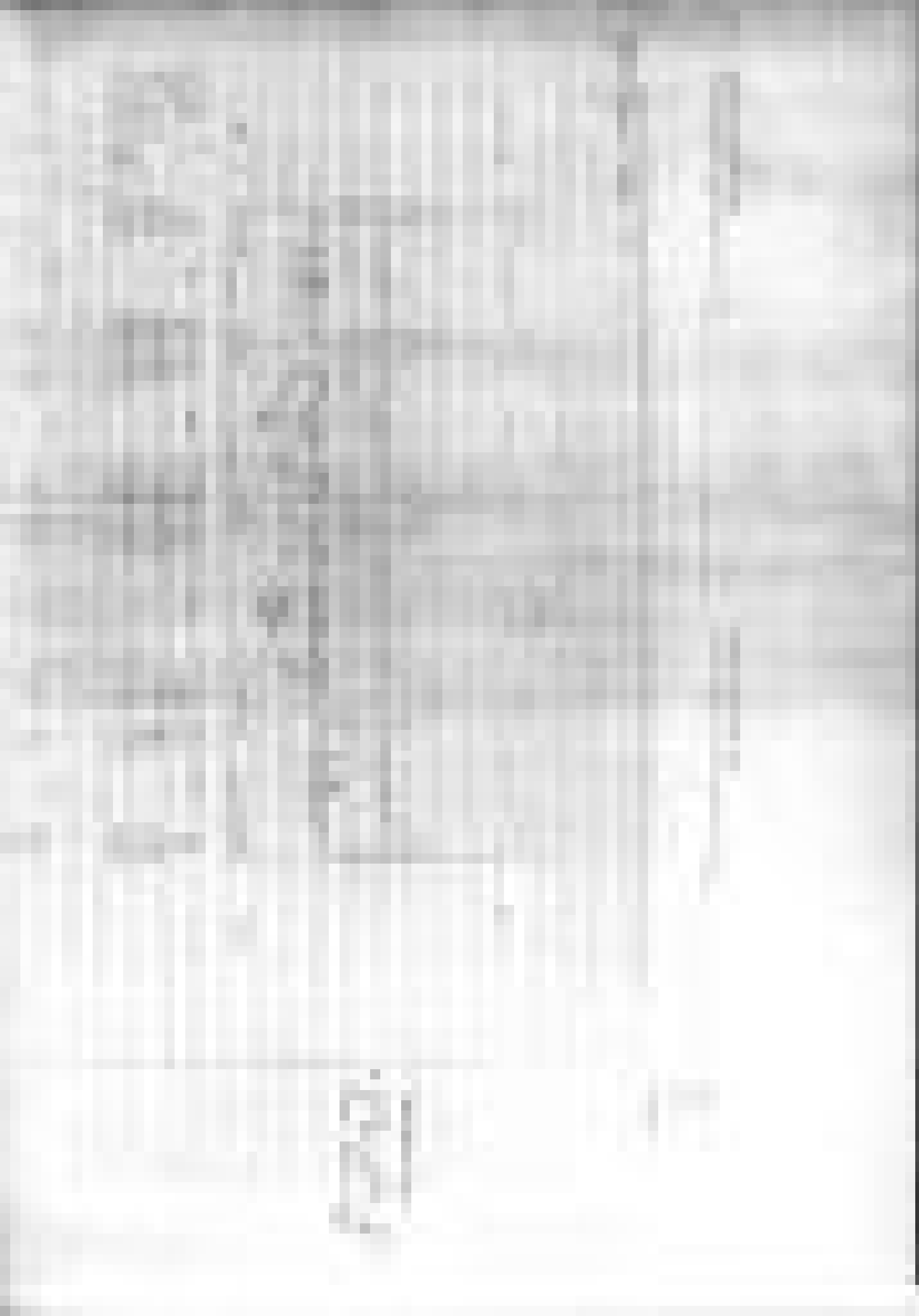
3 legs
H10 @ 100

3 legs
H10 @ 100

| | | | | | | | | | | | | |
|----------|------|----|------|------|----|------|-------|-----|------|------|----|------|
| D+1.34 | 80 | 60 | 80 | 100 | 90 | 100 | -1170 | 120 | 170 | 70 | 50 | 90 |
| E(I) | 430 | | 380 | 310 | | 220 | 200 | | 300 | 310 | | 200 |
| D+1.34+E | -510 | | +300 | -410 | | +120 | -370 | | +130 | -380 | | +110 |
| D+1.34-E | +350 | | -450 | +210 | | -320 | +30 | | -470 | +240 | | -290 |
| D+1.34+E | -430 | | +380 | -410 | | +120 | -370 | | +130 | -380 | | +110 |
| D+1.34-E | +380 | | -430 | +210 | | -320 | +70 | | -430 | +240 | | -290 |

| | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 219 | 237 | 219 | 260 | 121 | 250 | 303 | 303 | 182 | 130 | 188 |
| 15 | | 61 | 191 | | 191 | 222 | | 135 | | 135 |
| 219 | | 219 | 260 | 121 | 250 | 303 | 303 | 182 | 130 | 188 |
| 15 | | 61 | 191 | | 191 | 222 | | 135 | | 135 |

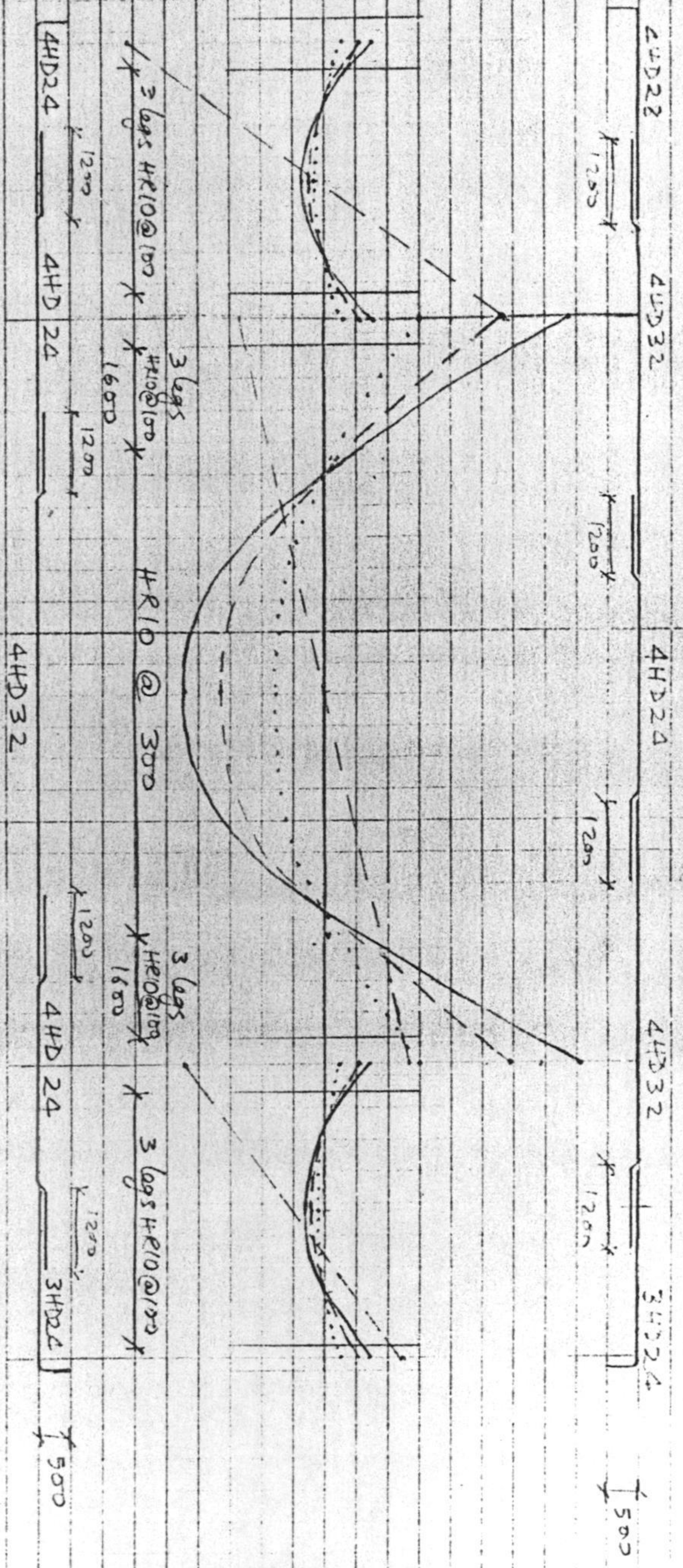
Transverse Rod
* Delete middle zone
if becomes long
than 1000



Project Name - Level 2 - E

DATE

BY



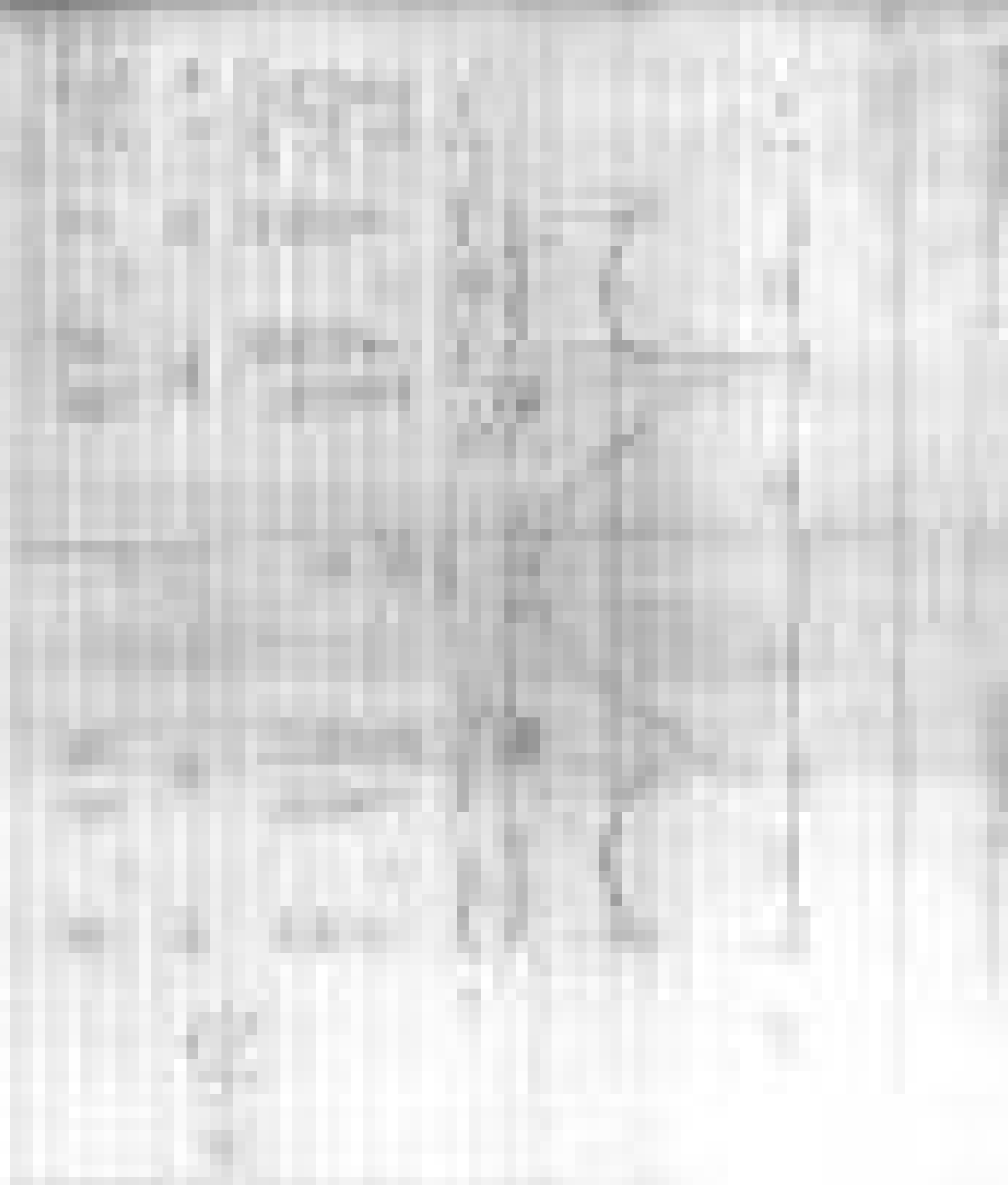
500 4HD24 1200 4HD24 1200 4HD24 1200 3HD24 500

| | | | | | | | | |
|----------------|------|------|------|-----|------|------|------|------|
| 1.4D+1.7Le | 50 | 50 | 620 | 450 | 650 | 50 | 50 | 90 |
| D+1.3Le | 30 | 30 | 230 | 330 | 490 | 50 | 50 | 40 |
| E ₁ | 500 | 450 | 250 | 330 | 250 | 380 | 210 | 210 |
| D+1.3Le+E | -550 | +390 | -700 | 330 | -240 | -430 | +120 | +120 |
| D+1.3Le-E | +450 | -510 | +200 | 330 | -740 | +330 | -300 | -300 |
| .9D+E | -530 | +430 | -480 | | +10 | -410 | +170 | +170 |
| .9D-E | +470 | -490 | +20 | | -490 | +350 | -250 | -250 |
| D+1.3Le-E adj | +430 | -530 | | | | | | |
| .9D-E adj | +430 | -530 | | | | | | |

| | | | | | |
|-----------------------|------|------|-----|------|------|
| Design M _u | -550 | -700 | 450 | -740 | -300 |
| | +430 | +430 | 450 | +350 | +170 |

Design done with no consideration to reduce possibility of midspan hinge

| | | | | | |
|---------------------------|-----|-----|-----|----|-----|
| Seismic SF | 277 | 219 | 359 | 47 | 148 |
| V _u 1.4D+1.7Le | 219 | 219 | 359 | | 128 |
| D+1.3Le | 161 | 161 | 262 | | 139 |
| V _u max | 438 | 438 | 359 | | 287 |



Transverse Reo

PH Regions $S_{max} = d/a = 183$ $6d_e = 150$

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

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

SH Region $S_{max} = \sqrt{c}/2$

$$V_i = 438 \times 10^3 / .85 \times 580 \times 730 = 1.41 \text{ MPa}$$

$$\rho_w = .0050 \quad \sqrt{c} = .6 \quad \sqrt{c}/2 = .3 \quad \sqrt{V_i} = 1.01$$

$$A_s = \sqrt{V_i} bws / f_y = 1.01 \times 500 \times 150 / 380 = 199$$

(⇒ 3 legs HR10 @ 150 OK)

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

Middle spans only

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

$$\sqrt{V_i} = .62 - .6 = .02$$

$$A_{s \text{ min}} = .35 bws / f_y$$

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

⇒ HR10 @ 300 OK

Transverse Reo

PH Regions

1500 from face
3 legs HR10 @ 100

Rem.

HR10 @ 300

Gravity Beam:

Beams MB1, 4-MB4

$$M_u = 265 \text{ kNm} \quad V_u = 230 \text{ kN}$$

Try 500x500

$$C_k = 265 \times 10^6 / .9 \times 500 \times 430^2 = 3.18 \quad \rho = .009$$

$$A_s = 1935 \text{ mm}^2$$

⇒ 4HD28

$$v_i = 230 \times 10^3 / .85 \times 500 \times 430 = 1.26 \text{ MPa}$$

$$f_w = .011 \quad v_c = .92 \quad v_s = .34$$

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

$$= .35 \times 500 \times 200 / 380 = 92 \text{ mm}^2$$

⇒ HR10 @ 200 OK

Pinned End Detail

Try 300x500 connection

$$v_i = 230 \times 10^3 / .85 \times 500 \times 230 = 2.35$$

$$.2 f_c = 5 \text{ MPa} \rightarrow \text{OK}$$

$$A_{vf} = V_u - P_u / \phi \mu f_y = 230 \times 10^3 / .85 \times 7 \times 380 = 1017 \text{ mm}^2$$

⇒ 6HD16 (3T & 3B)

End clips to take reaction

$$A_v = 230 \times 10^3 / .9 \times 380 = 673 \text{ mm}^2$$

$$\Rightarrow 673 / 157 = 4.3$$

$$673 / 226 = 3.0$$

$$673 / 339 = 2.0$$

Check

$$f_w = .0057 \quad v_c = .61 \quad v_s = 1.74$$

$$A_v = \sqrt{s} b_w s / f_y = 1.74 \times 500 \times 50 / 380 = 114 \text{ mm}^2$$

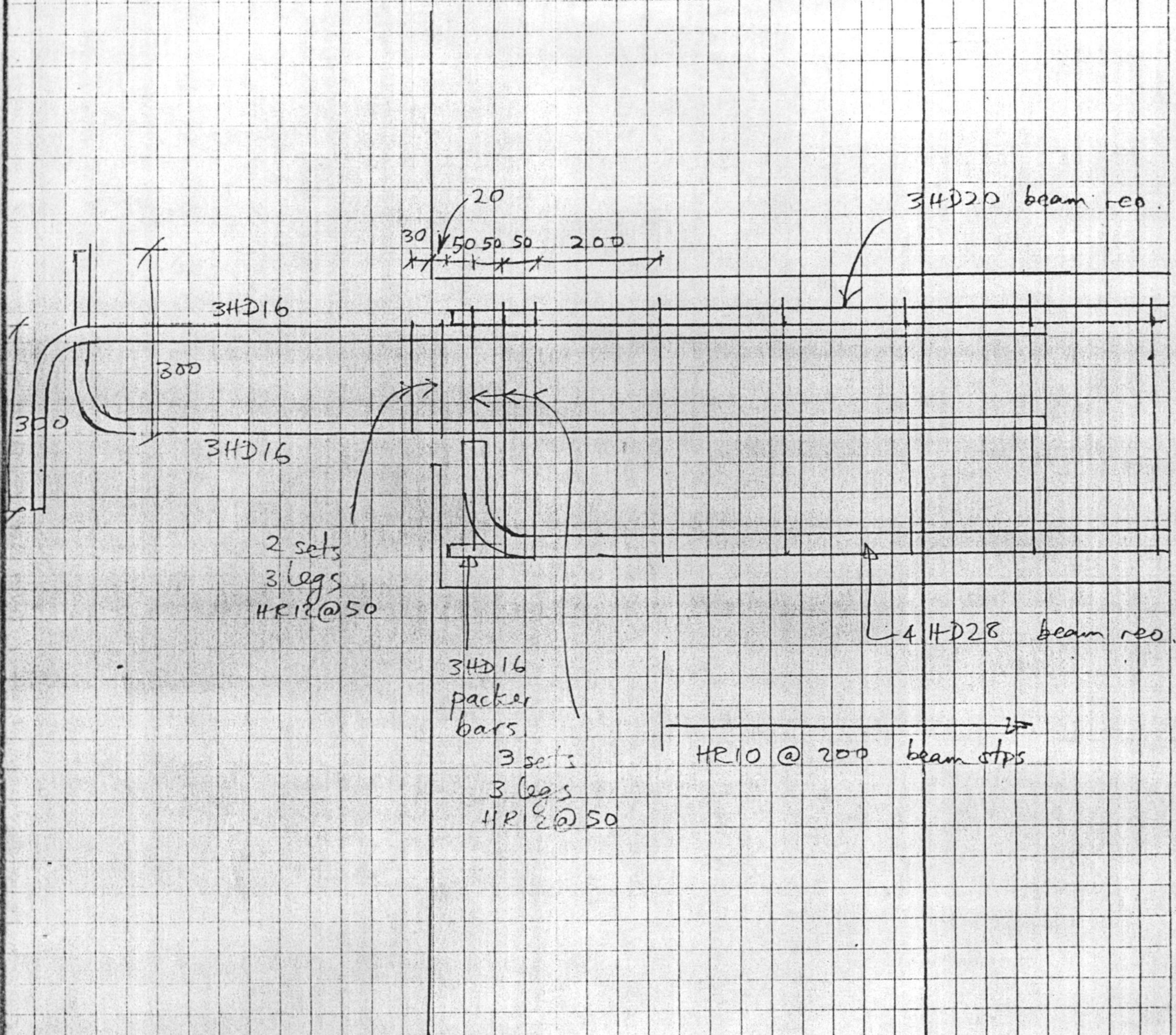
HR10 @ 50 OK

- North end level M
- South end levels M-4

(refer piers and beams shown on frame p. 32)

3 HD 20 T
4 HD 22 E
HR 10 @ 200.

Round End Delia





COLUMN AXIAL LOADS - EAST FRAME

| COL | LEV | D | LR | E(±) | D+LR | 1.4D+1.7LR | 1.4D+1.7LR+E | 1.9D+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 redn factor (cumulative) ⇒ conservative

COLUMN AXIAL LOADS - WEST FRAME

| COL | LEV | D | LR | E° | D - LR | 1.4D + 1.7LR | 2.4D + 1.7LR | 1.4D + 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 |

Col 3

$$\begin{aligned} 6.4 \text{ Max axial} &= .85 \phi P_o \\ &= .85 \phi [.85 f'_c (A_g - A_{st}) + f_y A_{st}] \\ &= .85 \times .7 [.85 \times 25 (500 \times 800 - 3968) + 380 \times 3968] \\ &= 5904 \text{ kN} \end{aligned}$$

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

$$\text{Max. } P_u = 2813 \text{ kN} \Rightarrow \text{OK}$$

$$b = 0.7$$

$$200 \times 500 \quad g = .8$$

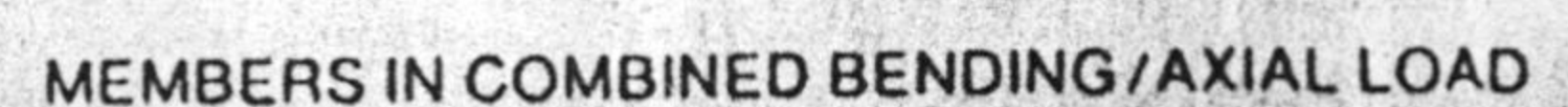
$$350 \times 200 \quad g = .6$$

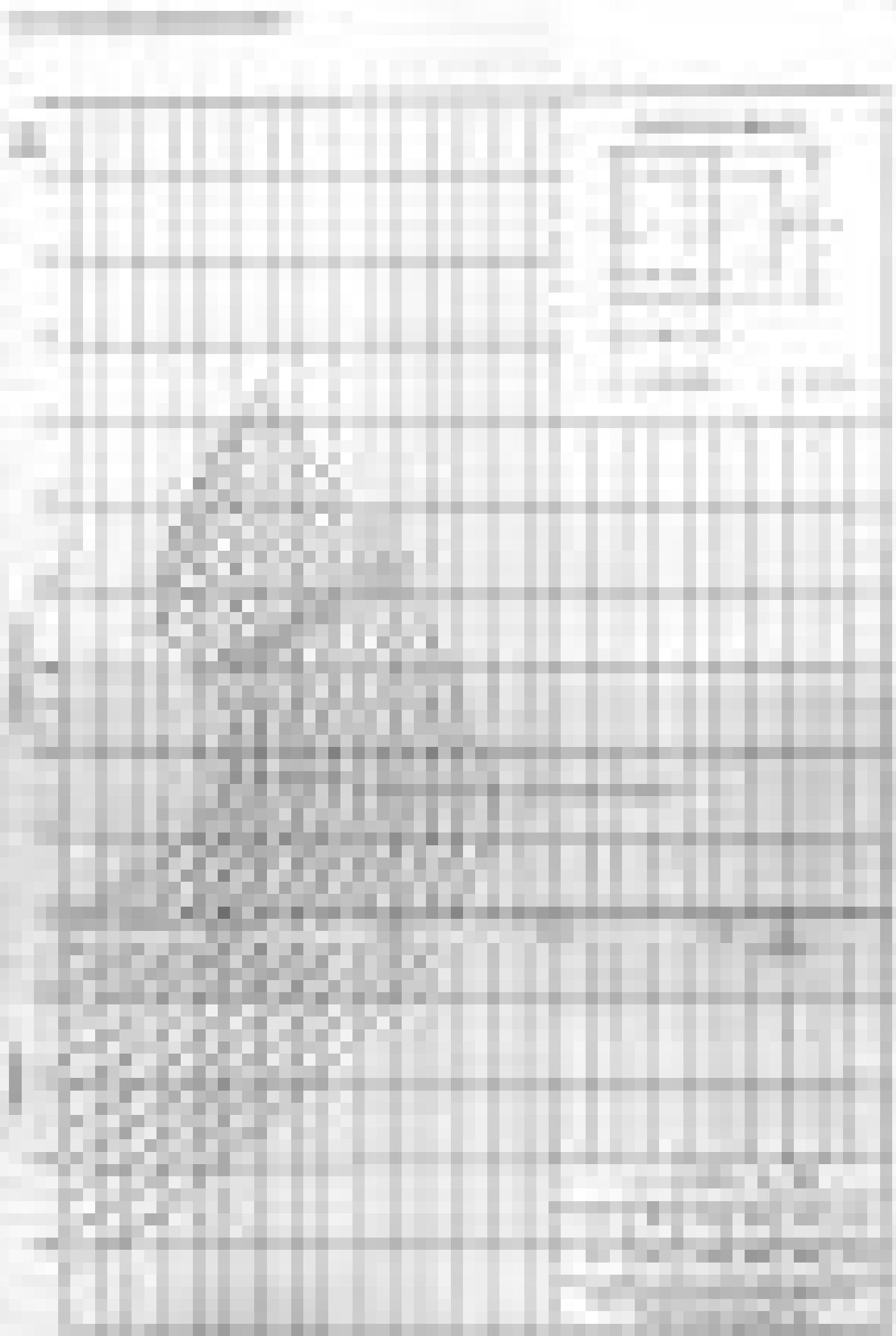
$$64D20 + 4HD20 \quad A_s = 3971 \quad \rho = .0099 \quad \rho_m = .177 (f'_c = 25) \quad 800 \times 500$$

$$10HD20 \quad A_s = 3142 \quad \rho = .0112 \quad \rho_m = .200 (f'_c = 25) \quad 350 \times 800$$

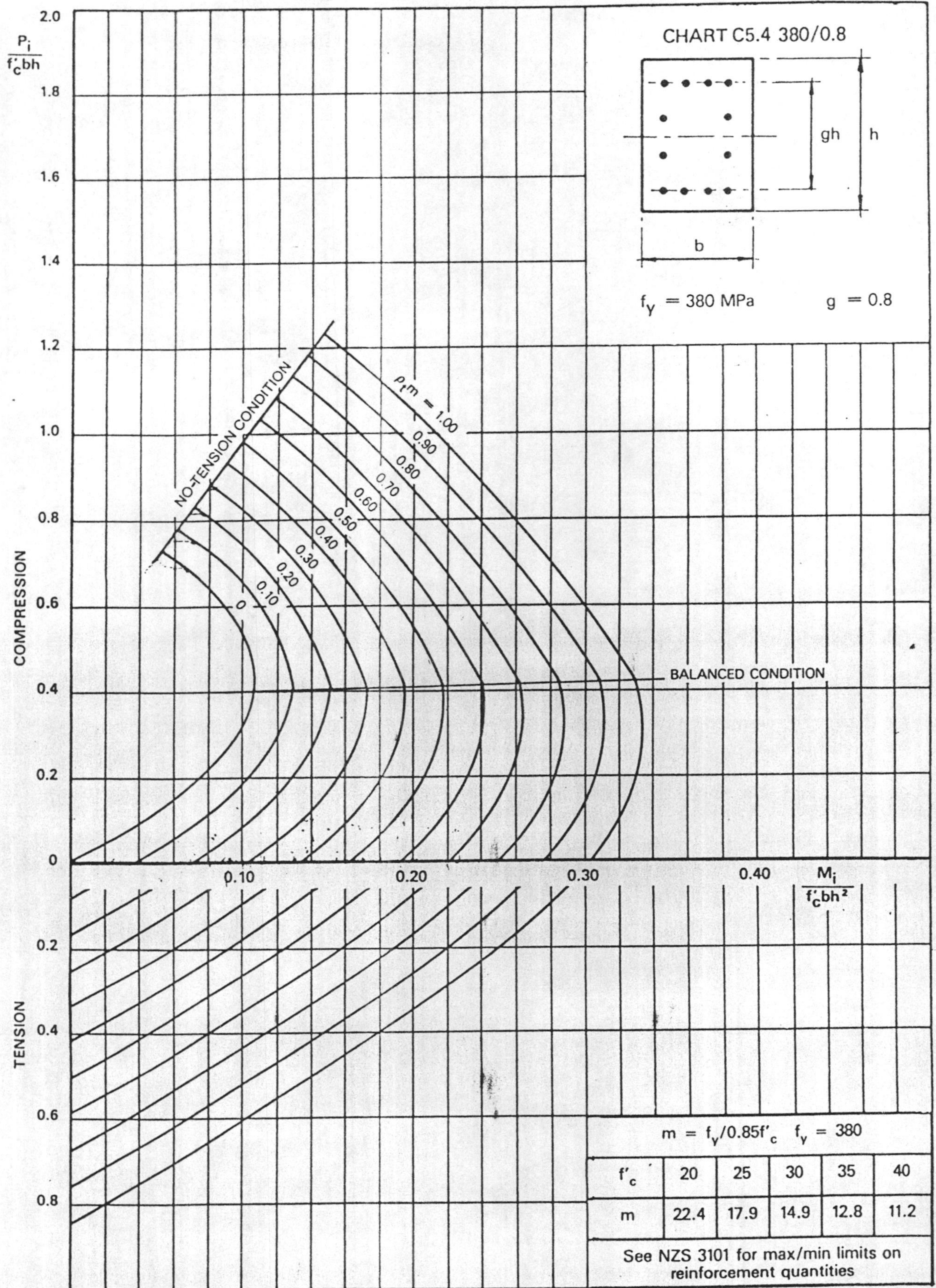


74



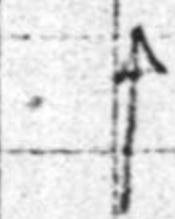


C5.4 COLUMN DESIGN CHART



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| COLUMNS - EAST FRAME | | | | | | | | | | |
|----------------------|-------------|-------------|-------|------------|--------------|----------|-------|-------|-------------|--------|
| LEV | $P_{u\max}$ | $P_{u\min}$ | M_u | $P_i/f'ck$ | $M_i/f'ck^2$ | P_{cm} | P_c | A_s | BARS | f'_c |
| | max | min | | max | min | | | | | |
| COL A | | 350x800 | | | | | | | | |
| 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 | — | .049 | | | | " | " |
| M | 1243 | -7 | 51 | .25 | .023 | | | | " | " |
| COL B | | 200x500 | | | | | | | | |
| 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 | .08 | .056 | | | | " | " |
| M | 2058 | 644 | 611 | .29 | .085 | | | | " | " |
| COL C | | 800x500 | | | | | | | | |
| 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 | .097 | | | | " | " |
| COL D | | 800x500 | | | | | | | | |
| 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 | .082 | | | | " | " |



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

are @

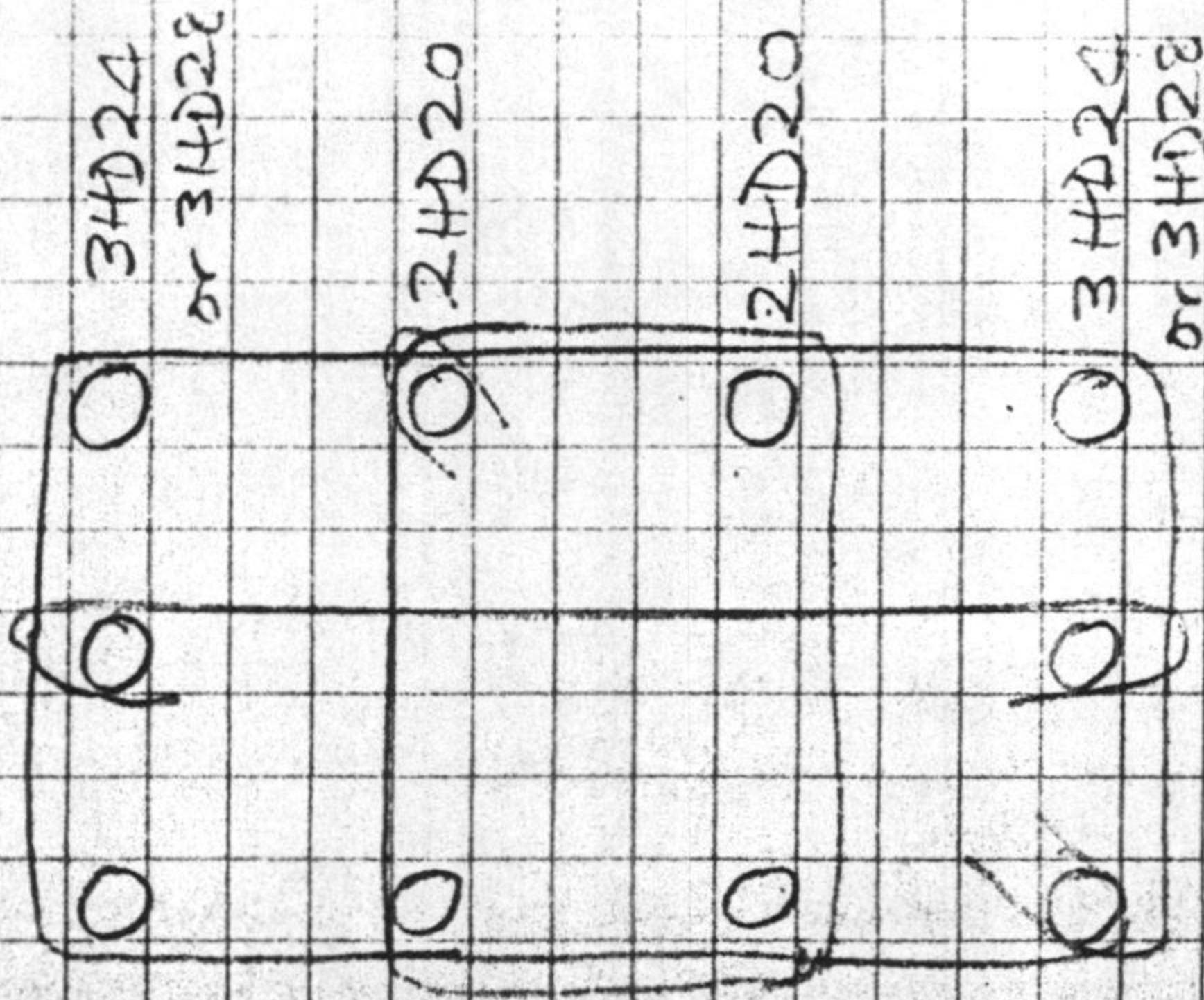
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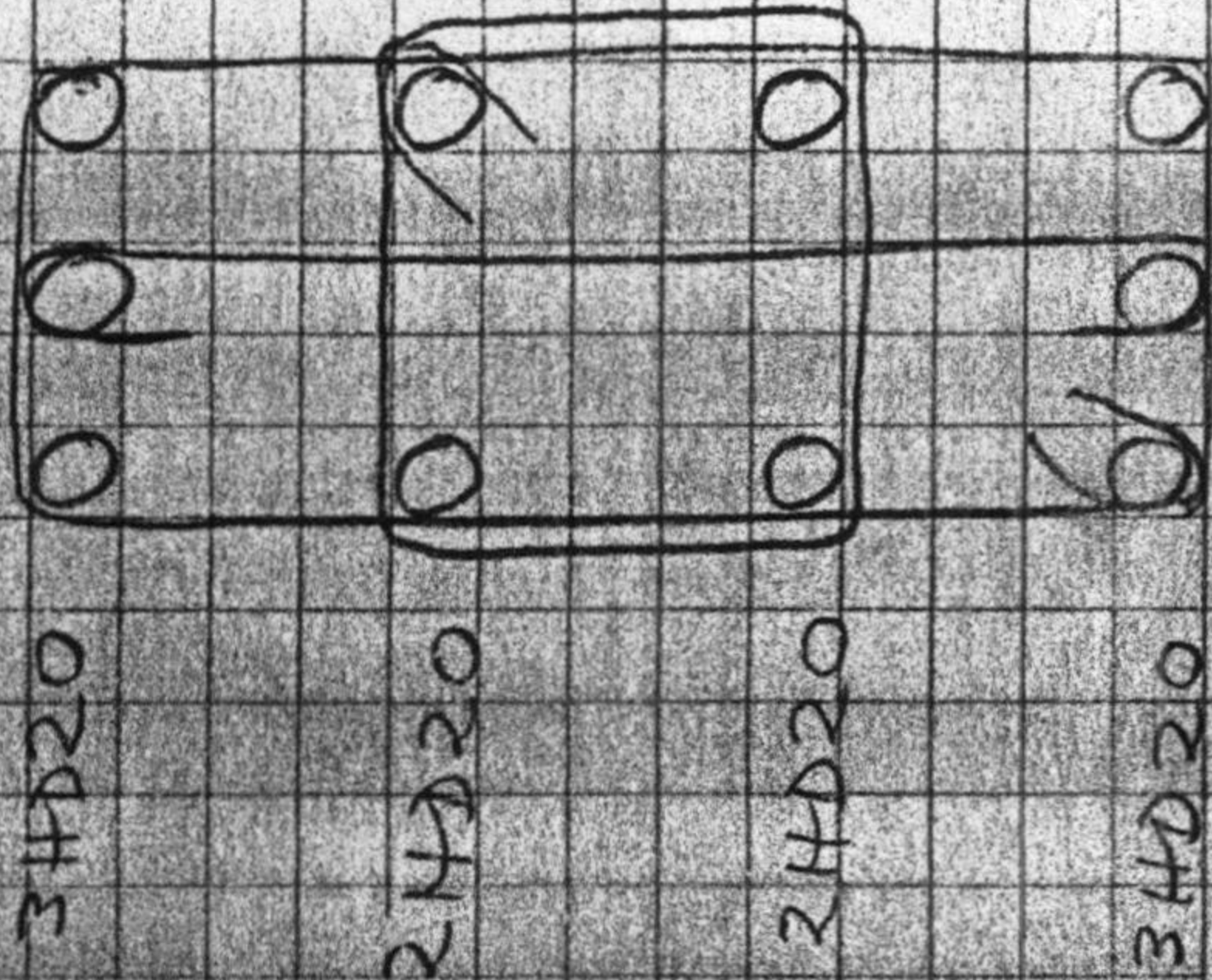
Conservative

| COLUMNS - WEST FRAME | | | | | | | | | | |
|----------------------|----------------------|----------------------|---------|----------------------------|-----------------|-------------|----------|-------|-------------|--------|
| LEV | P_u max DL + LL | P_u min DL + LL | M_u | $P_u/f_c b h$ max min | $M_u/f_c b h^2$ | ρ_{LM} | ρ_t | A_s | BARS | f'_c |
| COL E | | | 800x500 | | | | | | | |
| 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 | -381 | 206 | -.04 | .029 | | | | " | " |
| M | 1675 | -454 | 383 | .24 | .053 | .20 | | | " | " |
| COL F | | | 800x500 | | | | | | | |
| 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 | .062 | | | | " | " |
| COL G | | | 800x500 | | | | | | | |
| 1 | 381 | 150 | 513 | .02 | .071 | <.177 | | | 6HD24+4HD20 | 25 |
| M | 624 | 160 | 426 | .08 | .02 | .059 | | | " | " |
| COL H | | | 800x500 | | | | | | | |
| 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 | | | 350x800 | | | | | | | |
| 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 | .033 | | | | " | " |
| | | | | $\phi = .7 \rightarrow .9$ | $\phi = .9$ | | | | | |

Col

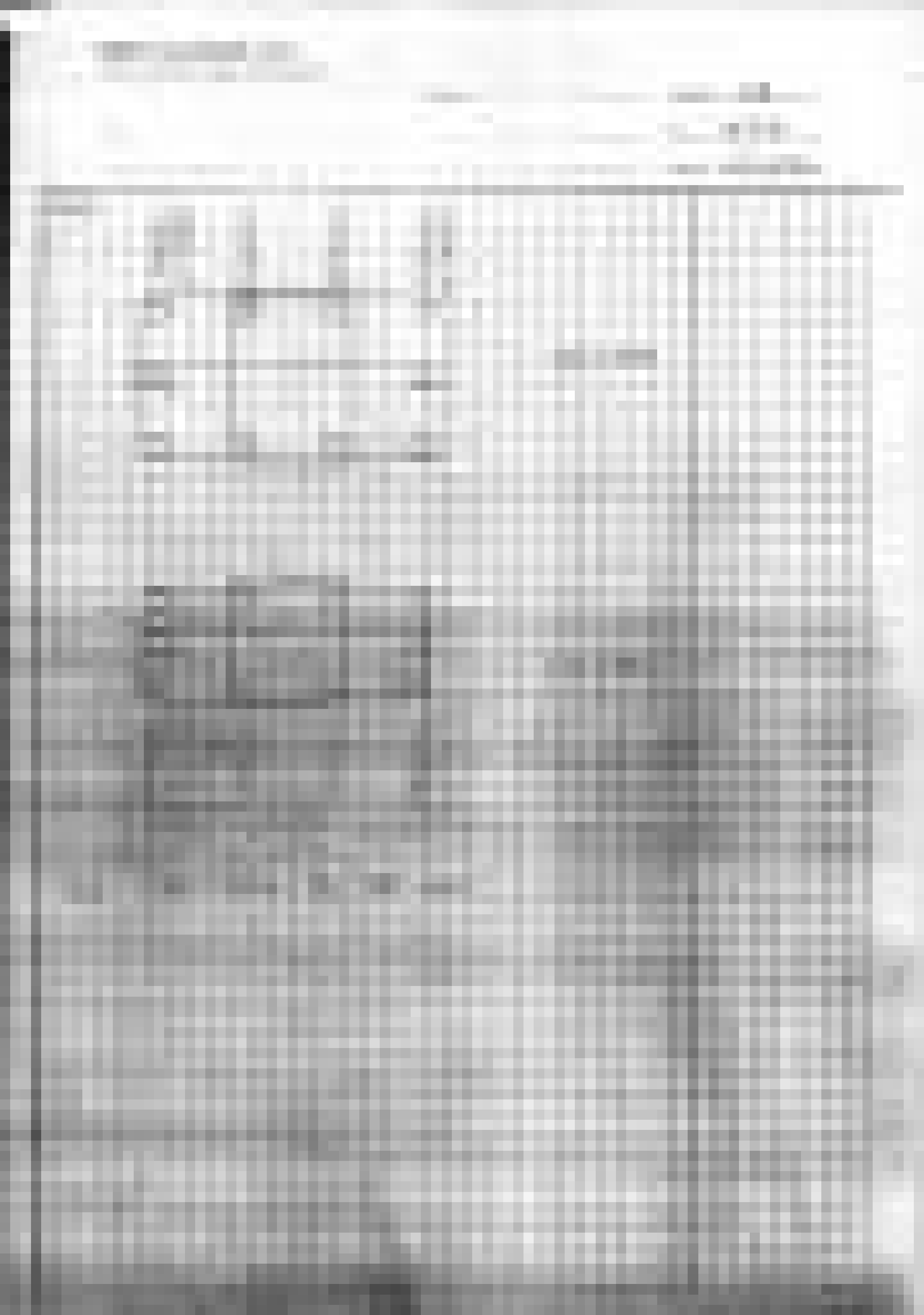


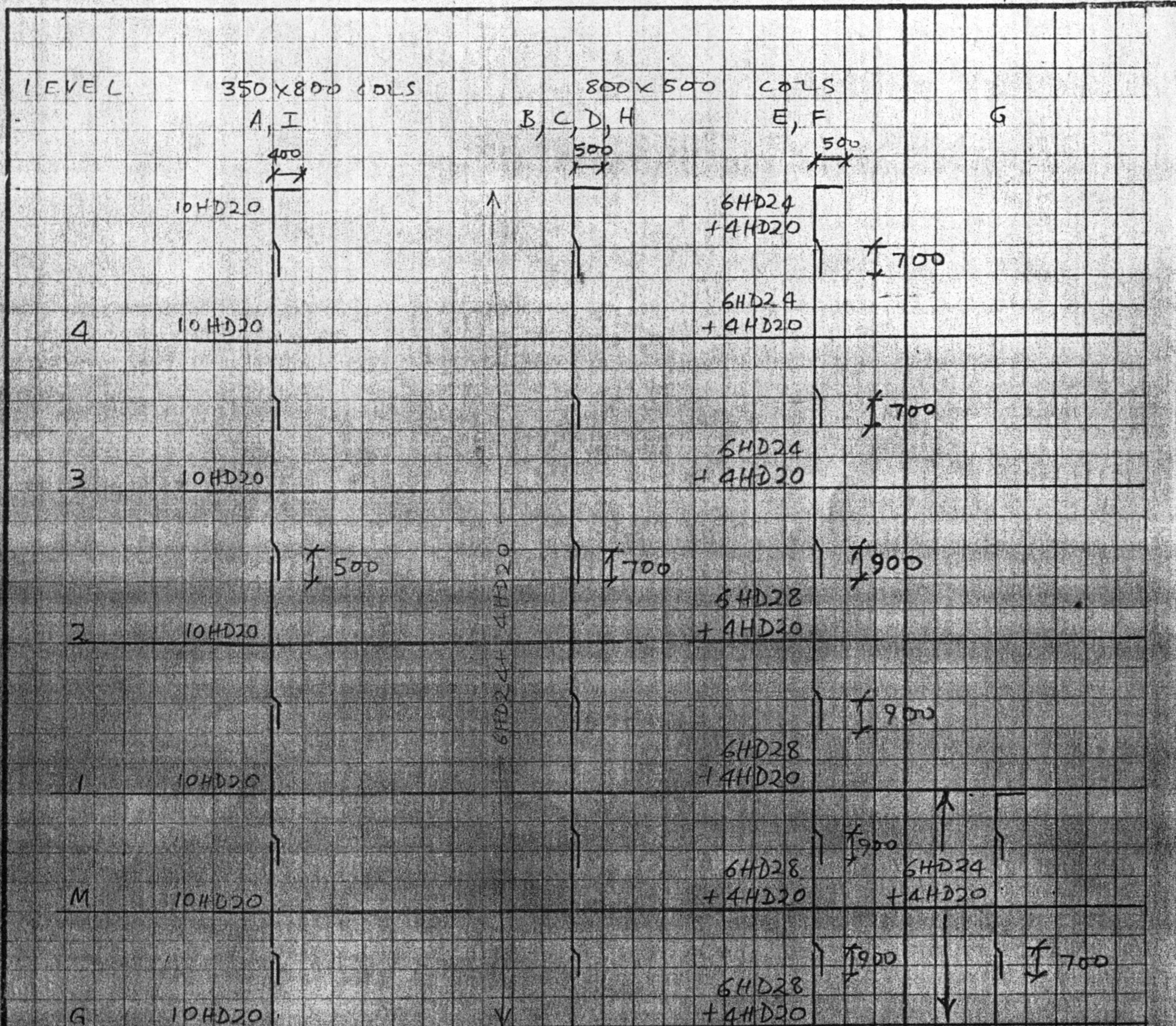
200 x 500

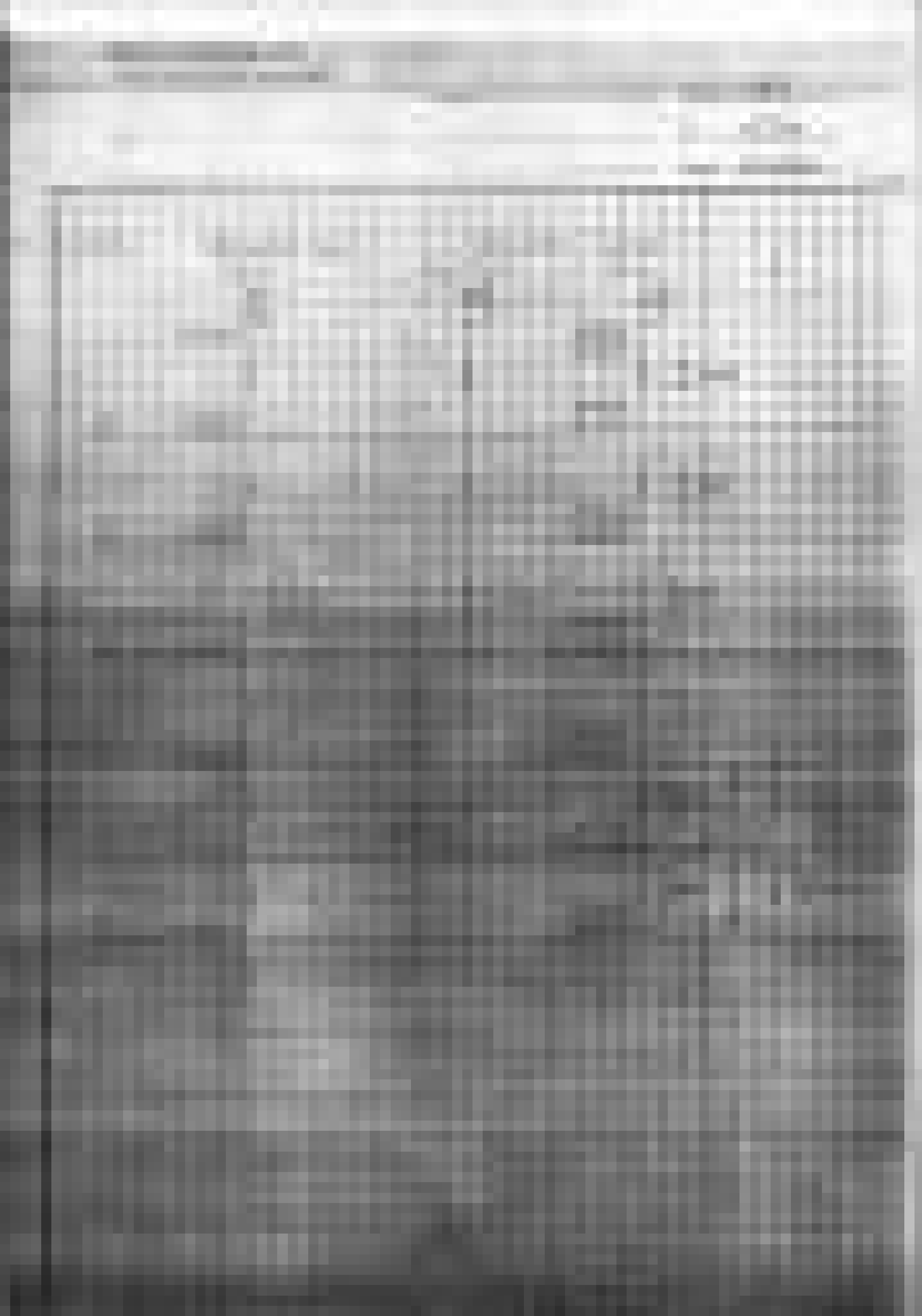


350 x 800

Note i) 50 cover to all bars







Transverse Rein

Confinement Reo - Ltd Ductile End Regions

$$\lambda = \frac{M_{e^*} + .3 f_{ck}}{.6 \phi f_l A_g^*} = \frac{695 \times 10^6 + .3 \times 2219 \times 10^3 \times 200}{.6 \times .9 \times 25 \times .2 \times 800 \times 500 \times 800} = 1.42$$

$$\lambda = \frac{587 \times 10^6 + .3 \times 2523 \times 10^3 \times 800}{.6 \times .9 \times 25 \times .2 \times 800 \times 500 \times 800} = 1.38$$

$$R_c = \frac{\lambda}{1 + \rho_{trm}} - 1 = \frac{1.42}{\left(1 + \frac{1848}{500 \times .2 \times 800} \times \frac{380}{.85 \times 25}\right)} - 1 = .005$$

$$A_{sh} = R_c (.025 s_n h f_c' / f_y h) = .005 (.02 \times 150 \times 800 \times 25 / 380) = 0.8 \text{ mm}^2$$

→ OK

$$S_{max} = 10 \times 20 = 200$$

$$V_u \text{ max} = 447 \text{ kN}$$

$$v_u = 447 \times 10^3 / .85 \times 500 \times 680 = 1.55$$

$$v_c = .4 \sqrt{P_c / A_g} = .4 \sqrt{969 \times 10^3 / 500 \times 800} = .62$$

$$v_s = .93 \quad S_{max} = 680 / 6 = 113$$

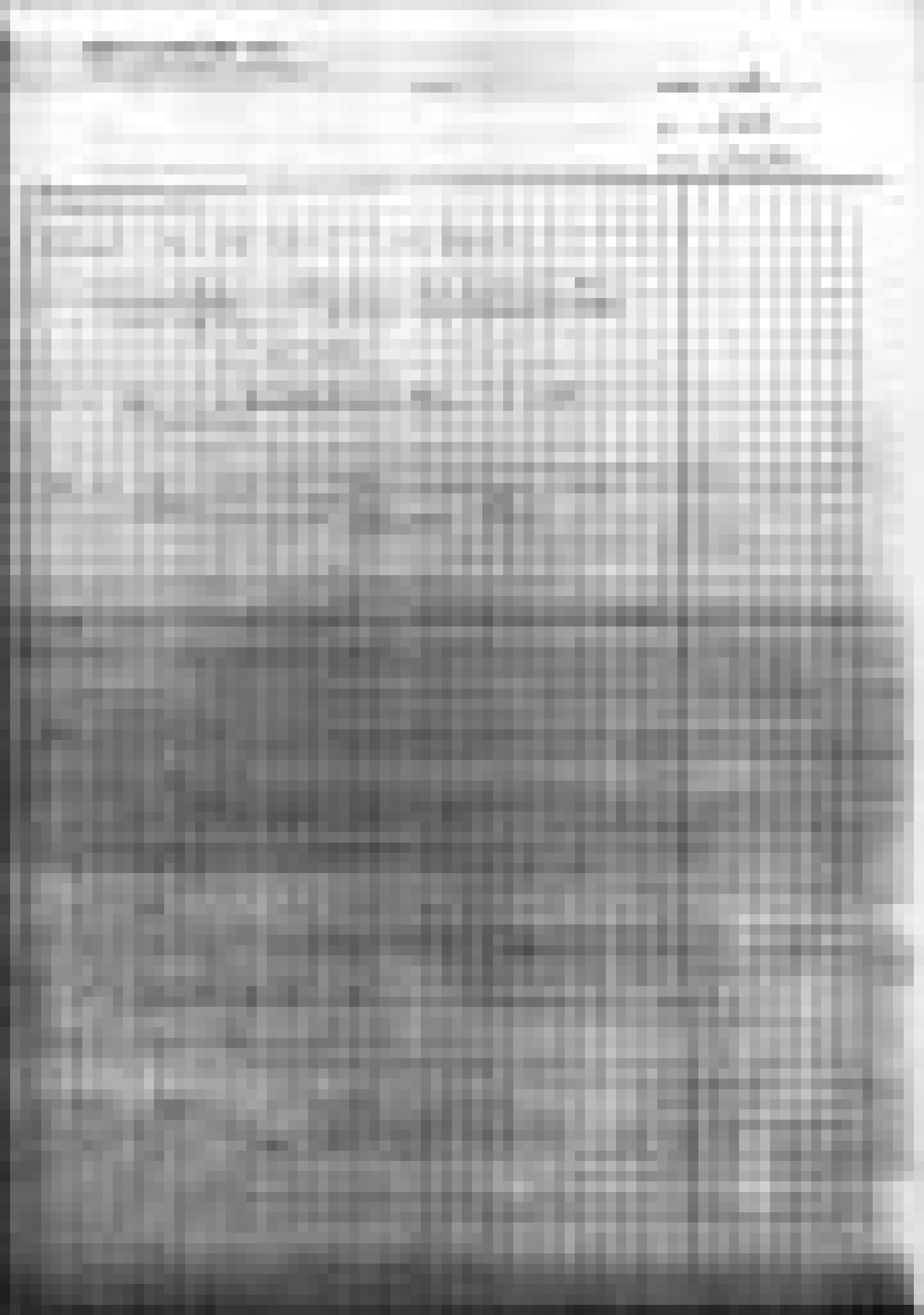
$$A_v = v_s b_w S / f_y = .93 \times 500 \times 150 / 380 = 184 \text{ mm}^2$$

→ 3 legs HR10 @ 150 OK

$$6.4 \quad S_{max} = 500, 16 \times 20 = 320, 480$$

→ End Regions HR 10 sets @ 150 OK

End Regions 800 from face



Outside ER

r_c 7.3.2

$$P_u = 3 \times 616 + 2 \times 314 / 500 \times 680 = .0073$$

$$r_b = .72$$

$$\left(1 + \frac{3 P_u}{A_g f_c}\right) r_b = \left(1 + \frac{3 \times 969 \times 10^3}{500 \times 800 \times 25}\right) .72 = .93$$

$$r_s = 1.55 - .93 = .62$$

$$A_v = r_s b_w s / f_y$$

$$\Rightarrow s_{max} = 236 \times 380 / .62 \times 500 = 289$$

\Rightarrow HR10 sds @ 250

Joint Rev

Design M_u beam = 560 + 330

$$T_{top} = 560 / .73 = 767 \text{ kN}$$

$$T_{bottom} = 330 / .73 = 452 \text{ kN}$$

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

$$V_{col} = 2 \left(\frac{5.3}{4.5} \times 330 + \frac{6.3}{5.5} \times 560 \right) / 6.6 = 312 \text{ kN}$$

$$V_{jk} = 767 + 452 - 312 = 907 \text{ kN}$$

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

$$v_{jk} = V_{ju} / b_j h_c = 907 \times 10^3 / (500 \times 800) = 2.27 \text{ MPa}$$

$$1.5 \sqrt{f_c'} = 7.5 \Rightarrow OK$$

$$V_{sk} = 1.5 v_{jk} \left(1 + \frac{P_u}{A_g f_c'}\right) = 1.5 \times 907 \left(1 + \frac{614 \times 10^3}{1.4 \times 500 \times 800 \times 25}\right) = 523 \text{ kN}$$

$$V_{sk} = 907 / 1.85 - 523 = 540 \text{ kN}$$

$$A_{sh} = V_{sh} / f_y = 544 \times 10^3 / 380 = 1432 \text{ mm}^2$$

$$\text{Clear space} = 620 \quad 1432 / 236 = 6$$

$$\rightarrow \text{HR10 sets @ 100} \quad (A_s = 1652 \text{ mm}^2)$$

$$V_{cv} = \frac{A_{sh}}{A_{sv}} V_{sv} \left(0.6 \frac{C_f P_u}{A_g f_c} \right) = 1 \times 907 \left(0.6 + \frac{614 \times 10^3}{500 \times 800 \times 25} \right) = 600 \text{ kN}$$

$$V_{sv} = 907 / 0.85 = 467 \text{ kN}$$

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

$$A_{sv} \text{ provided} = 4 \times 314 = 1256 \Rightarrow \text{OK}$$

350x800

$$\text{Max } V_u = 77 \text{ kN}$$

$$V_c = 77 \times 10^3 / 0.85 \times 800 \times 290 = 0.39 \text{ MPa}$$

$$0.07 f_c = 1.75 \Rightarrow \text{OK} \quad \text{min } d/2 = 145$$

$$\Rightarrow \text{HR10 @ 100}$$

$$\text{Outside PHR HR10 @ 150}$$

800x500 Cols
Transverse Rebar

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

350x800 Cols

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

Note - All cols.

Middle zone (rem)
Levels 2-4 only.
Levels 5-2
one zone for full
height between beam
faces

Refer P.
for stirrup sets

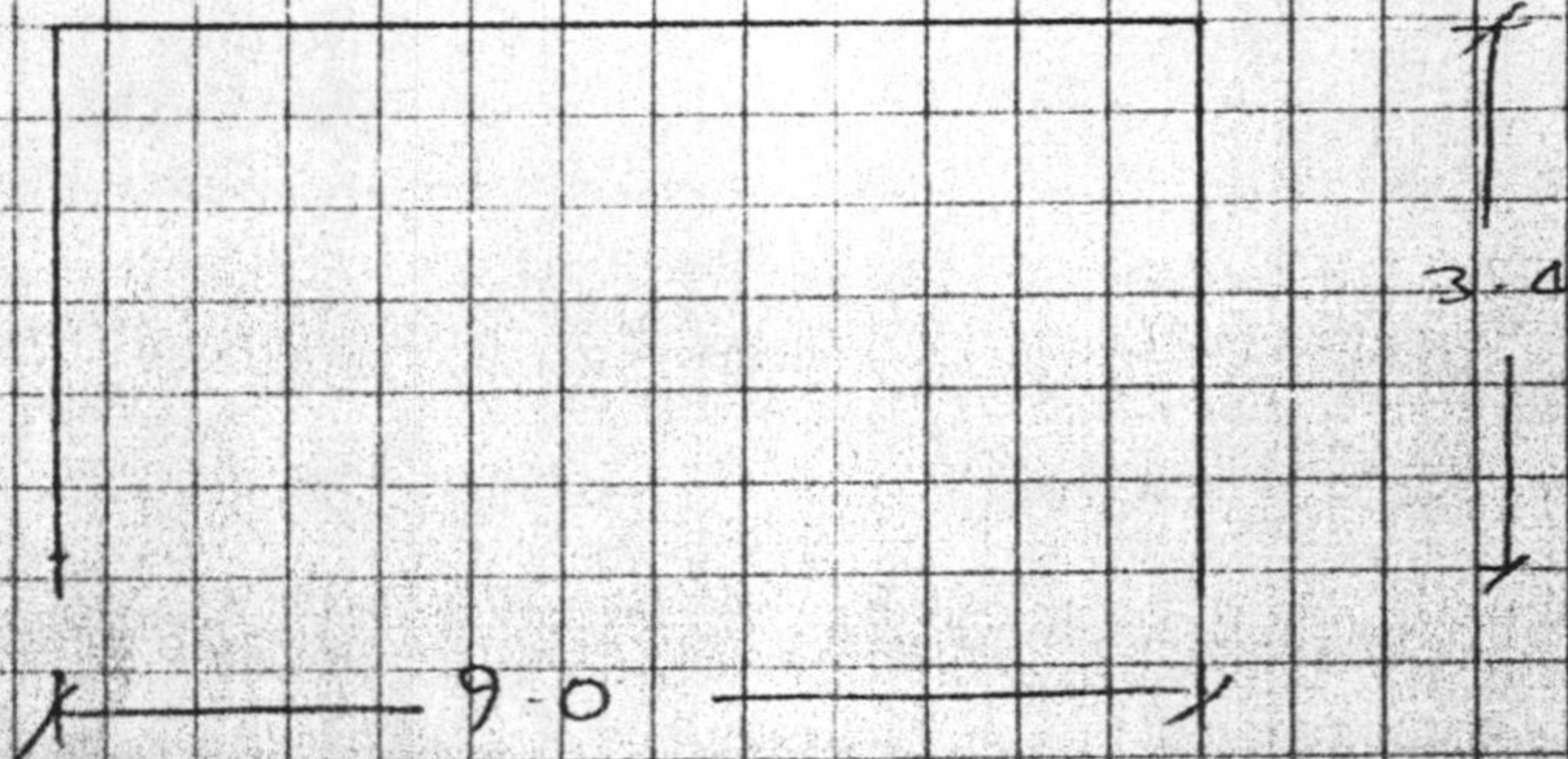
500 x 800



250 x 300



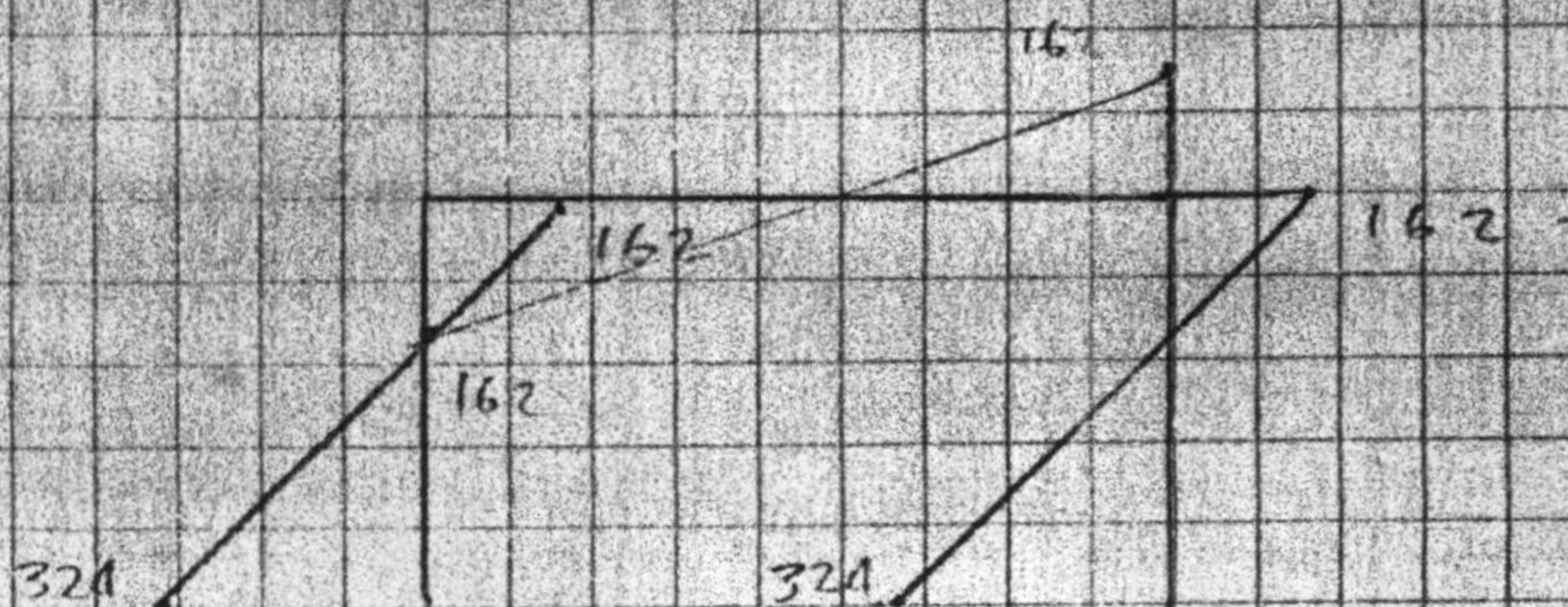
500 x 350



free conservatively frame takes $V/2 + \text{torsion}$

$$F = (476/2) + 48 = 286 \text{ kN}$$

800 + column pt of contraflexure @ $2/3 \text{ l.d.}$



$$C/L \quad \mu / I_y \cdot l^3 = 324 \times 10^6 / (9 \times 25 \times 800 \times 500^3) = 0.072$$

$$\mu / I_y = 0.20$$

$$\mu / I_y = 0.12$$

$$I_y = 4480$$

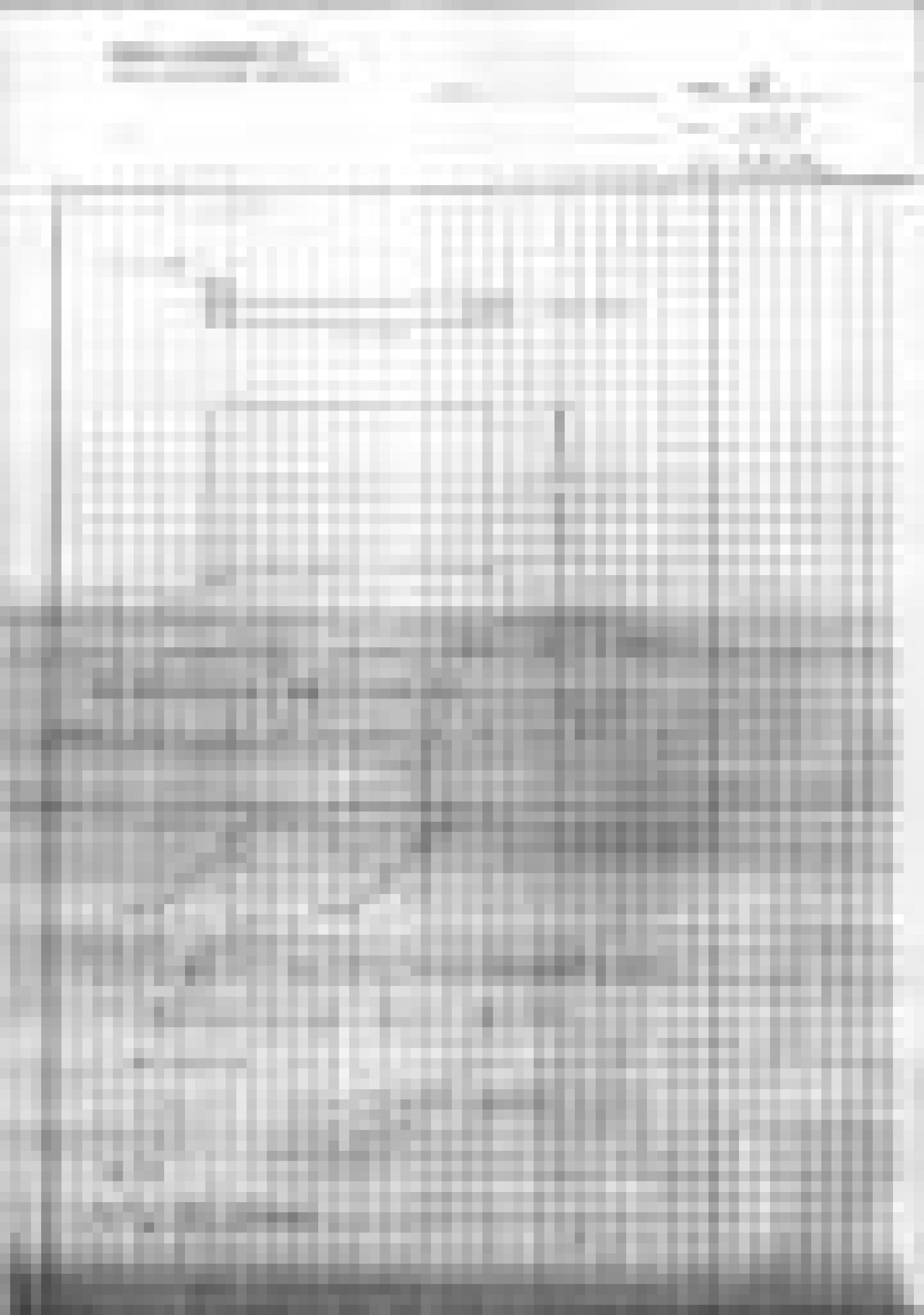
⇒ 10 HD 24

60 E

$$\mu / I_y \cdot l^3 = 324 \times 10^6 / (9 \times 25 \times 350 \times 500^3) = 0.165$$

⇒ NG

⇒ Try 2 frames



Distribute shears according to rel. stiffness

$$A = I/AE \left[\left(\frac{1}{11} \right) + 3 \right]$$

$$500 \times 800 \quad f = \frac{3.4}{.5 \times .8 \times 23500} \left[\left(\frac{3.4}{.5} \right)^2 + 3 \right] \times 10^3 = 17.81$$

$$500 \times 350 \quad f = 40.71$$

$$S = 1/f$$

$$500 \times 800$$

$$500 \times 350$$

$$S = .056 \times 3 = .168$$

$$.025$$

$$.193$$

Shear

$$500 \times 800$$

$$V = \left[\frac{.168}{.193} \times 286 \right] / 3 = 83 \text{ kN}$$

$$500 \times 350$$

$$V = \frac{.025}{.193} \times 286 = 37 \text{ kN}$$

$$500 \times 800$$

$$M = 188 \text{ kNm}$$

$$M_i / f b h^2 = .042$$

⇒ Min steel OK

$$500 \times 350$$

$$M = 84 \text{ kNm}$$

$$M_i / f b h^2 = .043$$

⇒ Min steel OK

$$f_{y \text{ min}} = 84 \text{ L16 but I use HD20's below}$$

$$\Rightarrow 8 \text{ HD20}$$

Beam

$$200 \times 500$$

$$M_E = 94 \text{ kNm}$$

$$W_D = 20 \times .8 \times .4 + 5 \times 1 + 1 \times 3 = 15.7 \text{ kN/m}$$

$$W_L = 3 \times 4 = 12 \text{ kN/m}$$

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

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

Column

$$P_u = 1.4 \times 20 \times .8 \times .4 \times 5 + 1.4 \times 60 + 1.4 \times 5 \times 5 \times .8 = 166 \text{ kN}$$

$$W_u = 1.4 \times 20 \times .8 \times .5 = 11.2 \text{ kN/m}$$

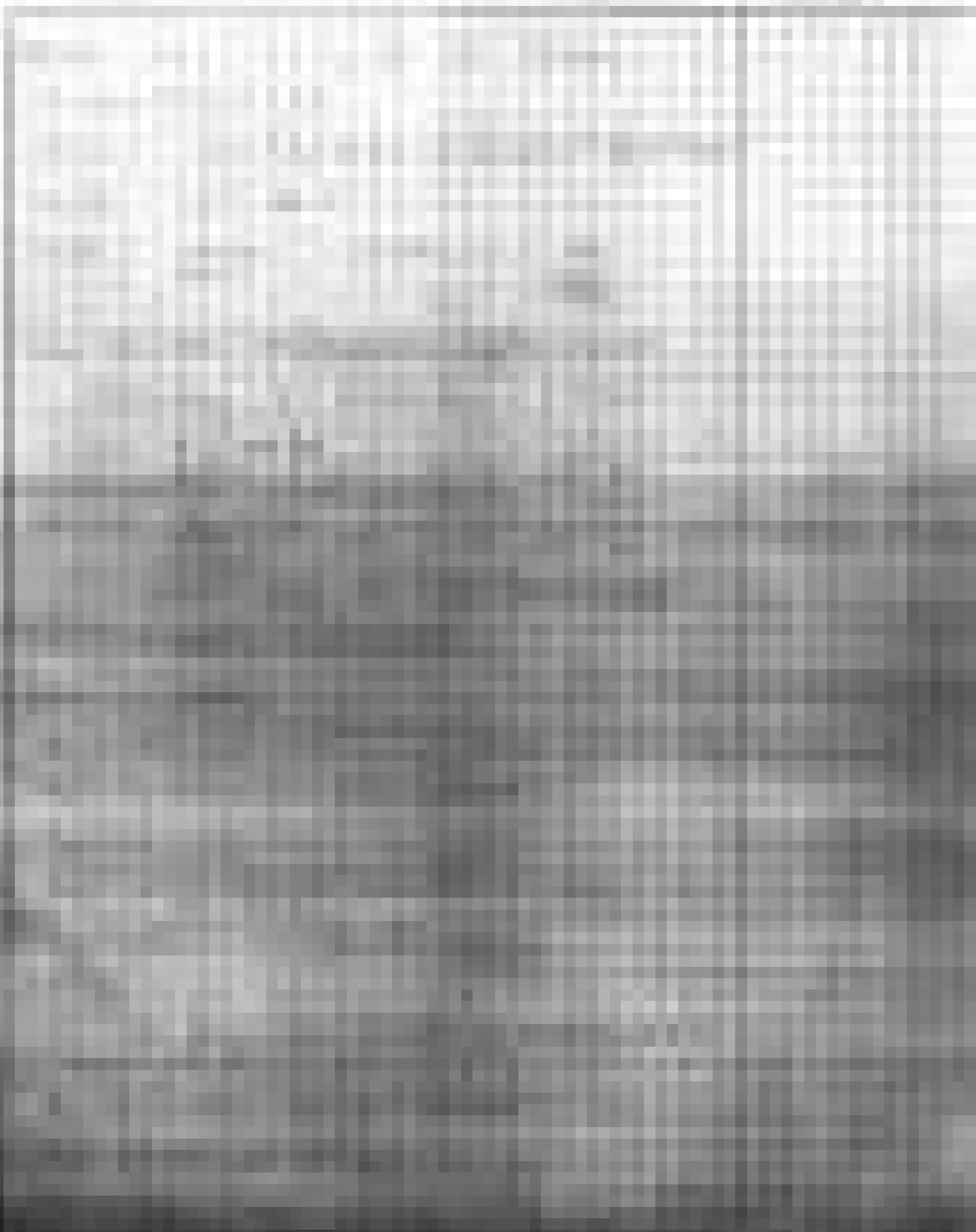
$$M_u = 11.2 \times 2^2 / 2 + 166 \times 2 = 359 \text{ kNm}$$

$$2 \times 17 \text{ L16}$$

$$M_u = 305 \text{ kNm}$$

$$\Rightarrow 4 \text{ HD24 T \& B}$$

100



Slab:

$$V_u = 166 + 13.0 \times 2 = 193 \text{ kN} \quad \text{or} \quad 47.0 \times 9/2 = 191 \text{ kN}$$

$$n = 193000 / (.85 \times 500 \times 730) = .62$$

$$\rho_w = .0050 \quad \rho_c = .60$$

$$A_{smin} = .35 bws / f_y$$

$$s_{min} = 157 \times 380 / (.35 \times 500) = 341$$

→ 3 logs HR10 @ 100 for 1620 from face
HR10 @ 300 rem

Edge Beam — Try 600 x 300

$$w_{DL} = 1.4 \times 24 \times .8 \times .4 + 1.4 \times 5 \times .8 + 1.4 \times 10 \times .3 = 30.8$$

$$M_u = 30.8 \times 2^2 / 2 = 62 \text{ kNm}$$

$$\text{or} \quad 30.8 \times 5^2 / 8 = 96 \text{ kNm}$$

$$R_u = 96 \times 10^6 / (.9 \times 300 \times 530^2) = 1.27 \quad \rho = .0035$$

$$A_s = .0035 \times 300 \times 530 = 568 \text{ mm}^2$$

⇒ 2HD29 T & B

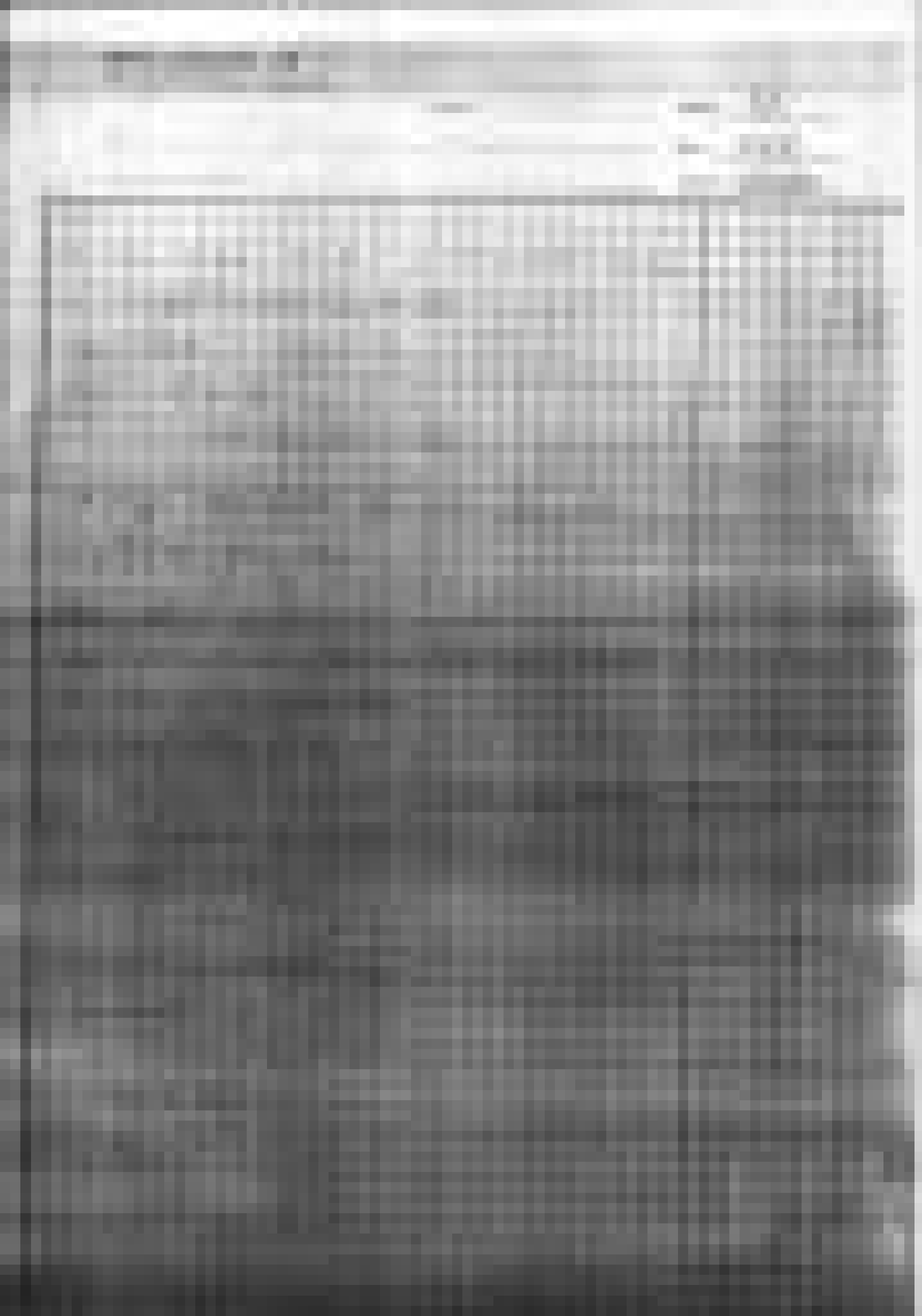
$$V_u = 30.8 \times 5/8 \times 5 = 96 \text{ kN}$$

$$n = 96 \times 10^3 / (.85 \times 300 \times 530) = .71$$

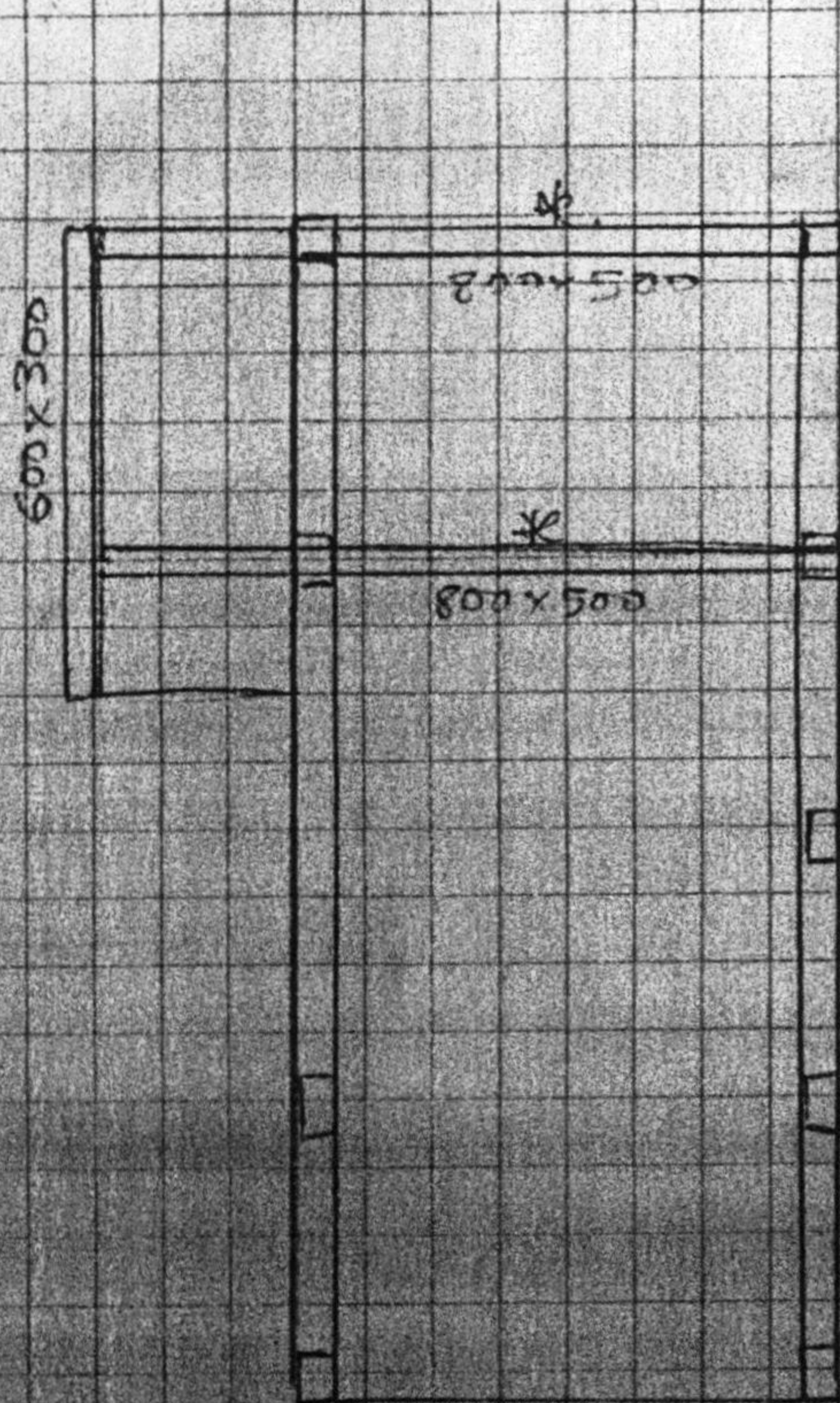
$$\rho_w = .0057 \quad .64$$

$$s_{min} = 157 \times 380 / (.35 \times 300) = 568$$

⇒ HR10 @ 200



Level 1 Floor



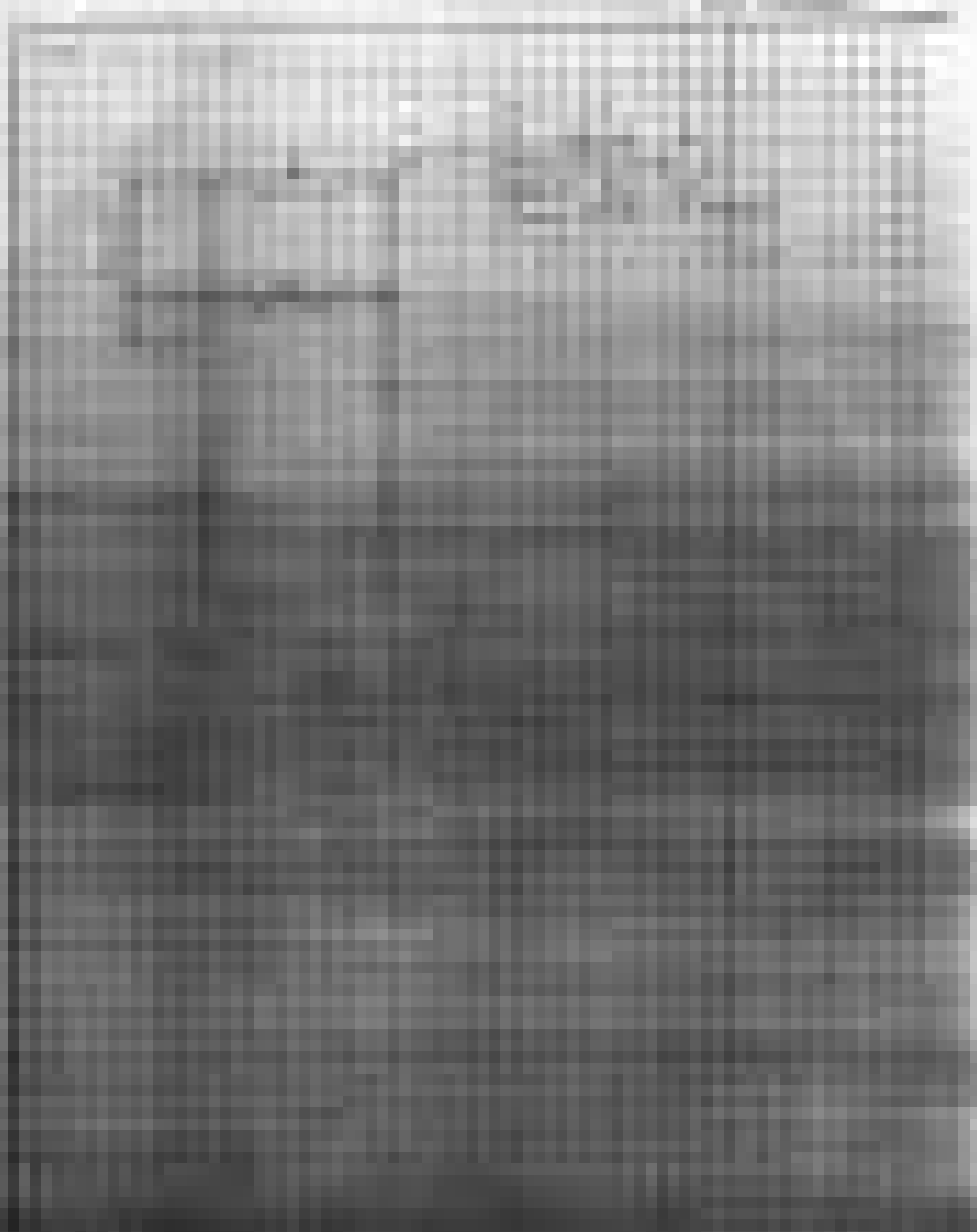
800 x 350
Col. reduced to
500 x 350 @ lev. 3
(Reduce long req.
from 10HD20 to 8HD20)

* 800 x 500 beam

4HD24 T & B
3 legs HR10 @ 100 for 1650 from face (not on cantilever)
HR10 @ 300 rem.
HR10 @ 200 cantilever.

600 x 300 beam

2HD24 T & B
HR10 @ 200



600x300 beam connection

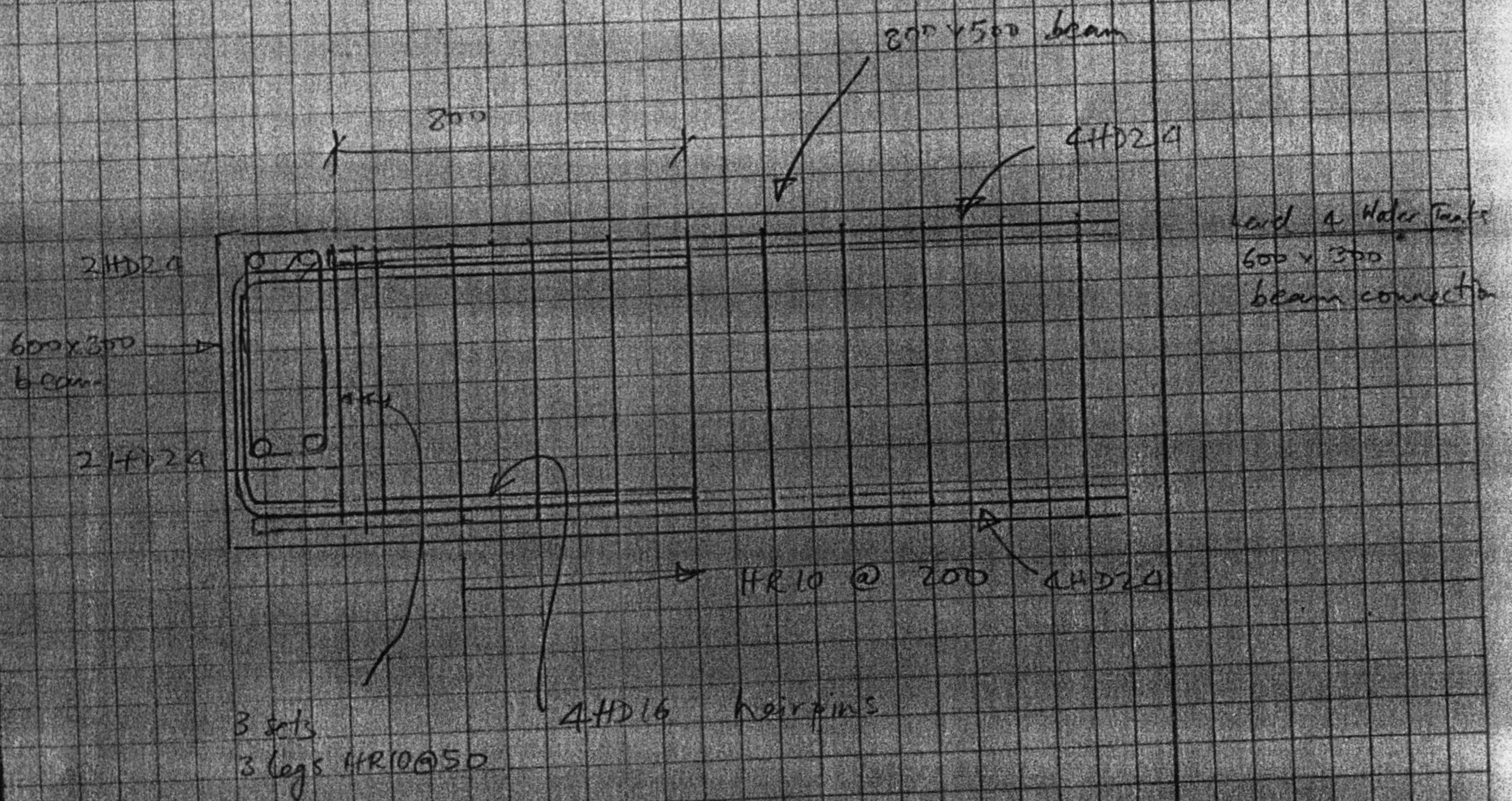
$$A_{st} = V_u / \phi \mu f_y = 166000 / (0.85 \times 7 \times 380) = 734 \text{ mm}^2$$

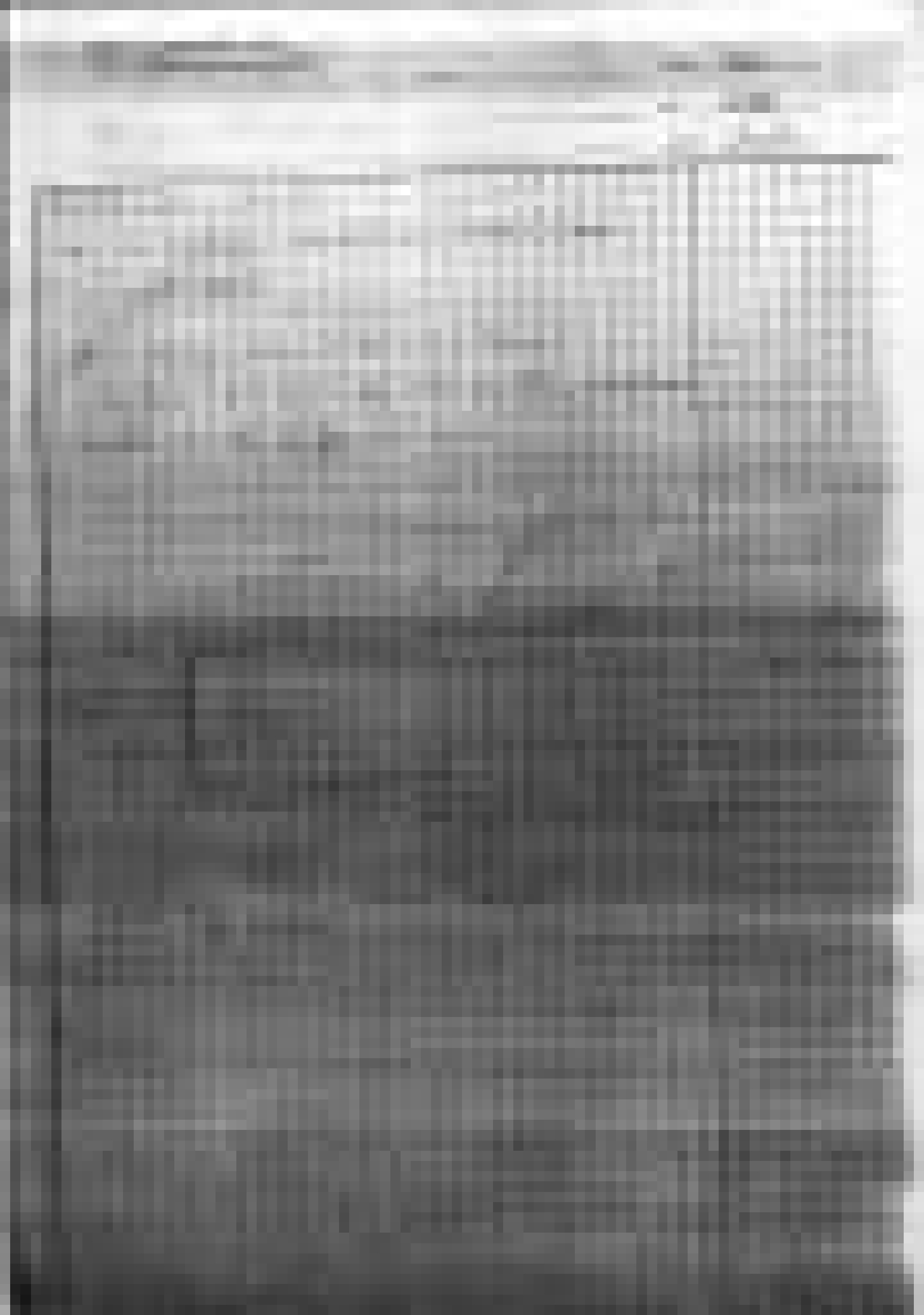
⇒ 4HD16

$$A_v = V_u / \phi f_y = 166 \times 10^3 / (0.85 \times 380) = 514 \text{ mm}^2$$

$$514 / 236 = 2.2 \text{ sets of legs HR10 w/ } 1/2 = 365 \text{ of beam}$$

require 3 sets 3 legs HR10 @ 50





$W_p = 1 \times 8 \times 5 = 40 \text{ kN}$

$R_p = 1.5 \quad C_{p \text{ max}} = 1.6 \quad C_{p \text{ min}} = .3$

$C_p = 1.5 K_z S_p M_p R_p C_i$

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

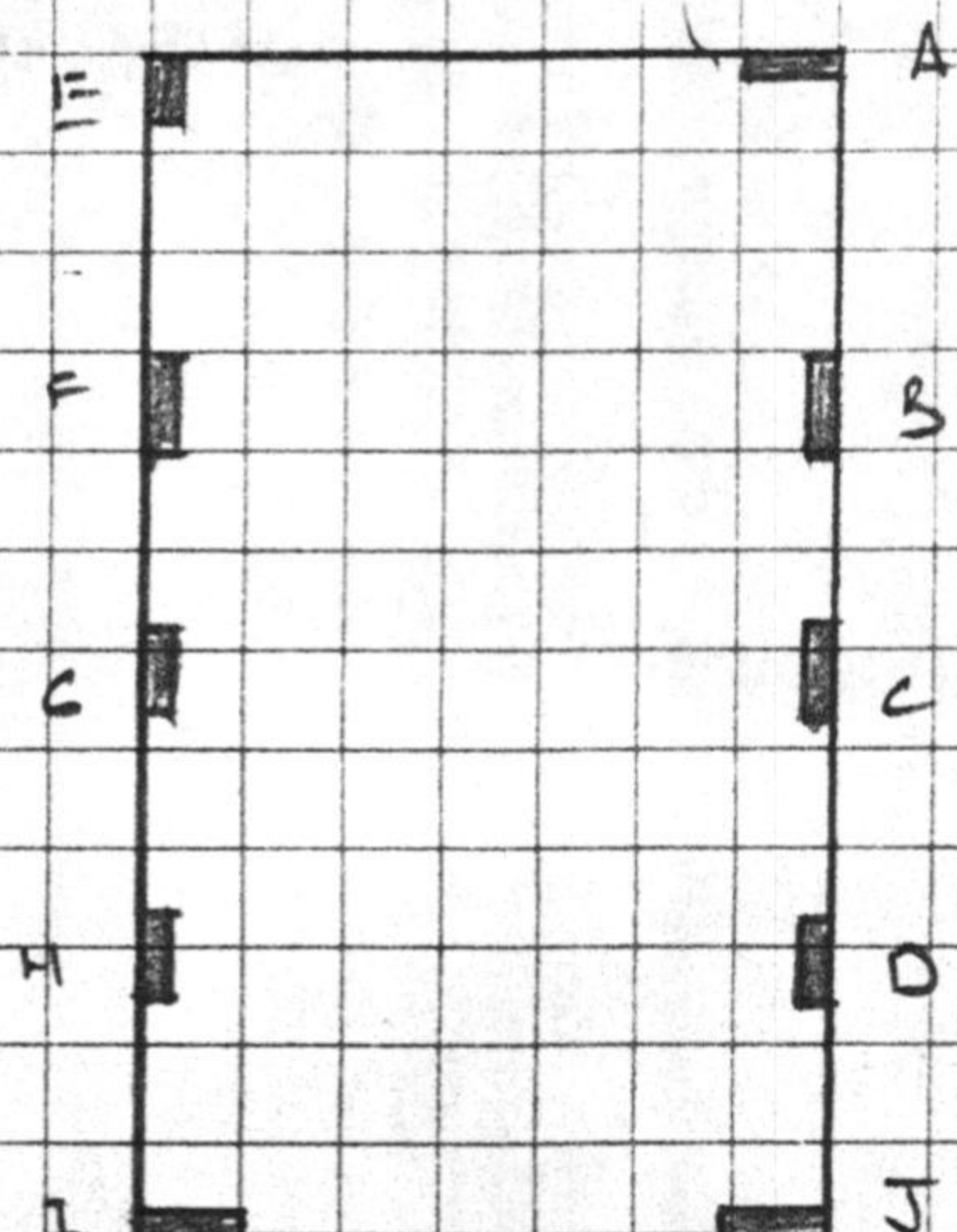
$\alpha K_z Z R C_{p \text{ min}} = \frac{9}{15.8} \times \frac{19}{9} \times 1 \times .3 = .36$

$F_p = .38 \times 40 = 15.2 \text{ kN}$

$M = 15.2 \times 3.2 = 49 \text{ kNm}$

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

$\Rightarrow \text{OK} \quad (\text{also OK for min steel})$



N-S torsion

$$1530 \times \frac{.45}{6} = \pm 122.4$$

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

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

Uplift 2m ϕ , 7m depth.

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

| Column | D | L | D+L | E'Quake | | | | D+L+.8E | .7D+.8E |
|--------|------|-----|------|---------|-------|--------------|---------------|---------|---------|
| | | | | E | W | N | S | | |
| 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 | - | - | 1924 | -734 |

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Handwritten text enclosed in a rectangular box, likely a title or a specific section header.

Handwritten text located to the right of the boxed area, possibly a subtitle or introductory paragraph.

| Date | | Description | | Amount | | Total | |
|------|-------------|---------------------|--|---------|--|---------|--|
| 1890 | Jan 1 | Balance | | 100.00 | | 100.00 | |
| 1890 | Jan 15 | Received from A. B. | | 50.00 | | 150.00 | |
| 1890 | Feb 1 | Received from C. D. | | 25.00 | | 175.00 | |
| 1890 | Feb 15 | Received from E. F. | | 75.00 | | 250.00 | |
| 1890 | Mar 1 | Received from G. H. | | 100.00 | | 350.00 | |
| 1890 | Mar 15 | Received from I. J. | | 125.00 | | 475.00 | |
| 1890 | Apr 1 | Received from K. L. | | 150.00 | | 625.00 | |
| 1890 | Apr 15 | Received from M. N. | | 175.00 | | 800.00 | |
| 1890 | May 1 | Received from O. P. | | 200.00 | | 1000.00 | |
| 1890 | May 15 | Received from Q. R. | | 225.00 | | 1225.00 | |
| 1890 | Jun 1 | Received from S. T. | | 250.00 | | 1475.00 | |
| 1890 | Jun 15 | Received from U. V. | | 275.00 | | 1750.00 | |
| 1890 | Jul 1 | Received from W. X. | | 300.00 | | 2050.00 | |
| 1890 | Jul 15 | Received from Y. Z. | | 325.00 | | 2375.00 | |
| 1890 | Aug 1 | Received from A. B. | | 350.00 | | 2725.00 | |
| 1890 | Aug 15 | Received from C. D. | | 375.00 | | 3100.00 | |
| 1890 | Sep 1 | Received from E. F. | | 400.00 | | 3500.00 | |
| 1890 | Sep 15 | Received from G. H. | | 425.00 | | 3925.00 | |
| 1890 | Oct 1 | Received from I. J. | | 450.00 | | 4375.00 | |
| 1890 | Oct 15 | Received from K. L. | | 475.00 | | 4850.00 | |
| 1890 | Nov 1 | Received from M. N. | | 500.00 | | 5350.00 | |
| 1890 | Nov 15 | Received from O. P. | | 525.00 | | 5875.00 | |
| 1890 | Dec 1 | Received from Q. R. | | 550.00 | | 6425.00 | |
| 1890 | Dec 15 | Received from S. T. | | 575.00 | | 7000.00 | |
| 1890 | Jan 1, 1891 | Balance | | 7000.00 | | 7000.00 | |

SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No.

1868

PAGE

F/2

JOB

BY

MYO

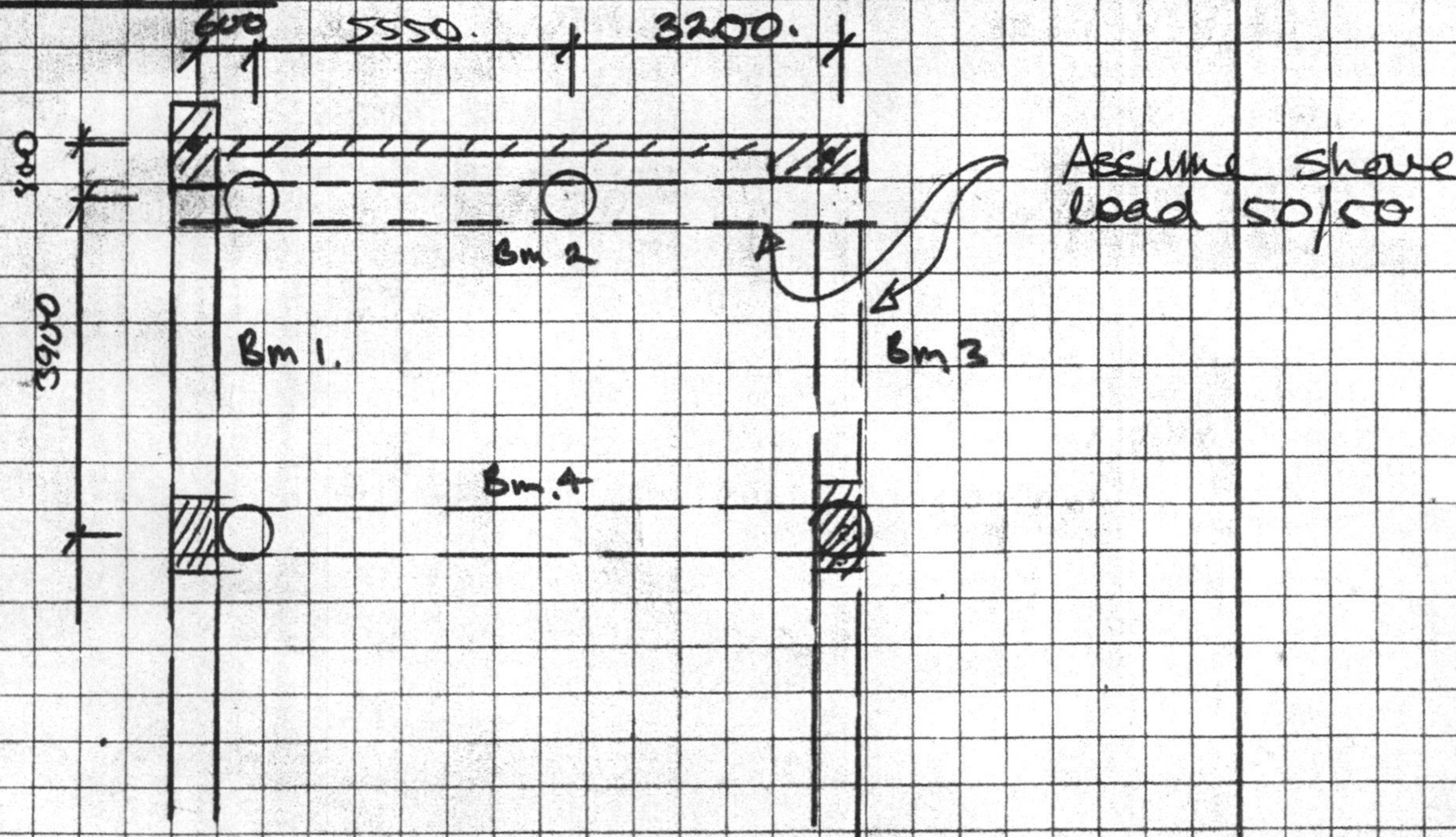
DATE

10/86

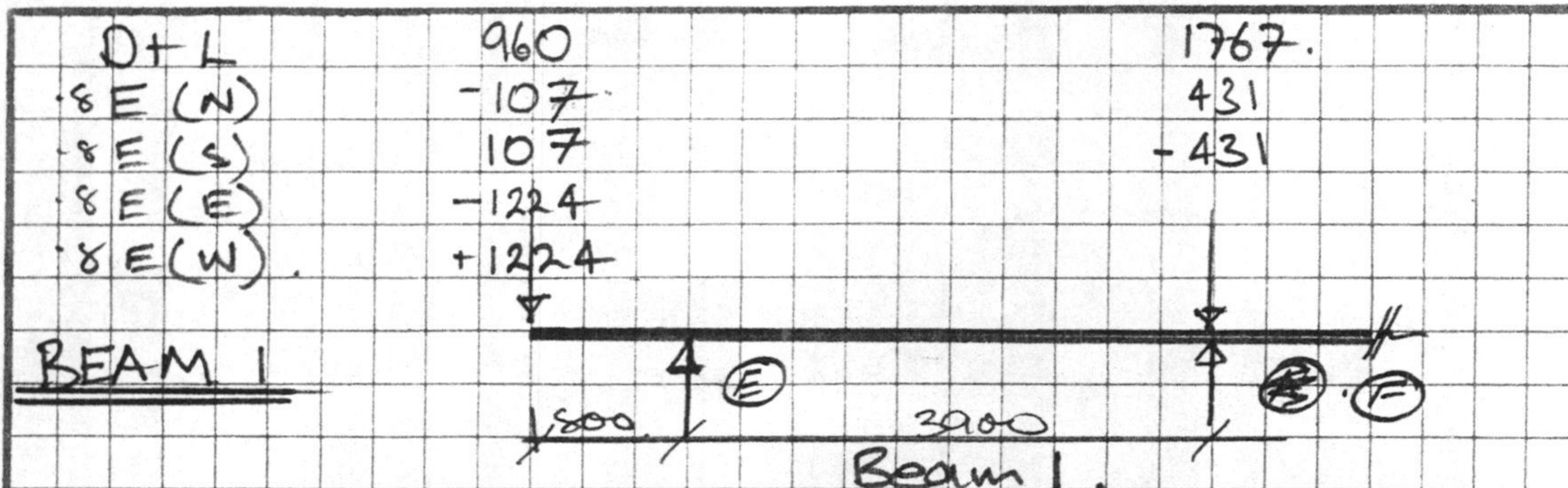
| Pile | O+L | O+L+SE | 70+18E | Pile G. | Area S. | Pile Bell ϕ . |
|------|-----------------------|--------|--------|---------|---------|--------------------|
| A | 967 | 2291 | -831 | 967 | 1.53 | 1400 |
| B | 1598 | 1832 | | 1.598 | 1.22 | 1426 |
| C | 1875 | 2000 | | 1.875 | 1.33 | 1545 |
| D | 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.



| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 | 2080 | 2081 | 2082 | 2083 | 2084 | 2085 | 2086 | 2087 | 2088 | 2089 | 2090 | 2091 | 2092 | 2093 | 2094 | 2095 | 2096 | 2097 | 2098 | 2099 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 | 2080 | 2081 | 2082 | 2083 | 2084 | 2085 | 2086 | 2087 | 2088 | 2089 | 2090 | 2091 | 2092 | 2093 | 2094 | 2095 | 2096 | 2097 | 2098 | 2099 | |



Reactions

$$\frac{8}{39} = .205$$

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

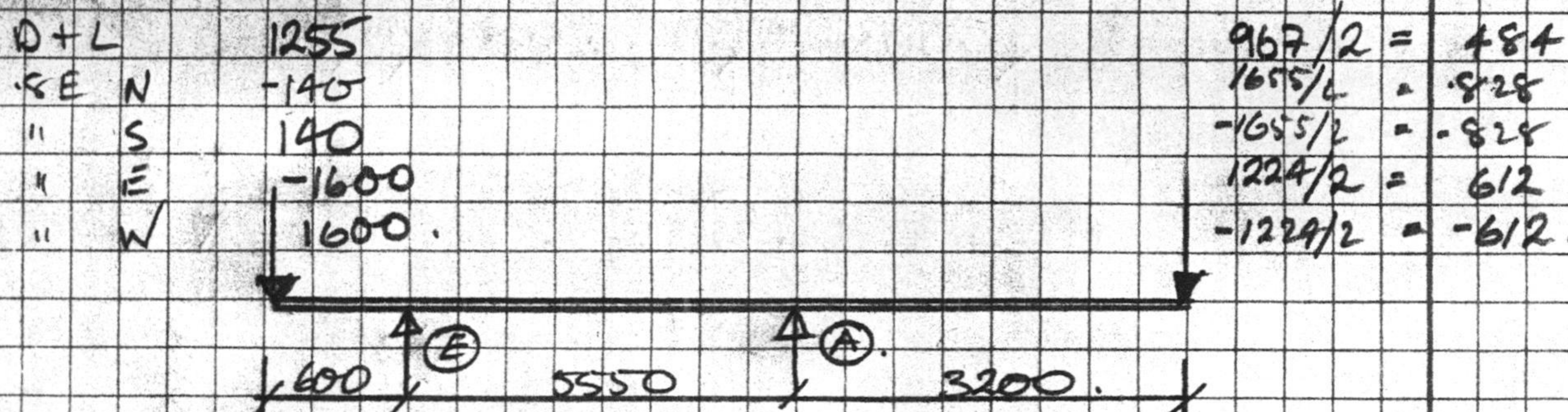
$$\frac{3}{2} \times .205 = .307$$

| | | |
|-------|-------|-------------------|
| 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



Reactions:

$$= \frac{6.15}{5.55} \times \frac{3.2}{5.55} - \frac{.6}{5.55} + \frac{8.75}{5.55}$$

$$= \frac{.6}{5.55} - \frac{.6}{5.55} = 1.58 \times - 12$$

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

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | | | | | | | | | | | | | | | | | | | | |

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.

| | | |
|------|--------------------------|-------------------|
| | $\times \frac{9.5}{5.0}$ | $- \frac{1.5}{5}$ |
| 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-SE ↑ | D+L ↑ | +SE | Area load | φ, mm |
|------|-------|---------|-------|-------|-----------|-------|
| A | 614 | 1939 | — | 711 | 1.29 | 1281 |
| B | 2517 | 4324 | — | — | 2.88 | 1915 |
| E | 1100 | 3215 | — | -1015 | 2.14 | 1651 |
| F | 1534 | 2008 | — | — | 1.53 | 1396 |

1911

1911

1911

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1911

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1911

1911

Ground Beams

Beam 1

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

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

$$\sigma_c \leq .2 \times 25 = 5 \text{ MPa}$$

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

(600 x 1340)

Say 1500 x 600 beam.

$$R_u = \frac{2360 \text{ EG}}{.9 \times 1500^2 \times 600} = 2.59 \text{ MPa}$$

OK

Beam 1
1500 x 600

Beam 2

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

Only 600 long \therefore corbel.

At other End.

$$V_u = 1.48 \times 484 + \frac{828}{.8} = 1751 \text{ kN}$$

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

1500 x 800 beam.

$$R_u = 4.6 \text{ MPa}$$

Beam 2
1500 x 800

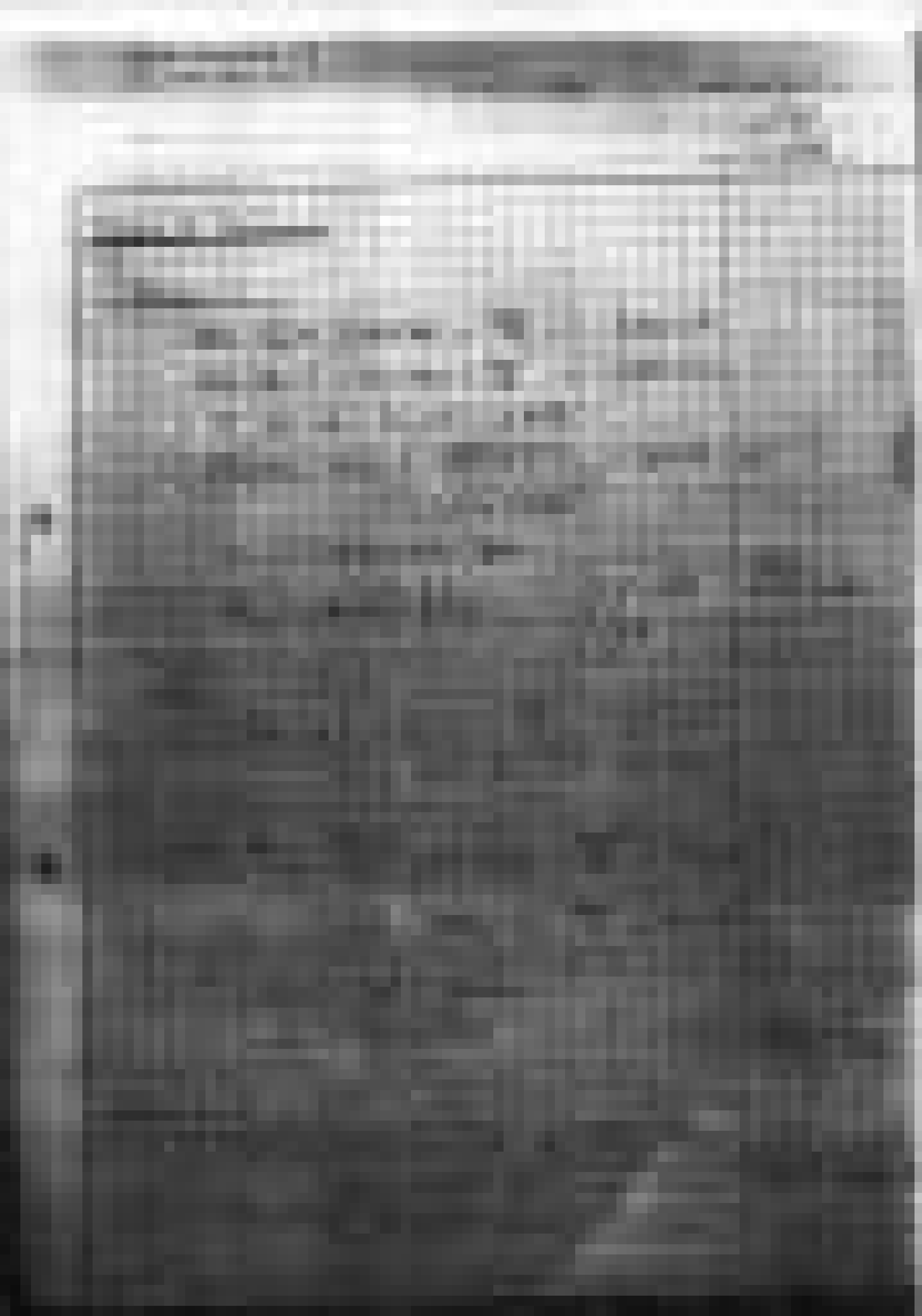
Beam 3

$$M_u = 1.48 \times 2178 + \frac{3726}{.8} = 7880 \text{ kNm}$$

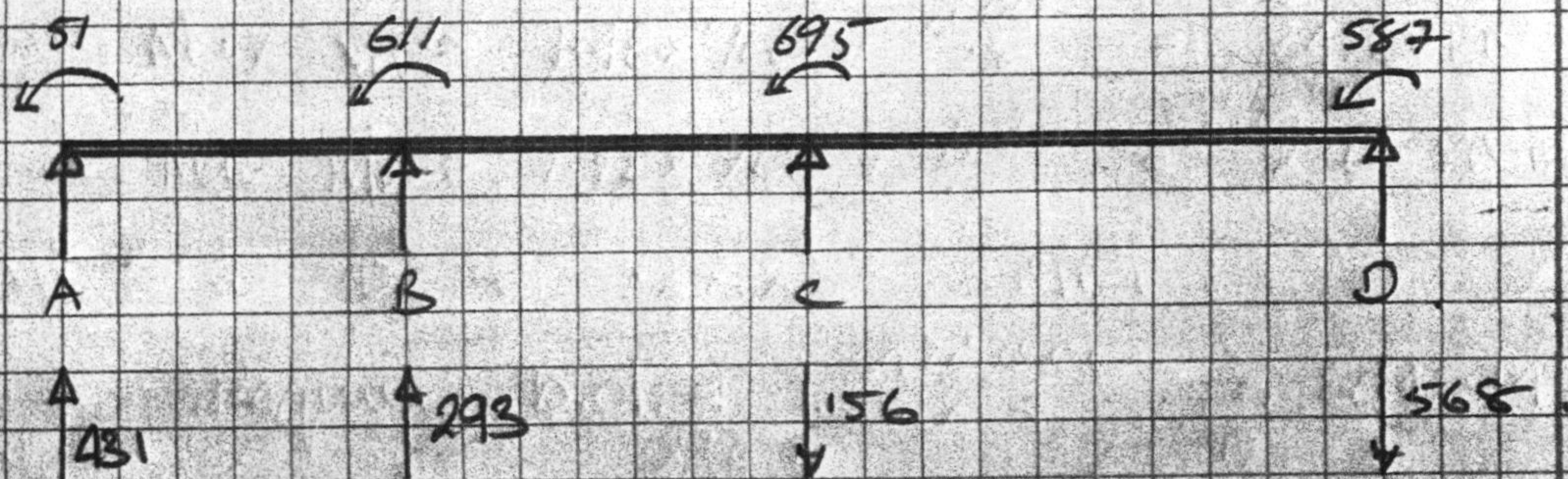
2000 x 800 beam.

$$R_u = 3.38 \text{ MPa}$$

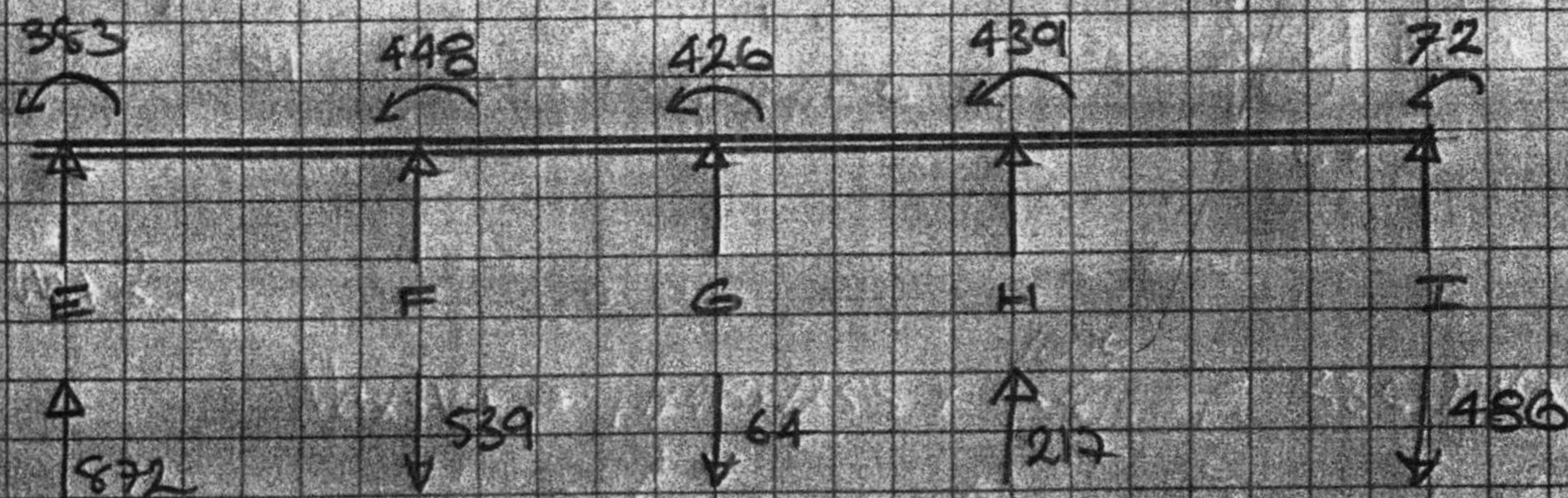
Beam 3
2000 x 800



Ground beam forces from Seismic Frame.
Refer Sheets 21 - 32.



EAST



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

1875

1875

1875

1875

1875

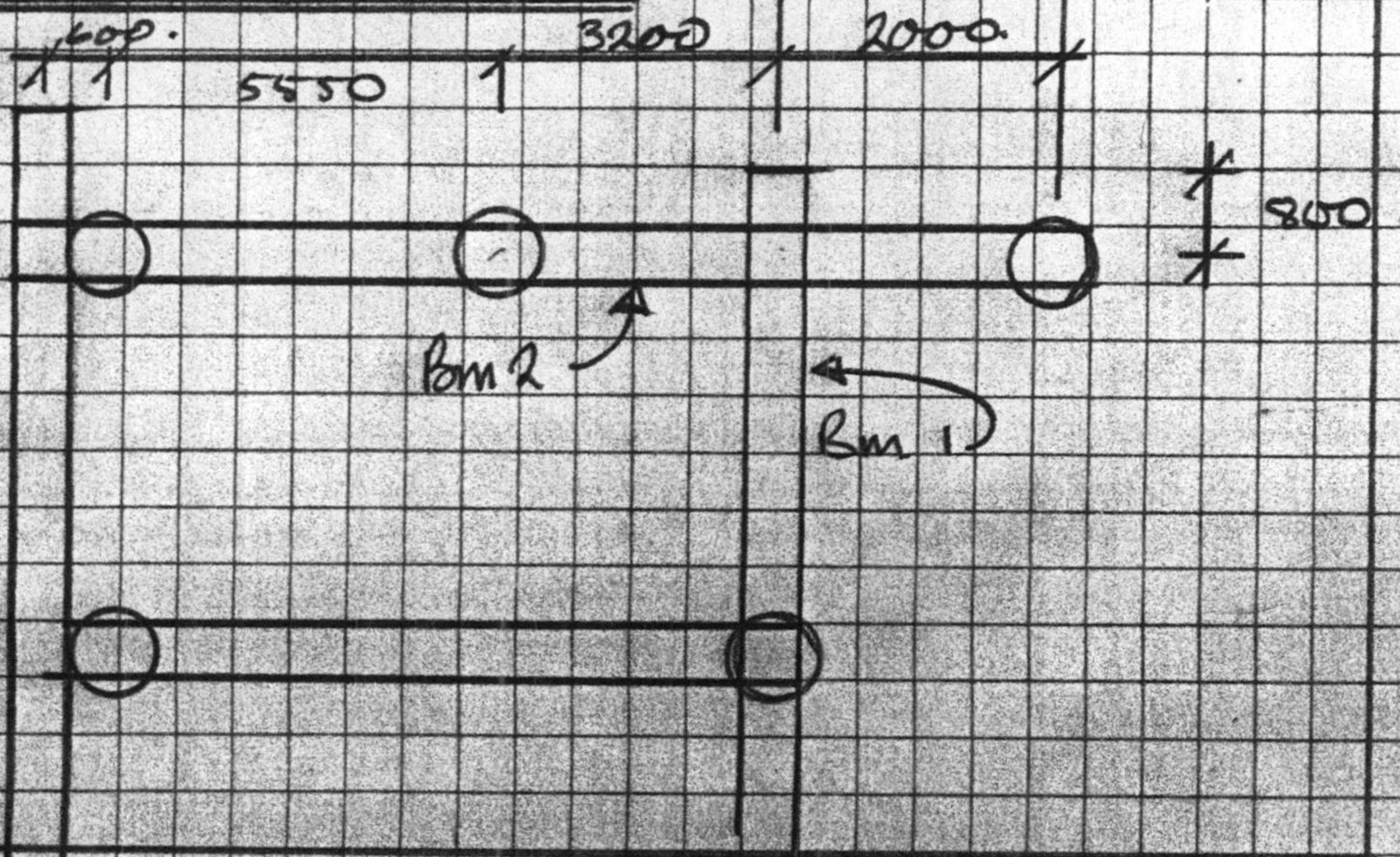
1875

1875

1875

1875

Option 2 - North End



Beam 1.

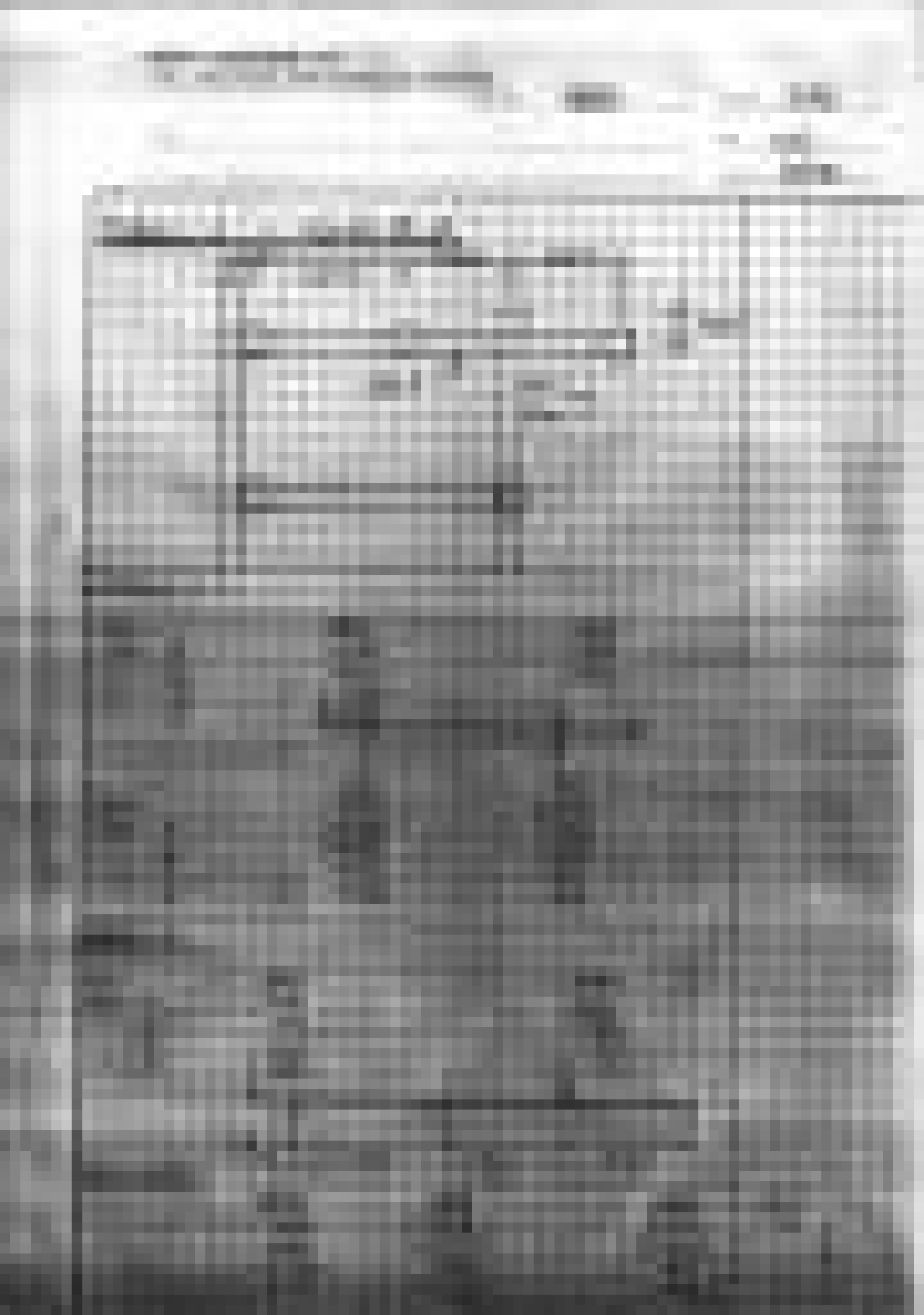
| | | | |
|-----|---|-------|------|
| D+L | | 967 | 1595 |
| SE | N | 1655 | 234 |
| " | S | -1655 | -234 |
| " | E | 1224 | |
| " | W | -1224 | |
| | | 1267 | -267 |
| D+L | | 1224 | 1540 |
| SE | N | 2096 | -207 |
| " | S | -2096 | 207 |
| " | E | 1550 | -326 |
| " | W | -1550 | 326 |

Beam 2.

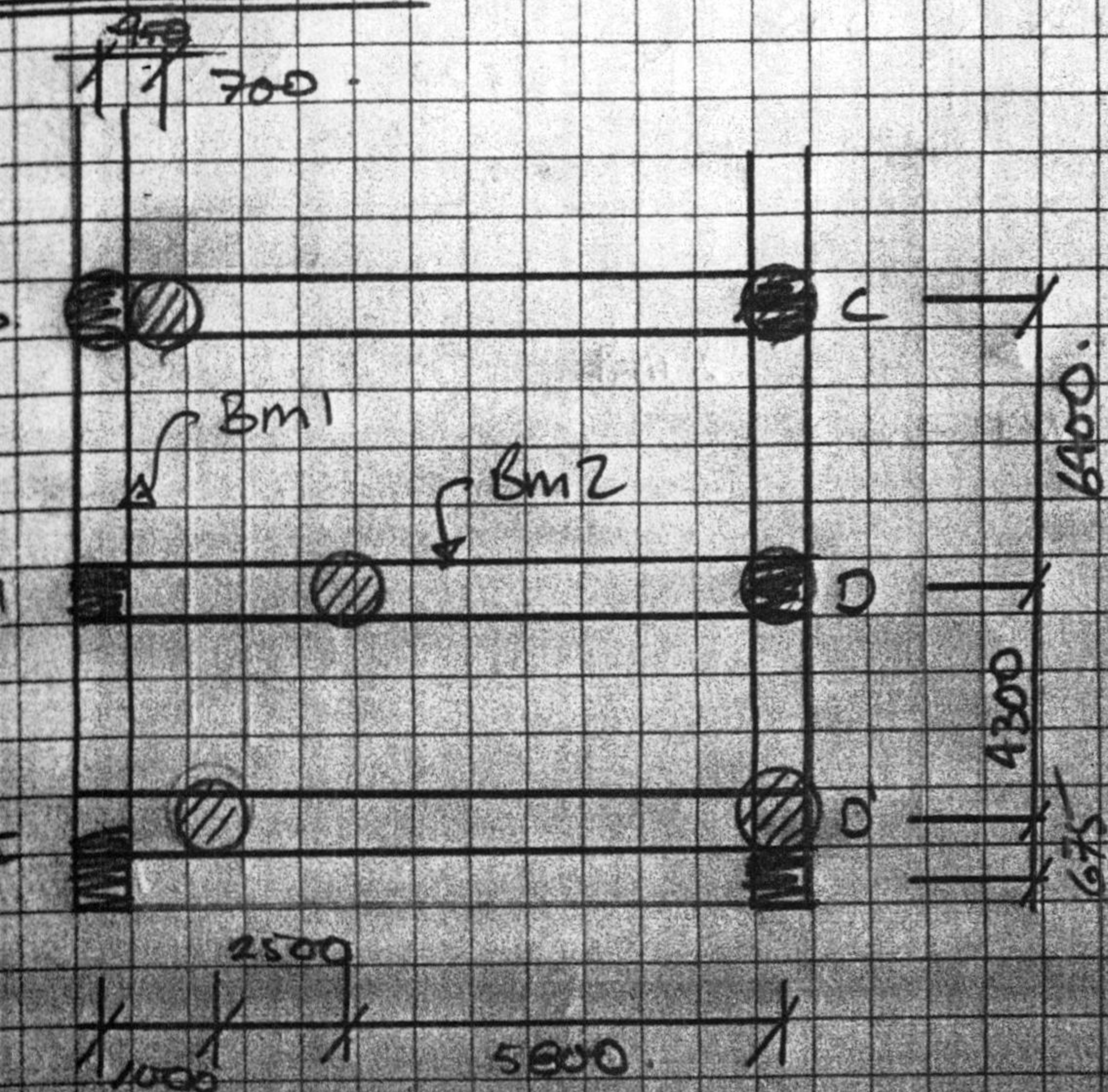
| | | | |
|-----|---|-------|-------|
| D+L | | 1255 | 1244 |
| SE | N | -140 | 2096 |
| " | S | 140 | -2096 |
| " | E | -1600 | 1550 |
| " | W | 1600 | -1550 |
| | | 1267 | -267 |
| | | 1224 | 1540 |
| | | 2096 | -207 |
| | | -2096 | 207 |
| | | 1550 | -326 |
| | | -1550 | 326 |

Approx reactions

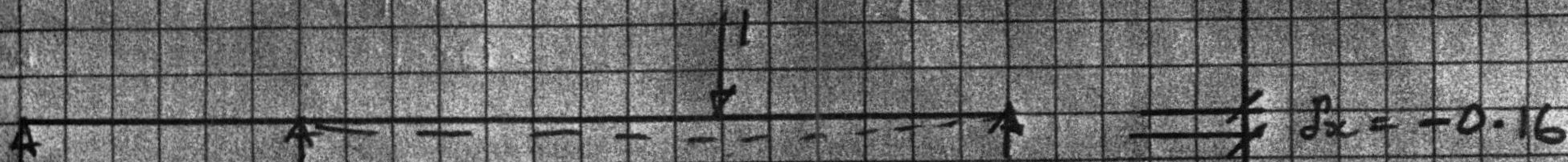
| | | | |
|-------|-------|-------|------|
| 1343 | 458 | 660 | D+L |
| -306 | 1155 | 1110 | SE N |
| 306 | -1155 | -1110 | " S |
| -1932 | 1109 | 821 | " E |
| 1932 | -1109 | -821 | " W |



South End



Stiffness:



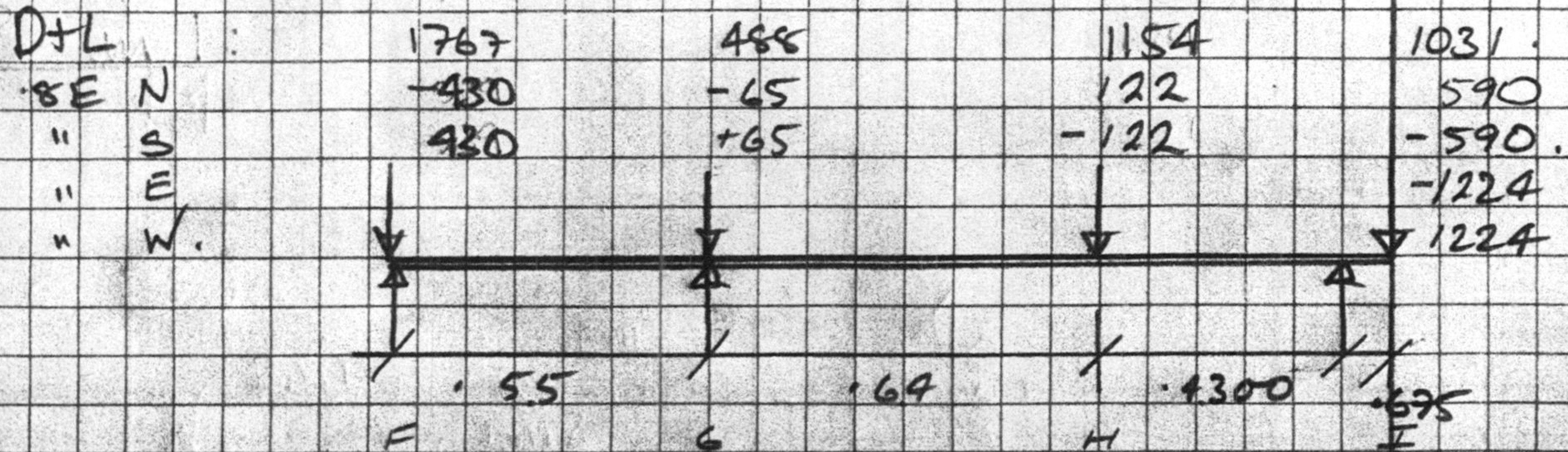
\approx Bm1 : Bm2 Load Share
 : 0.421
 (70.4%) (29.6%)

Load

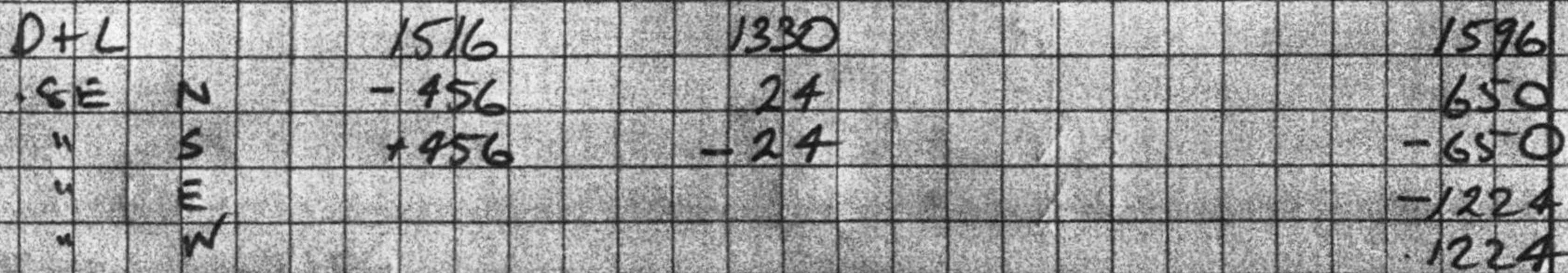
Bm1 Bm2

| | | | |
|---|------|------|-----|
| L | 1639 | 1154 | 485 |
| N | 217 | 153 | 64 |
| S | -217 | -153 | -64 |
| E | - | - | - |
| W | - | - | - |

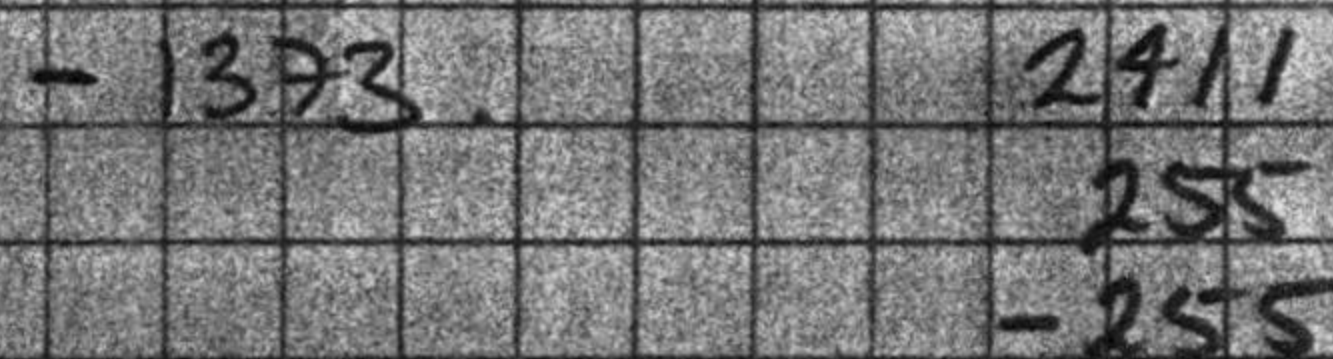
Beam 1:



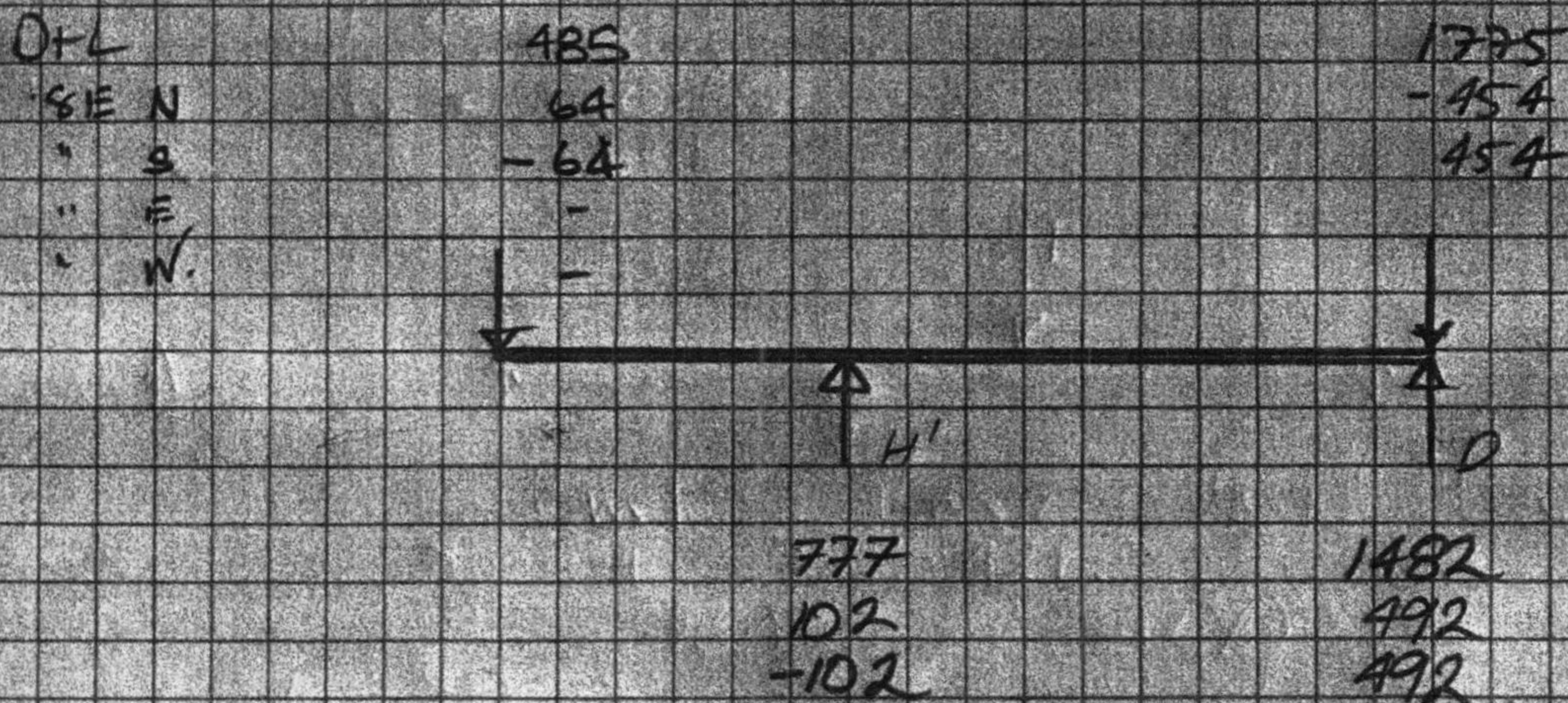
Reactions:



Moments:

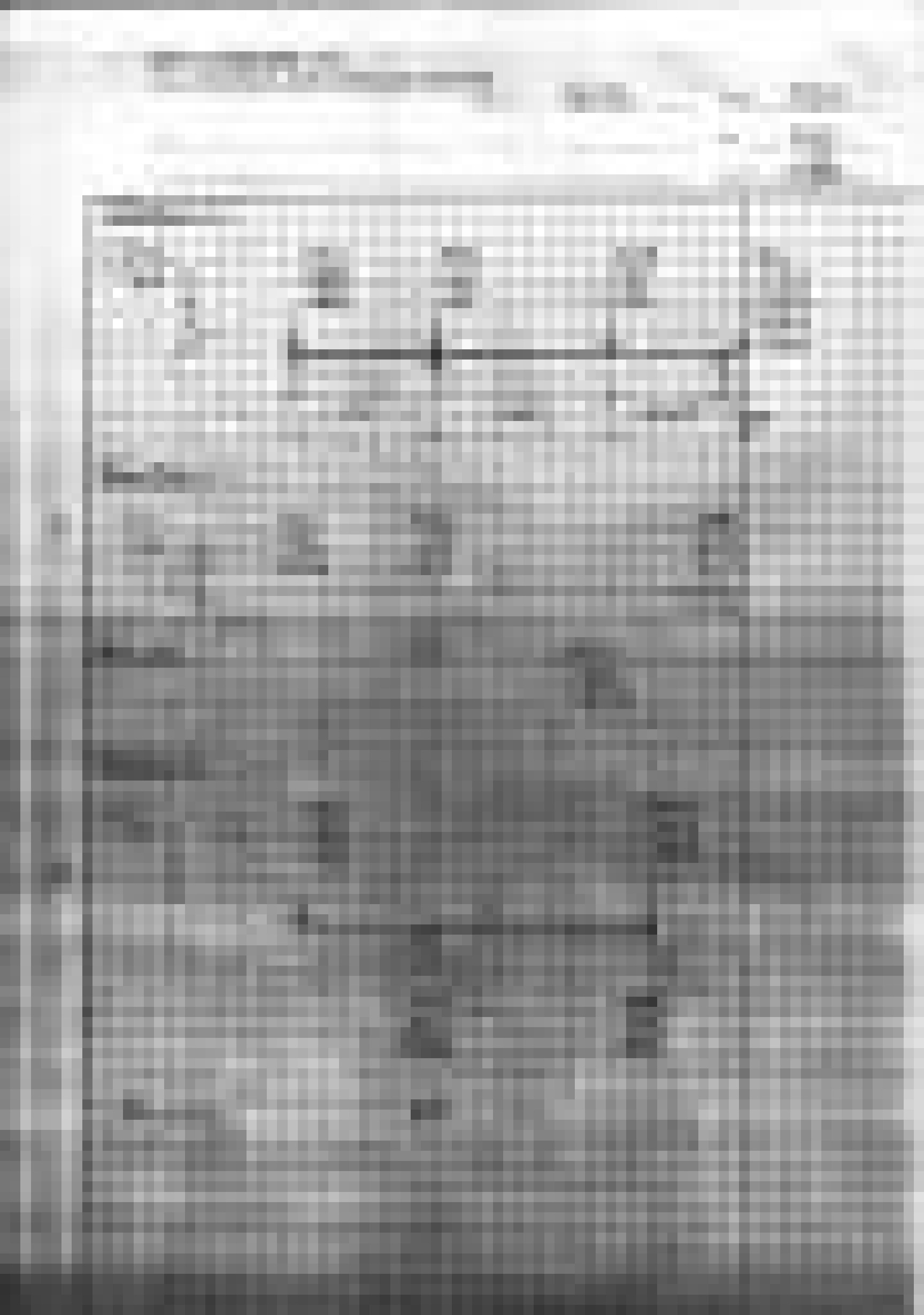


Beam 2:



Moments:



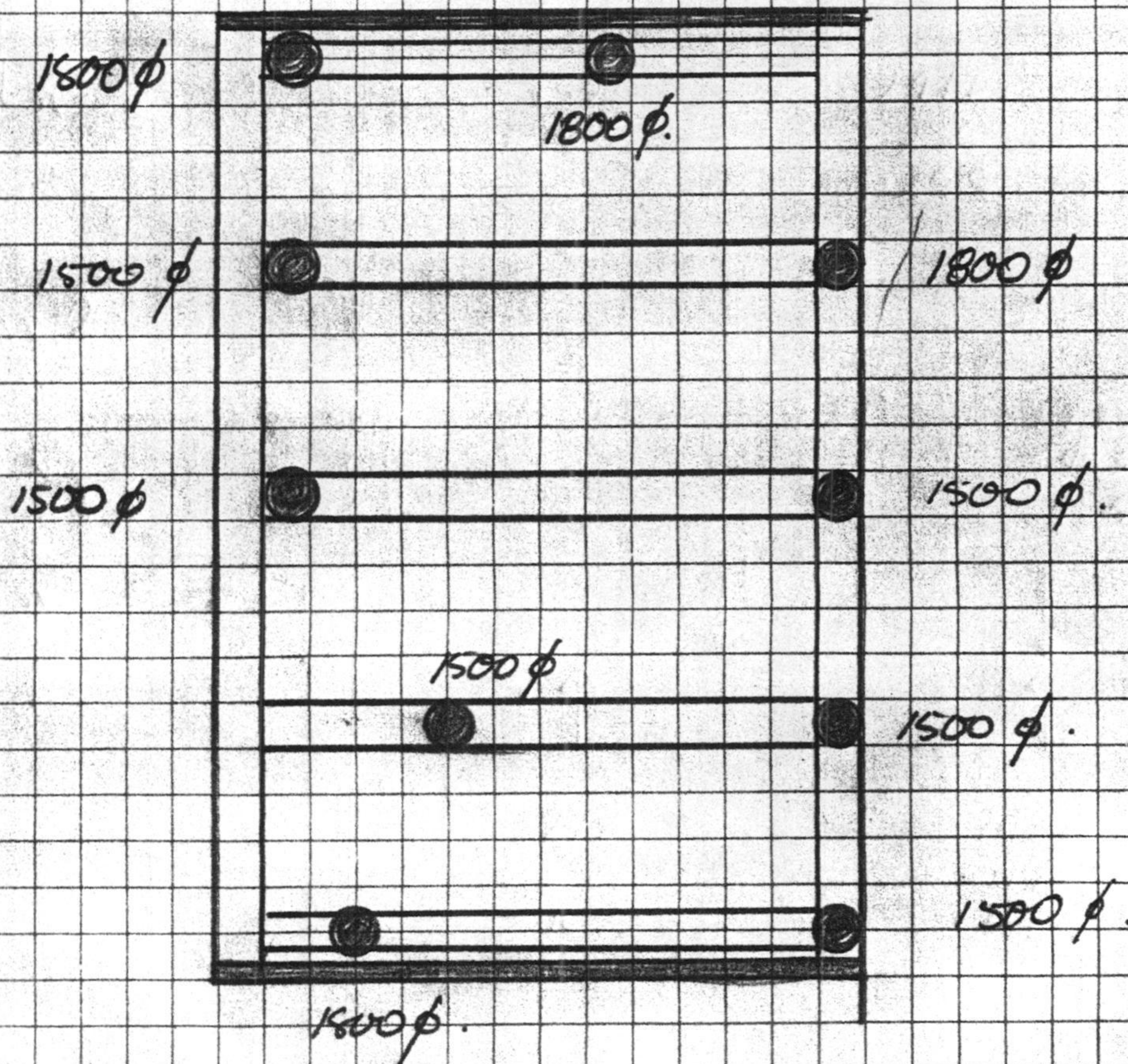


Piles

| | D+L ↓ | +0.8E | D+L ↑ | +0.8E. | Pile Area | φ mm. |
|----|-------|-------|-------|--------|-----------|-------|
| F | 1516 | 1972 | | | 1.52 | 1391 |
| G | 1330 | 1354 | | | 1.33 | 1301 |
| I | 1596 | 2820 | | | 1.88 | 1547 |
| H' | 777 | 879 | | | .78 | 997 |
| D | 1482 | 1974 | | | 1.48 | 1372 |

NO TENSION

All pile stems. 900 φ.



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Lateral load

$$V_b = 2055 \text{ kN}$$

V_{passive}

$$P_p = k_p \times d \times 3 \times 18 \times 1.5 = 81 \text{ kPa}$$

$$P_p = 0.5 \times 81 \times 1.5 = 60.8 \text{ kN/m}$$

$$V = 2 \times 9.6 \times 60.8 = 1167 \text{ kN}$$

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

$$\Rightarrow V/\text{pile} = 89 \text{ kN/pile}$$

Say, pile fixed into rock

$$M_u = 89 \times 7.4 = 659 \text{ kNm} \quad g = 0.8$$

$$M_u / f_c D^3 = 0.40 \quad \rho_{\text{reqd}} = 0.15 \quad f_c = 0.0089 \text{ - OK}$$

$$P_i = 0$$

Check beam cap for lateral pressure

$$w_u = 60.8 \text{ kN/m} \quad W = 60.8$$

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

$$R_u = 60.8 \times 10^6 / (0.9 \times 1000 \times 520^2) = 0.25 \quad p = 0.0005$$

$$A_s = 260 \text{ mm}^2/\text{m} \Rightarrow \text{HR10 @ 300 OK}$$

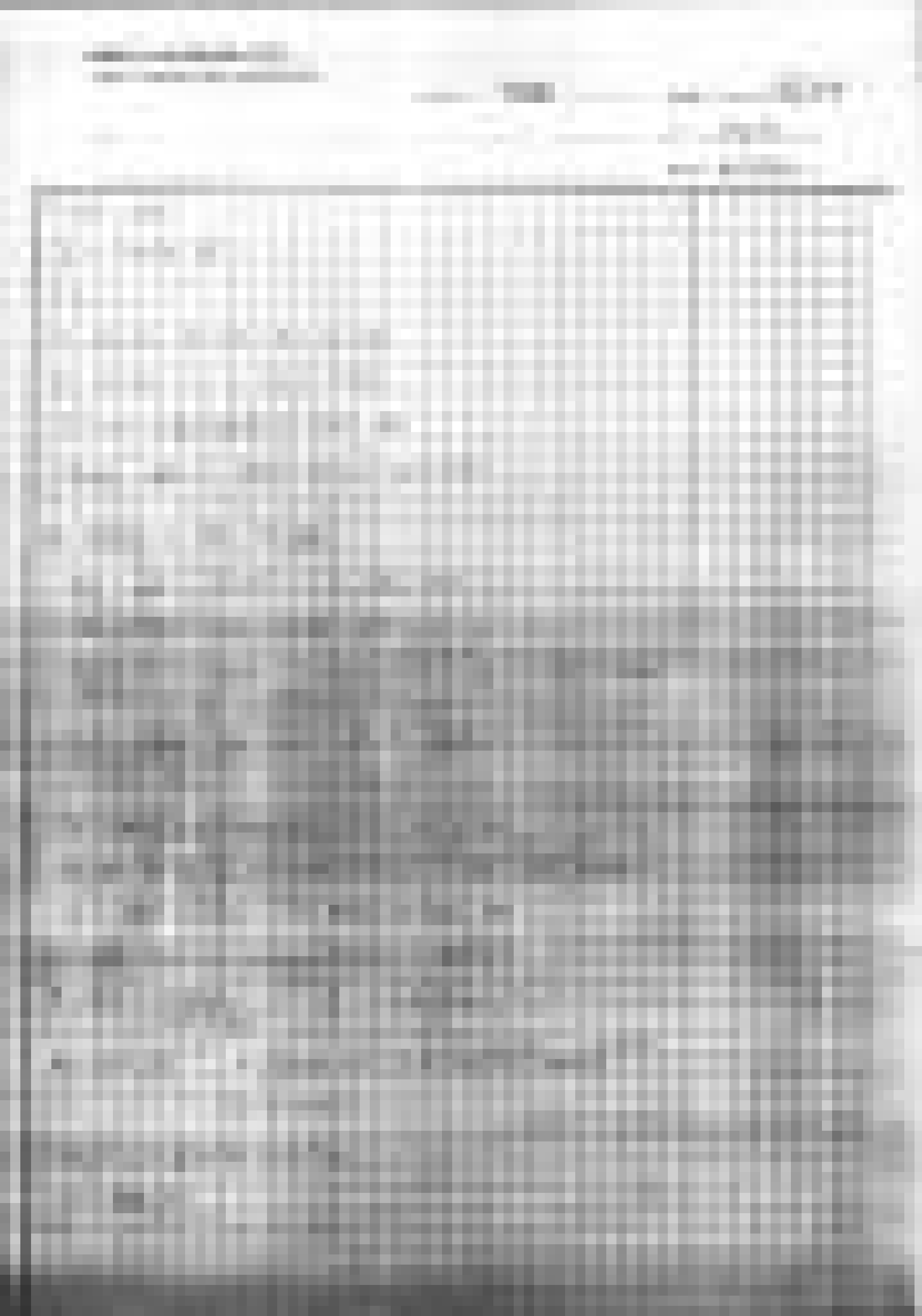
Try full load on piles - Reese & Matlock

$$P = P_T/n = 2055/10 = 205.5 \text{ kN} \quad f = 7 \text{ kPa/mm}$$

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

$$L/T = 7/2.551 = 2.74$$

$$z = \text{depth}/T$$



| Depth | Z | F _d ' | F _m ' | δ _p (mm) | M _p (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 |

$$\delta_p = F_d' \left(\frac{PT^3}{EI} \right) = F_d' \left(\frac{205.5 \times 2.551^3}{23.5 \times 10^6 \times 3.22 \times 10^{-2}} \right) = 4.508 \times 10^{-3} F_d' \text{ (m)}$$

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

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

$$M_u / f_c D^3 = 498 \times 10^6 / .9 \times 25 \times 900^3 = .030$$

$$\text{Form } P_i \text{ and } = 0 \text{ (conservative)} \Rightarrow \lambda_m = .10 \quad f_t = .0056$$

$$A_g = .636 \times 10^6 \text{ mm}^2$$

$$A_{t \text{ min}} = 2200 / f_y \sqrt{2 A_g} = .0051$$

$$A_g = .0056 A_t = 3562 \text{ mm}^2$$

→ 12HD20 OK

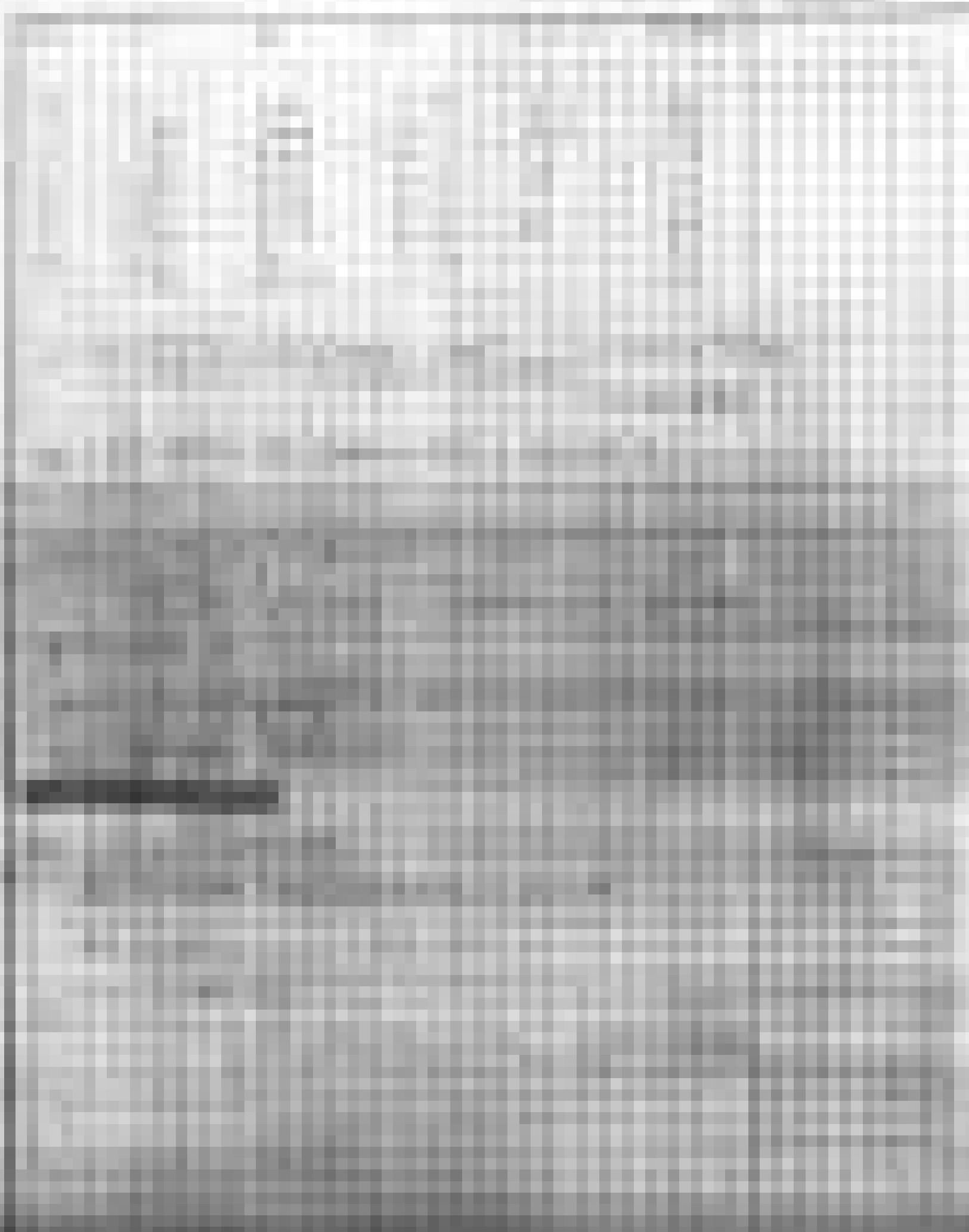
$$\text{Stress } V_u = 205.5 \text{ kN}$$

$$v_u = 205500 / .85 \times 600 \times 600 = .67 \text{ MPa}$$

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

$$A_{t \text{ min}} = .35 b_w s / f_y$$

$$s_{\text{min}} = 151 \times 320 / .35 \times 600 = 284 \Rightarrow 1P10 @ 280 \text{ spaced Min.}$$



Transverse Area $2.5 \times 2.5 = 6.25$

Area $900/5 = 180$
 $6 \times 2 = 120$
200

Length = 900

$$.45 \left(\frac{A_n}{A_g} - 1 \right) = .45 \left(\frac{\pi \times 450^2}{\pi \times 385^2} - 1 \right) = .165$$

$$P_s = .165 \frac{f_c}{f_y} \left(2.5 + \frac{1.25 f_c}{\phi f_y A_g} \right) \quad P = 37.1 \times 9.3 = 3897.1$$

$$= .165 \times \frac{25}{380} \left(.5 + \frac{1.25 \times 3897 \times 10^3}{.9 \times 25 \times \pi \times 450^2} \right) = .0091$$

$$P_s = \frac{A_s f_y d_s}{s \pi d_s^2 / 4} = \frac{4 A_s}{s d_s}$$

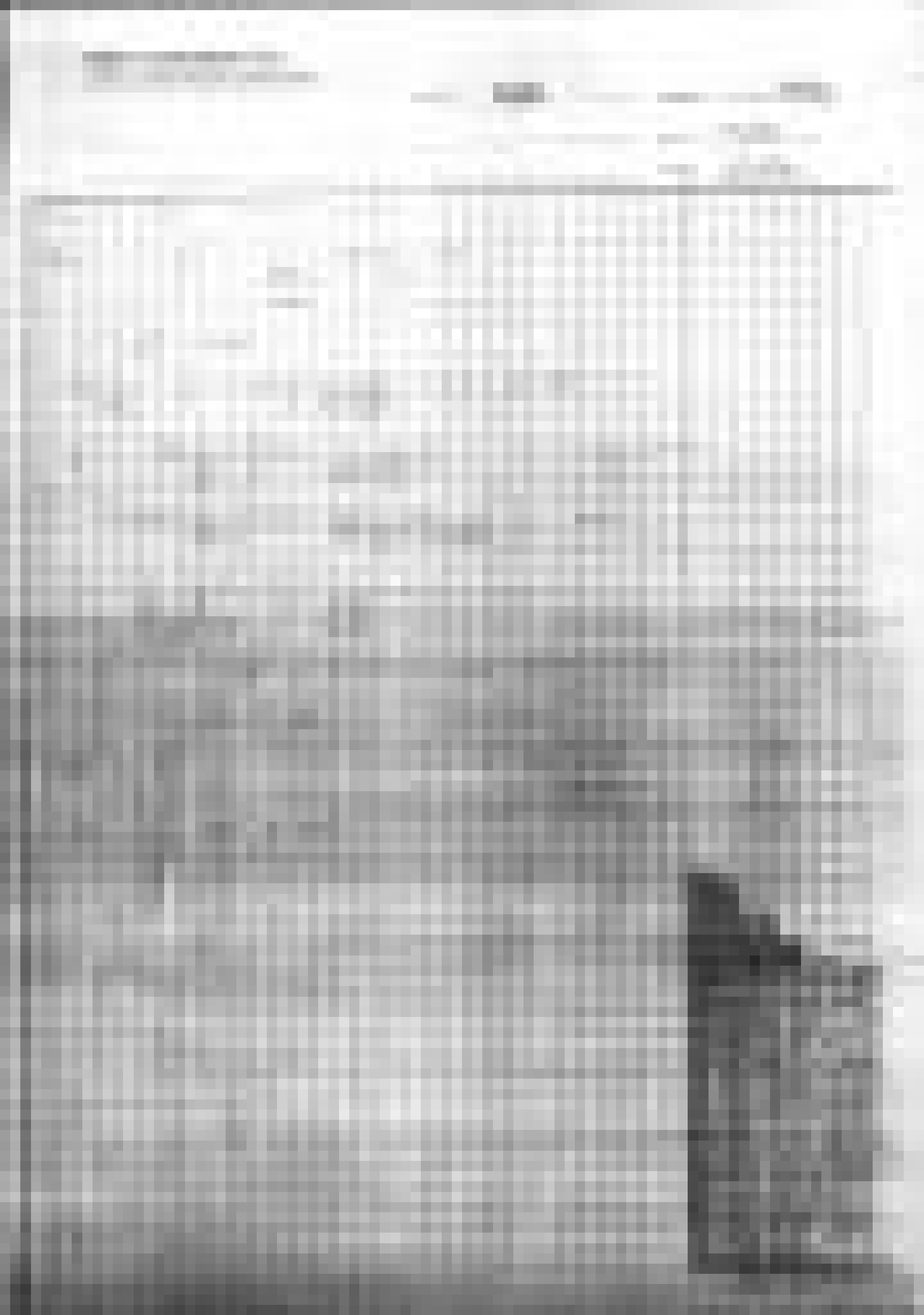
$$HR12 \quad .0091 = \frac{4 \times 18 / s \times 770}{s d_s}$$

$$s d_s = 65 \Rightarrow HR12 @ 60$$

$$HR12 \quad HR200 \quad .5 P_s = HR12 @ 120 \text{ for } 2700 \text{ (3 pile dia.)}$$

$$Rem \quad HR12 @ 300$$

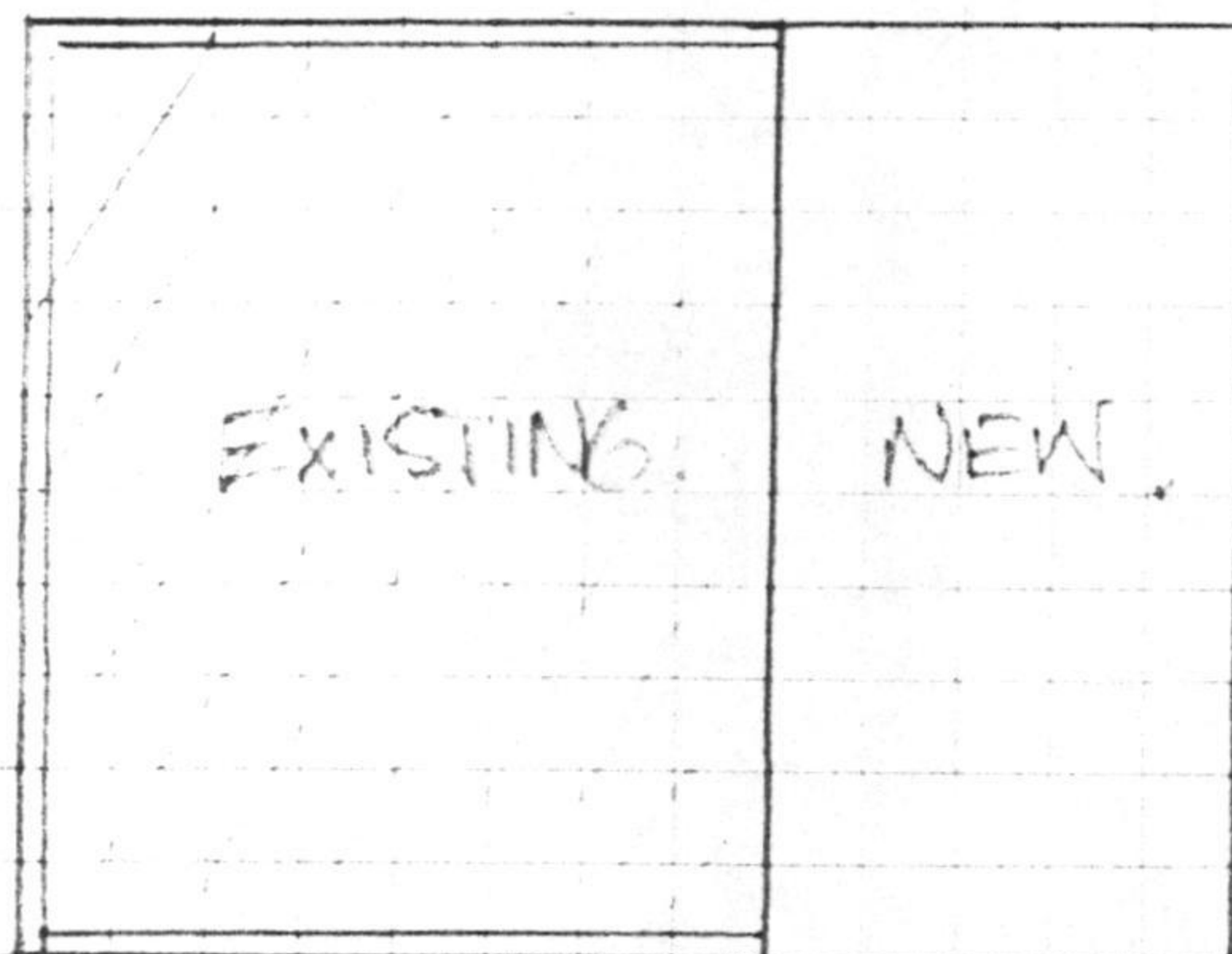
Piles
900 ϕ
25 MPa
12-H200
Square Holes (corner)
piles 1800 ϕ bell
Middle pile on
west frame - no bell
Remainder 1500 ϕ
bell
HR12 @ 60 for 900
from beam face
HR12 @ 120 for next
2700
HR12 @ 300 rem.



1868.

P/O
M/O
8/86

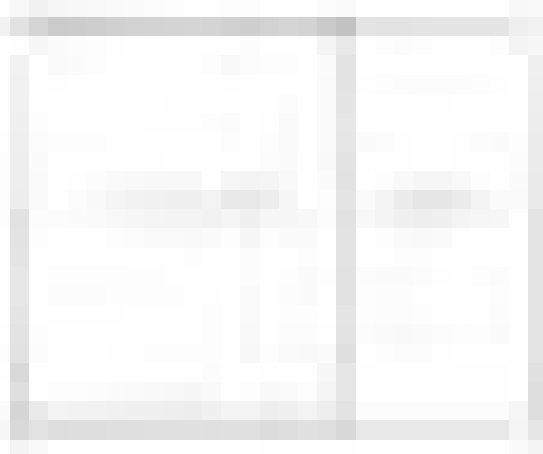
Strengthening of Existing Bldg.



Design Philosophy

1. Strengthen to $\frac{2}{3}$ 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 trussing members. (which will also carry existing floor joists should brick walls fail)

100



100

100

100

1868

2/1

MJO
8/86

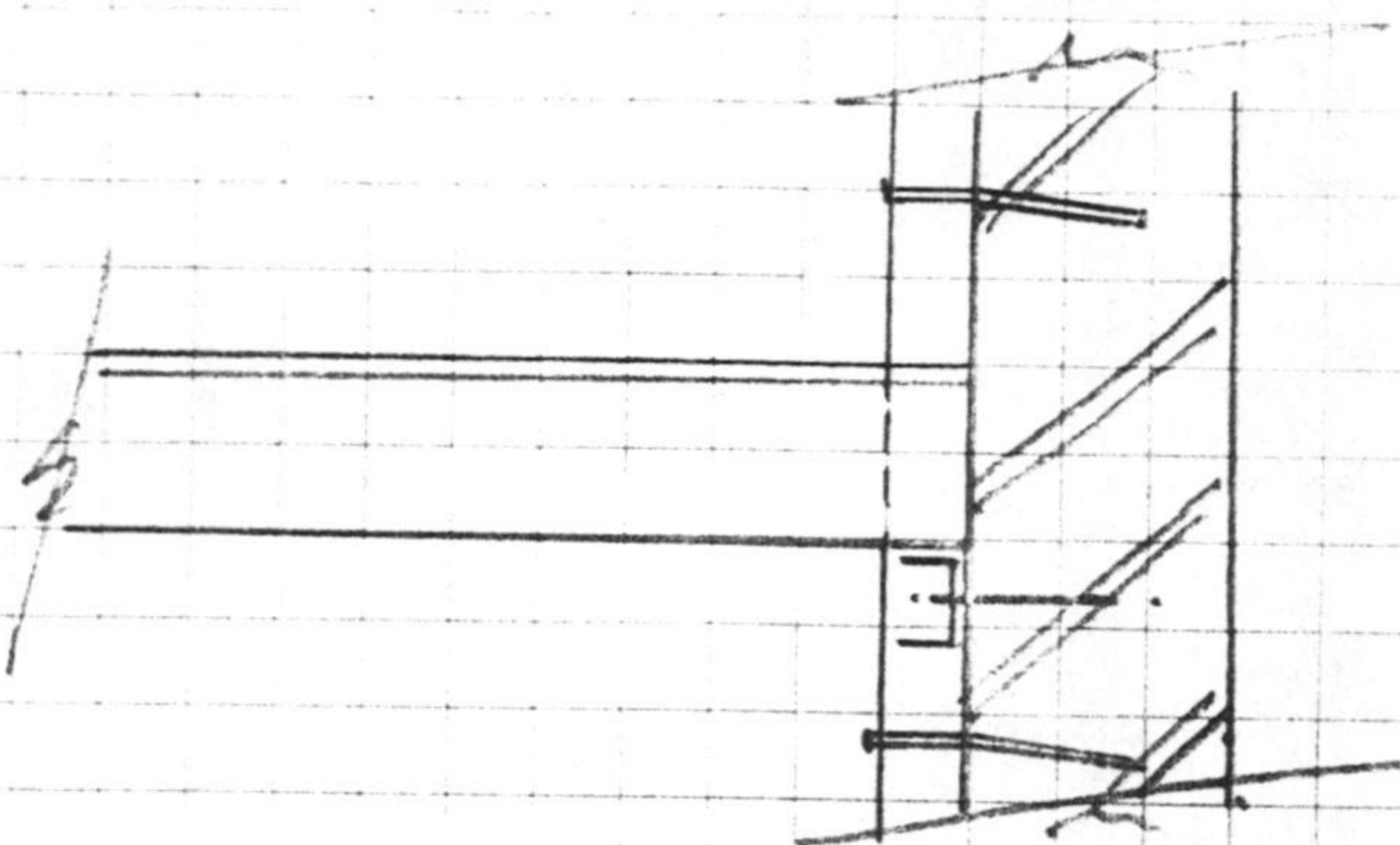
WWMC & LI

Strengthening Scheme

Existing Walls

Design Assumptions

Design to support wall face loads
+ Floor gravity.



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

Treat as veneer:

$$\text{Veneer} = \frac{2}{3} \times 6 \times 12 = .48$$

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

N7S 4203

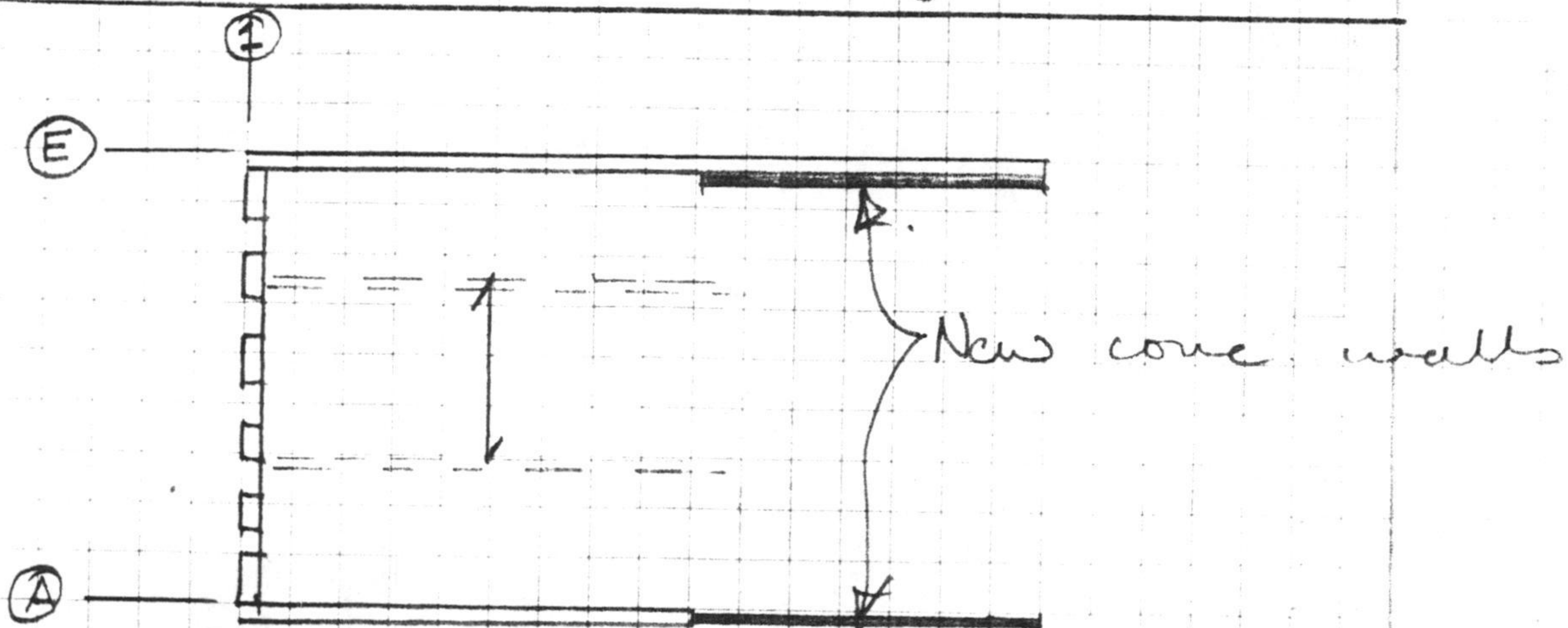
$$C_p = 2.0$$

Use

$$C_p = 0.48$$

$$C_p = 1.0$$

for walls
for connections



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1862

P/2

WAO

2/86

Wall type (A) & (E).

Flow span = 4.5 m

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

Brick strength spanning horizontally.

Allowable Tensile = say $2 \times 10 = 20 \text{ psi} (= 136 \text{ KPa})$.

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

$$W = t \times 22 \times 48 = 106t \text{ KN/m/m}$$

$$f_{bt} = \frac{M}{Z} = \frac{1 \times t^2}{6} = \frac{t^2}{6} \text{ m}^3/\text{m}$$

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

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

240 wall Max Brick span = 2.27 m.

360 " " " " = 2.77 m

480 " " " " = 3.2 m.

Use 3.0 steel crs for 360 & 480 walls.

& 2.3 " " " 240 walls.

$$10.6 \times 24 \times 2.3 \times 1.2 \text{ continuity} = 7 \text{ KN/m}$$

$$10.6 \times 48 \times 3.0 \times 1.2 = 18.3 \text{ KN/m}$$

Steel: Assume steel fully laterally supported.

1865

P/2

MJO.
2/16.

| Floor/Floor | Span | loads | axial | face | Calc. | Size |
|---|--------------|--|--------|------|--|------------|
| Roof → 2nd c | 2400. | 10 kN | 5 kNm | | $\frac{5}{1.33 \times 165} = 23 \text{ cm}^3$ | 102 x 51 E |
| 2nd c → G. | 5000 max. | 10 + $2 \times 2 \times \frac{4.5}{2} \times 3$ = 37 | 57 kNm | | $\frac{57}{1.2} = 286 \text{ cm}^3$ $f_{ac} = \frac{37000}{3800} = 10 \text{ MPa.}$ $\delta = \frac{5 \times 2000^4 \times 18.3}{384 \times 21 \times 10^5 \times 79.456}$ = 24 mm (= 0.05 L) | 200 WB 30 |
| Will refine for smaller spans & wall etc later. | | | | | | |

Flow Support. (if wall collapses).

$$\text{Span} = 3 \text{ m.}$$

$$\text{load} = (0.5 + 1.5) \times \frac{4.5}{2} = 4.5 \text{ kN/m.}$$

$$M = 5 \text{ kNm.}$$

$$\frac{5}{1.65} = 31 \text{ cm}^3$$

$$102 \times 51 \text{ E OK.}$$

$$102 \times 51 \text{ E.}$$

Ground → 1st Partitions

$$\text{Span} = 4.267.$$

240 mm brick

Support at bay 2.3 m c/c.

$$M = 7 \times \frac{4.267^2}{8} = 16 \text{ kNm.}$$

$$\text{Axial} = 15 \text{ kN.}$$

$$\frac{16}{1.33 \times 165} = 73 \text{ cm}^3$$

$$127 \times 64 \text{ E.}$$

$$127 \times 64 \text{ E.}$$

| Date | Time | Location | Activity | Remarks | Signature |
|------------|-------|----------|----------|---------------------------|--------------|
| 2023-10-01 | 08:00 | Room 101 | Meeting | Initial meeting with team | John Doe |
| 2023-10-02 | 09:00 | Room 102 | Work | Project planning | Jane Smith |
| 2023-10-03 | 10:00 | Room 103 | Work | Data analysis | Mike Johnson |
| 2023-10-04 | 11:00 | Room 104 | Work | Report writing | Emily White |
| 2023-10-05 | 12:00 | Room 105 | Work | Review meeting | David Brown |
| 2023-10-06 | 13:00 | Room 106 | Work | Client presentation | Sarah Green |
| 2023-10-07 | 14:00 | Room 107 | Work | Team discussion | Chris Black |
| 2023-10-08 | 15:00 | Room 108 | Work | Project update | Alex Grey |

2. Summary of activities and results.

The activities were carried out as planned, with all team members contributing to the project. The results of the activities are as follows:

- Initial meeting with team: All team members present, discussed project goals and timeline.
- Project planning: Detailed project plan created, including tasks and responsibilities.
- Data analysis: Data collected and analyzed, showing positive trends.
- Report writing: Progress report written and submitted to management.
- Review meeting: Meeting with management to discuss progress and next steps.
- Client presentation: Presentation given to client, receiving positive feedback.
- Team discussion: Team meeting to discuss challenges and solutions.
- Project update: Update provided to stakeholders, showing progress.

3. Conclusion and next steps.

The project is progressing well, and the team is on track to complete the project by the deadline.

Next steps include:

- Continuing data analysis and reporting.
- Preparing for the final client presentation.
- Monitoring project progress and addressing any issues.

4. Appendix: Additional information.

Appendix A: Project timeline and milestones.

Appendix B: List of team members and their roles.

Appendix C: Detailed project budget and financials.

Appendix D: Client feedback and survey results.

1868

P/3A

14/10/86

Reinforced Vertical face leading Sillwork.

Roof \rightarrow 2nd Ceiling:

$$\text{Span} = 2.0 \text{ m}$$

$$W = 7 \text{ kN/m}$$

$$M = \frac{2^2}{8} \times 7 = 3.5 \text{ kNm}$$

$$\frac{3.5}{0.2} = 17.5 \text{ cm}^2$$

Use 102x51 MSC (E). (or 70x70x3.6 RHE).
2.3 m as

Second Floor:

$$\text{Span} = 3.3 \text{ m}$$

$$W = 18.3 \times \frac{36}{48} = 13.7 \text{ kN/m}$$

$$M = 18.7 \text{ kNm}$$

$$Z = \frac{18.7}{0.2} = 93 \text{ cm}^3$$

Use 120x80x8 RHS. - 3000 \rightarrow

First Floor:

$$\text{Span} = 3.6 \text{ m}$$

$$W = 18.3 \text{ kN/m}$$

$$M = 29.6 \text{ kNm}$$

$$Z = 148 \text{ cm}^3$$

Use 200x100x6.3 RHS. - 3000 \rightarrow

Ground Floor:

480 wall.

$$M = 18.3 \times \frac{4.2^2}{8} = 40.3$$

$$Z = 201 \text{ cm}^3$$

Use 200x100x6.3 RHS. 2000 \rightarrow

240 wall.

$$M = 16 \text{ kNm}$$

$$Z = 93 \text{ cm}^3$$

Use 100x100x6.3 RHS.

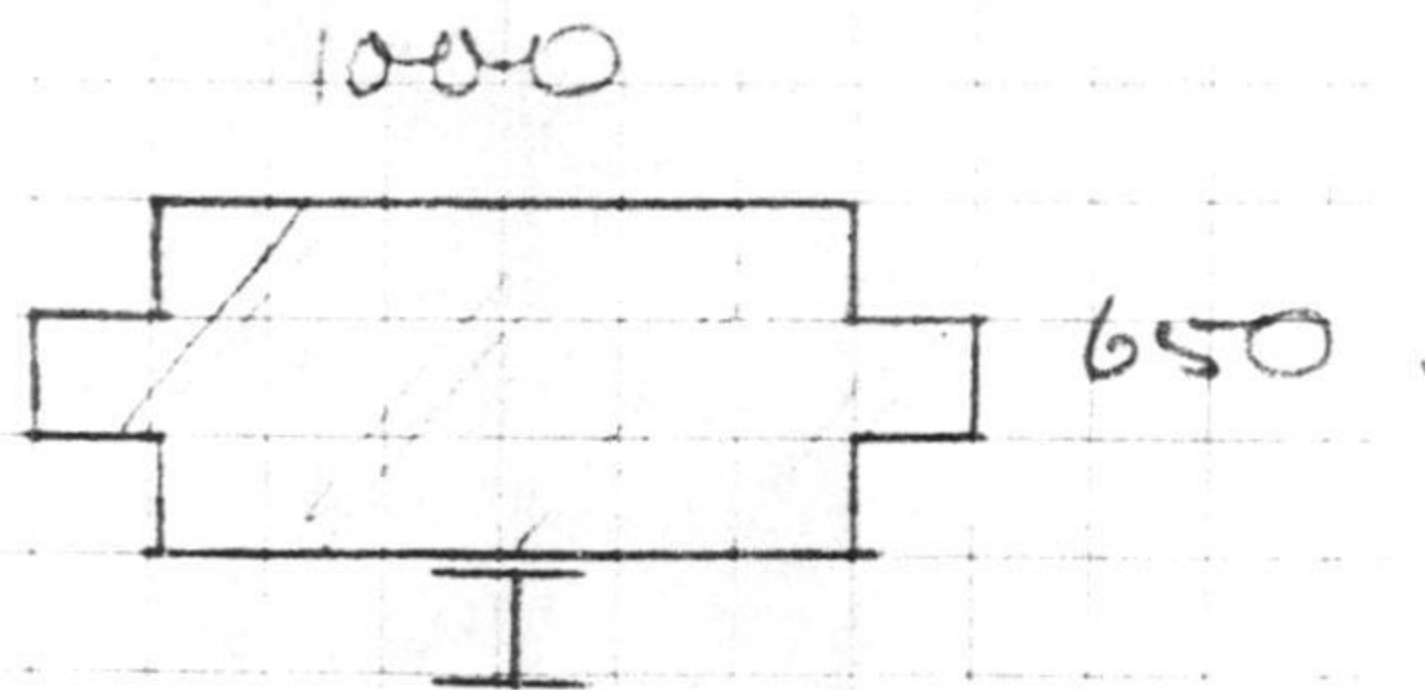
[illegible]

1868

P/A
MJC

Wall type ①.

Large Piers:



$$\text{Max span} = 4000.$$

$$W = 1.0 \times 0.65 \times 22 \times 48 = 6.86 \text{ kN/m}.$$

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

$$\frac{13.7}{0.2} = 68.5 \text{ cm}^3.$$

$$152 \times 76 \text{ L. } (Z = 112 \text{ cm}^3) \quad 152 \times 76 \text{ L}$$

$$I = 12.8 \text{ mm} = 0032 \text{ L. } \therefore \text{OK.}$$

or 100x100x63 RLS

Small piers.

$$500 \times 650$$

$$M = \frac{13.7}{2} = 6.9 \text{ kNm}.$$

$$\frac{6.9}{0.18} = 38 \text{ cm}^3$$

$$102 \times 51 \text{ L.}$$

102x51 L
or 90x90x3.6 RLS

Connections.

From previous testing use max. all. load = 15 kN (D12 dowells).

$$\text{Max loading} = 8.3 \text{ kN/m}.$$

\therefore use D12 (M12) dowells.

a) say 800 CS max.



120 short.

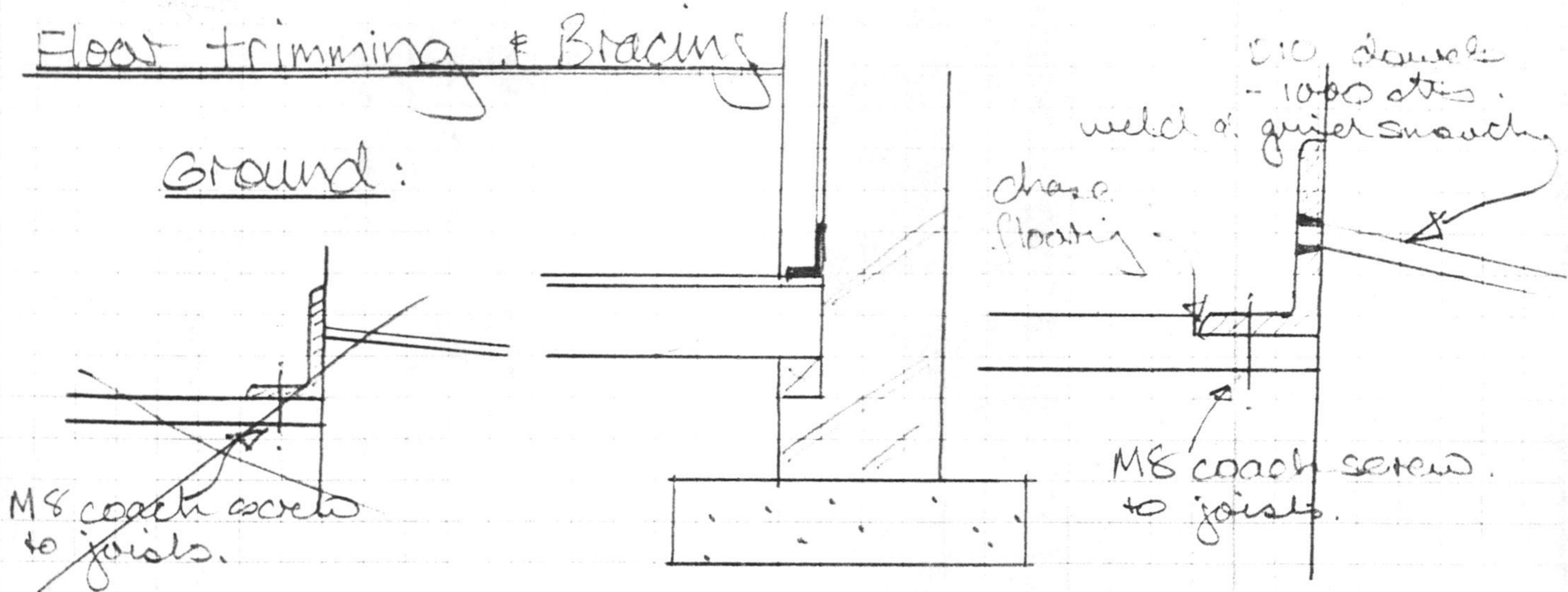
10

| | |
|---|--|
| 1. The first part of the document is a list of the names of the people who were present at the meeting. | |
| 2. The second part of the document is a list of the topics that were discussed. | |
| 3. The third part of the document is a list of the actions that were taken. | |
| 4. The fourth part of the document is a list of the decisions that were made. | |
| 5. The fifth part of the document is a list of the conclusions that were reached. | |
| 6. The sixth part of the document is a list of the recommendations that were made. | |
| 7. The seventh part of the document is a list of the conclusions that were reached. | |
| 8. The eighth part of the document is a list of the recommendations that were made. | |
| 9. The ninth part of the document is a list of the conclusions that were reached. | |
| 10. The tenth part of the document is a list of the recommendations that were made. | |

1868

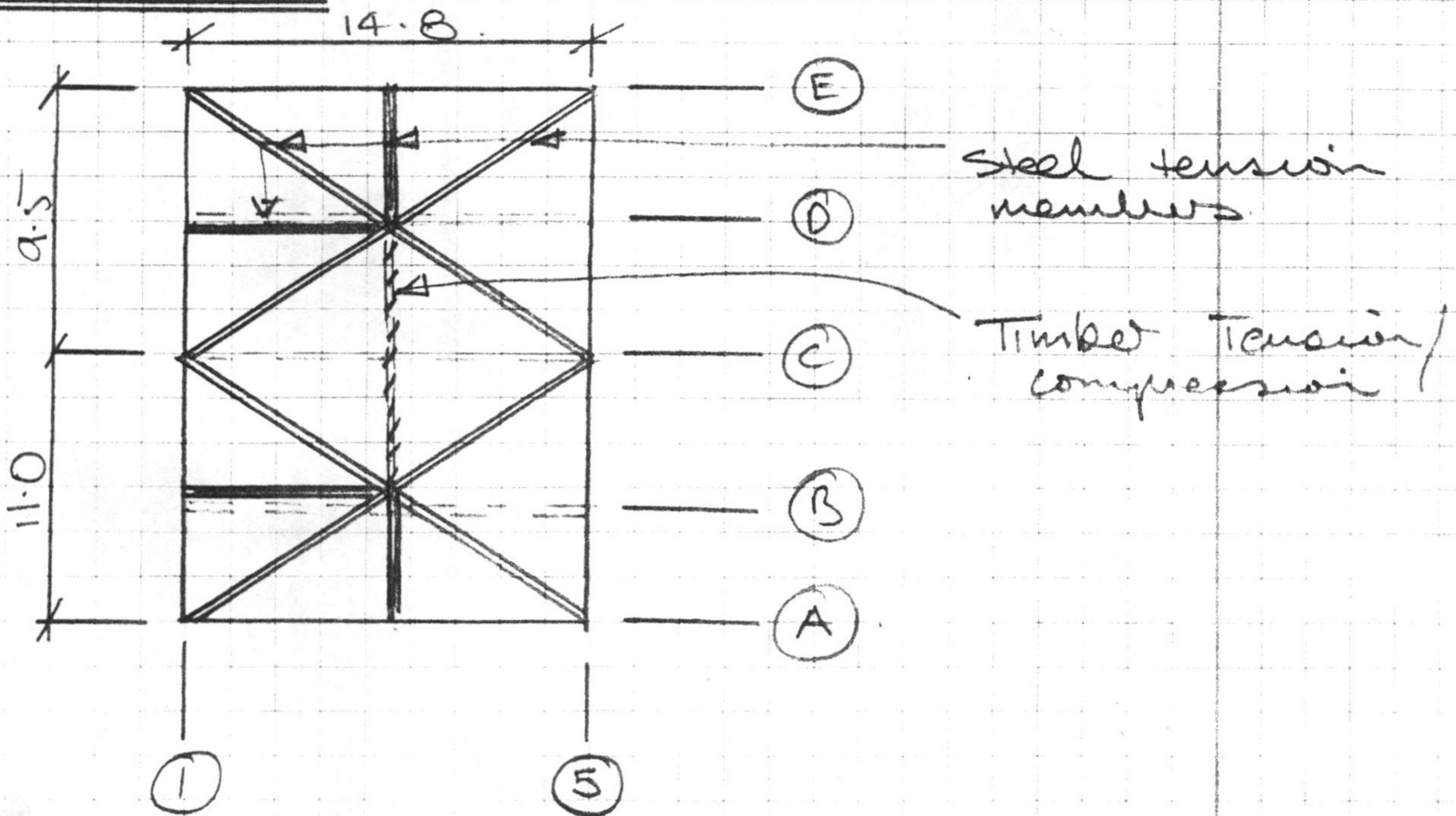
P/5

myo.
10/86.



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

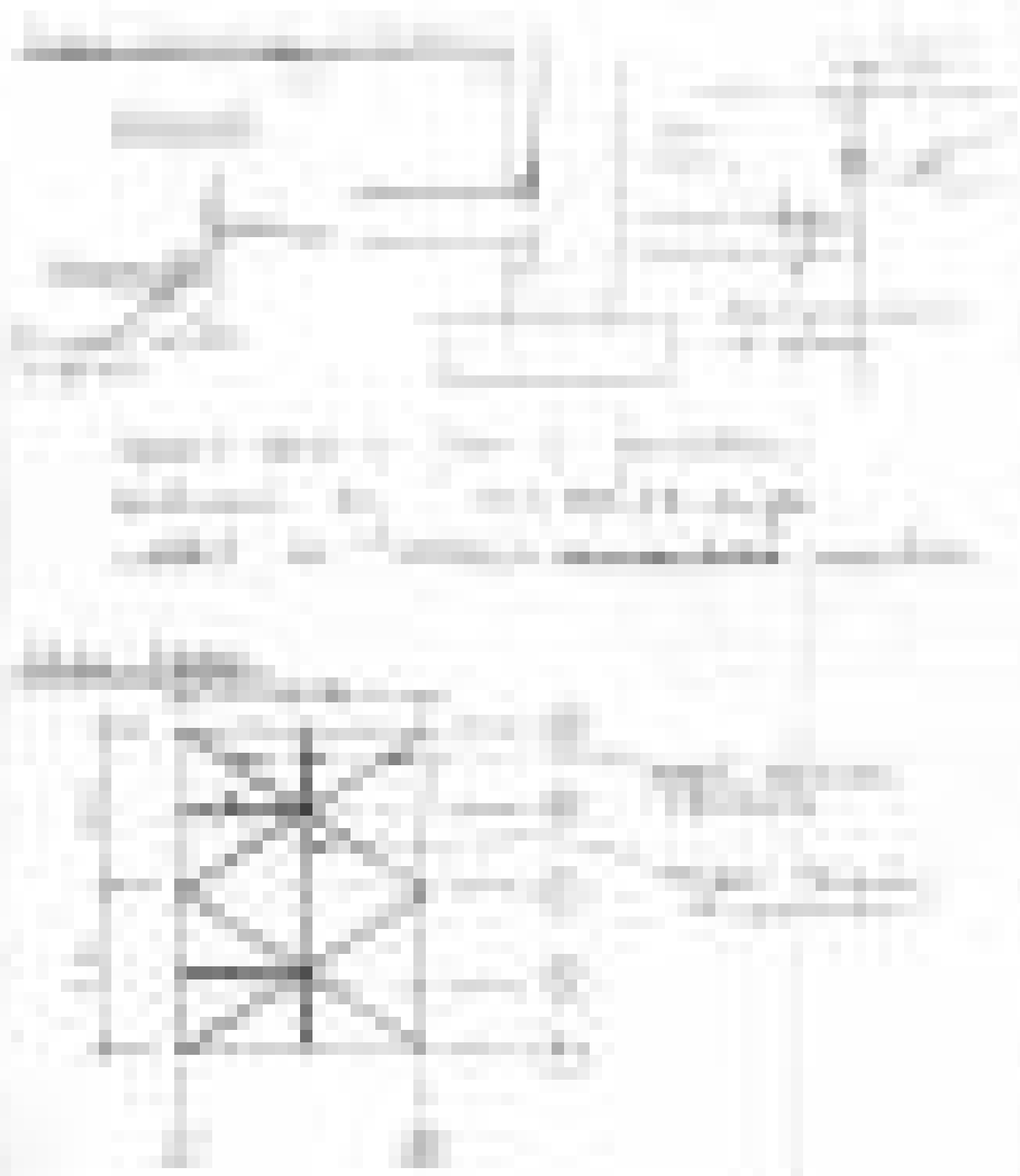
First Floor:



1000

1000

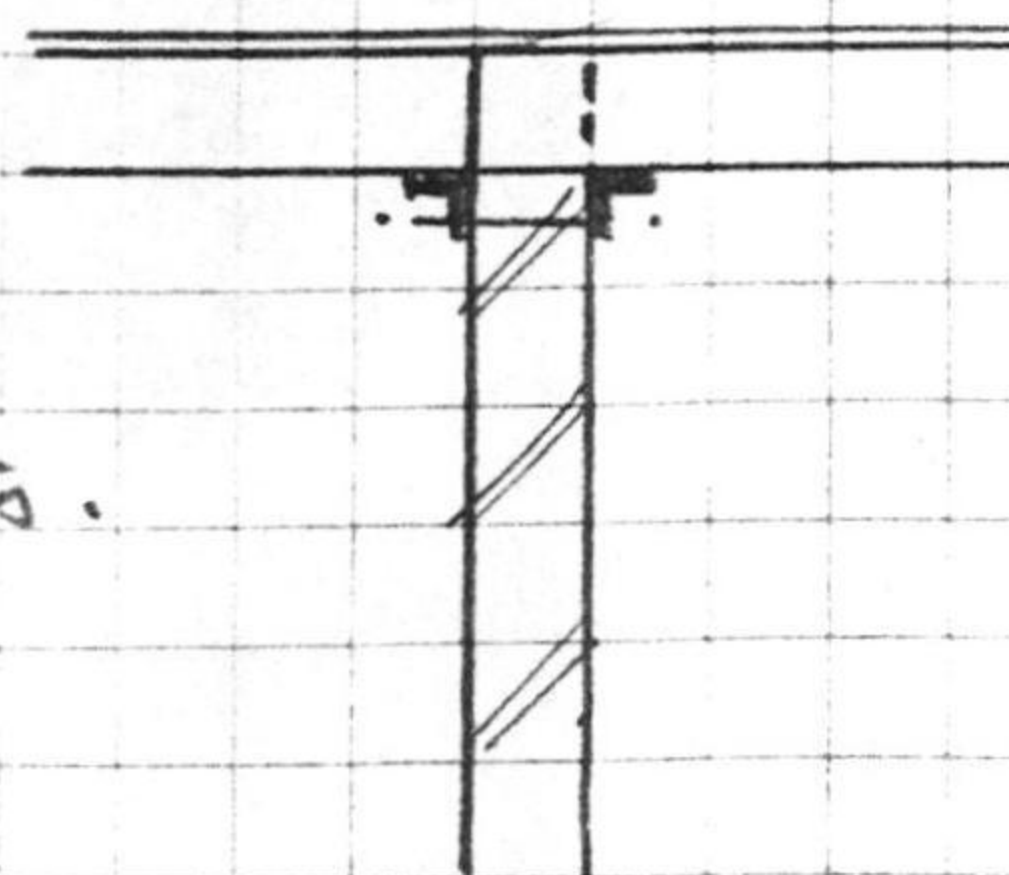
1000



Floor Truss

Walls B, C & D.

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



Use angles each side - composite action.

$$\text{Span} = \frac{14.8}{2} = 7.4 \text{ m}$$

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

$$M = 7.15 \times \frac{7.4^2}{8} = 49 \text{ kNm}$$

$$T = C = \frac{49}{2.5} = 19.6 \text{ kN}$$

$$\text{At } f_T = f_c = 150 \text{ MPa}$$

Use 80x80x8 L.

$$\text{End reaction} = 7.15 \times \frac{7.4}{2} = 26 \text{ kN}$$

$$\text{Horizontal shear} = \frac{26}{2.5} = 10.4 \text{ kN/mm}$$

Too high.

~~See~~ Thin tops of RHS sections -
with 80x80x8 L and
use diaphragm action
to transfer load to central
floor joists.

$$\text{Check. Joist load: } = 26 \text{ kN} \times 3 = 78 \text{ kN}$$

$$350 \times 57 \text{ joists: } f_{ac} = \frac{78}{3.5 \times 57} = 3.91 \text{ MPa} \therefore \text{OK}$$

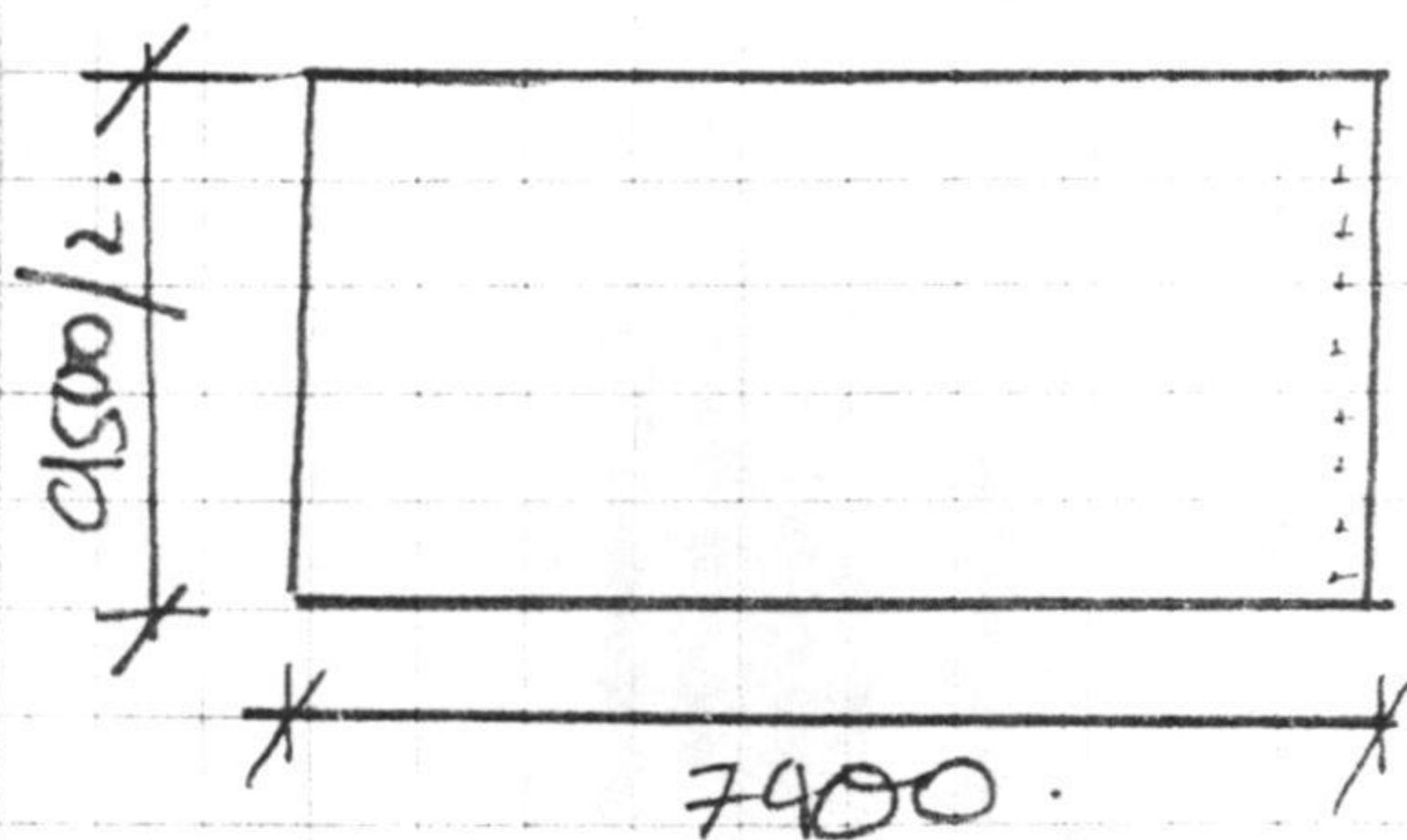
1868

P/7
MJO.
10/86.

Walls. (A) & (E) similar. except use brick under
As is wall (1).

Diaphragm & fixing

20mm particle board.



Max Shear =

$$\text{Load} = \frac{3.3 + 3.6}{2} \times 18.3/3 = 21 \text{ KN/m} \times \frac{4}{4.8}$$

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

$$\frac{78000}{9500 \times 20} \times 2 = 0.82 \text{ MPa}.$$

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

Use 4mm of nails @ $\frac{0.08}{16} = 60 \text{ mm}$ centres.

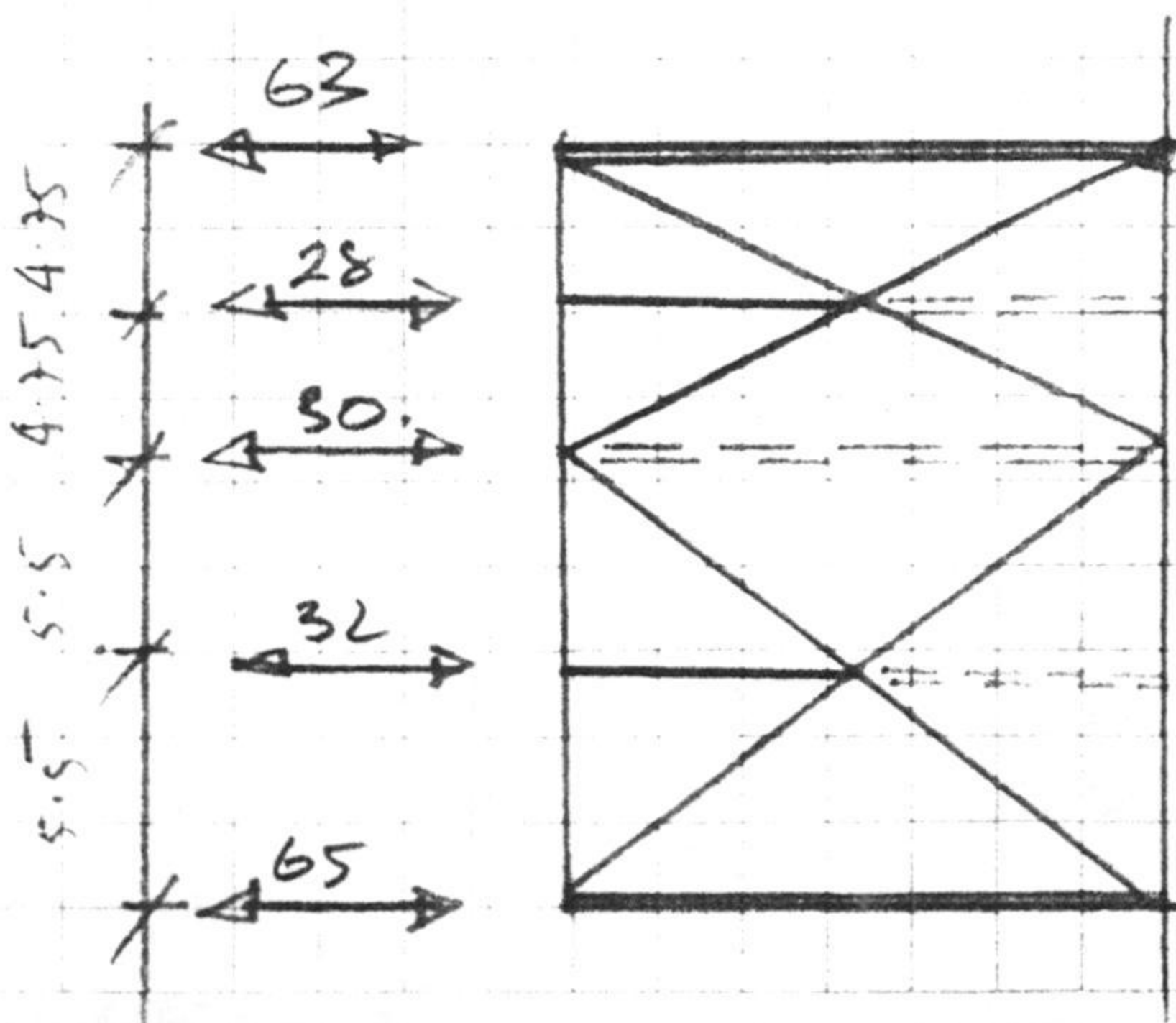
Note: have used $K_x = 4.8$.

Steel Bracing

Floor weight = particle board
+ oc board
+ flooring
+ ceiling
+ joists

$$\begin{aligned} &= 116 \\ &= 10 \\ &= 18 \\ &= 29 \\ &= 22 \\ &= 90 \text{ kPa} \end{aligned}$$

E-W Earthquake



$$F_s = C \cdot K_x \cdot W_s$$

$$K_x = \frac{F_x}{C \cdot W_s}$$

$$= \frac{234}{1 \times 40000} < 1.$$

$$\text{Use } C = 4.0, 0.1$$

$$K = 1.0.$$

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CHICAGO, ILL. 60637

1868

P/8

11/10
10/86

Wall (E) + (A) load = $491 \times 1 = 491 \text{ kN}$.

UDL = $(290 + 470 + 161 + 322) \times 1 / 21.5 = 5.8 \text{ kN/m}$.

$$\begin{aligned} 491 + 5.8 \times \frac{9.5}{4} &= 63 \text{ kN} \\ 491 + 5.8 \times \frac{11}{4} &= 65 \\ 5.8 \times 4.75 &= 28 \\ 5.8 \times 5.5 &= 32 \\ 5.8 \times \frac{5.5 + 4.75}{2} &= 30 \end{aligned}$$

Line (E) + (A) ties : Have provided

102 x 51 L : Tall = $1330 \times 2 = 266 \text{ kN}$.

Lines (B) (C) + (D) Compression

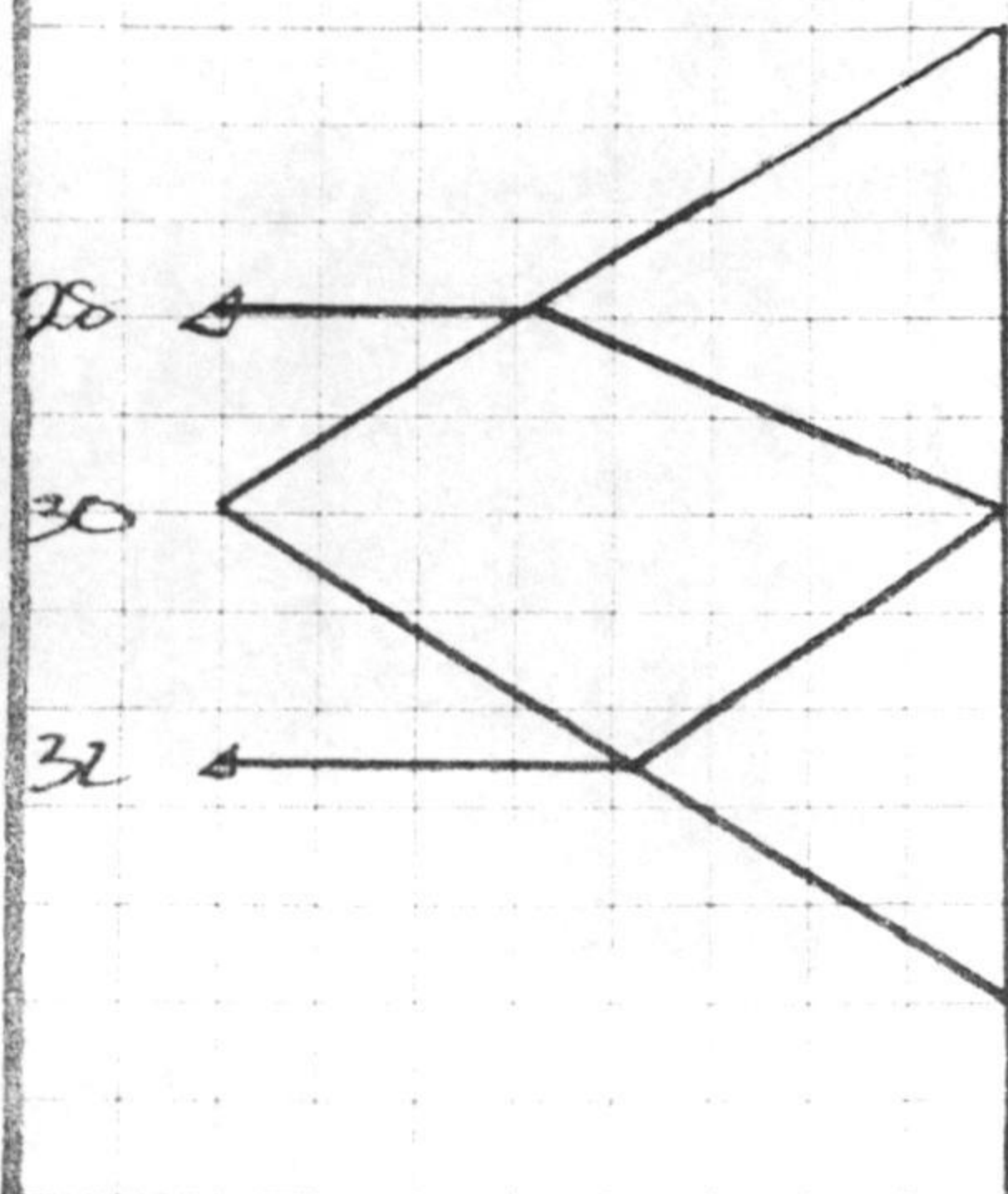
Max C = 32 kN.

@ Fac = $1.5 \times 7.1 = 10.65 \text{ MB}$

need 3004 mm^2

Use 150 x 50 timber blocking.

Bracing.



Max Tie force

$\left(32 + \frac{30}{2} \right) \times \frac{\sqrt{5.5^2 + 7.1^2}}{7.4} \quad (a.22)$

= 58 kN.

\therefore need $\frac{58}{1.2} = 292 \text{ mm}^2$ steel

$\begin{cases} 30 \times 10 \text{ R} \\ \text{or} \\ 60 \times 5 \text{ R} \end{cases}$

Max reactions

Line.

A
C
E

65

63

or

39

20 + 20.

39

the first 10 years of the 21st century. The first 10 years of the 21st century are the first 10 years of the 21st century.

THE FIRST 10 YEARS OF THE 21ST CENTURY

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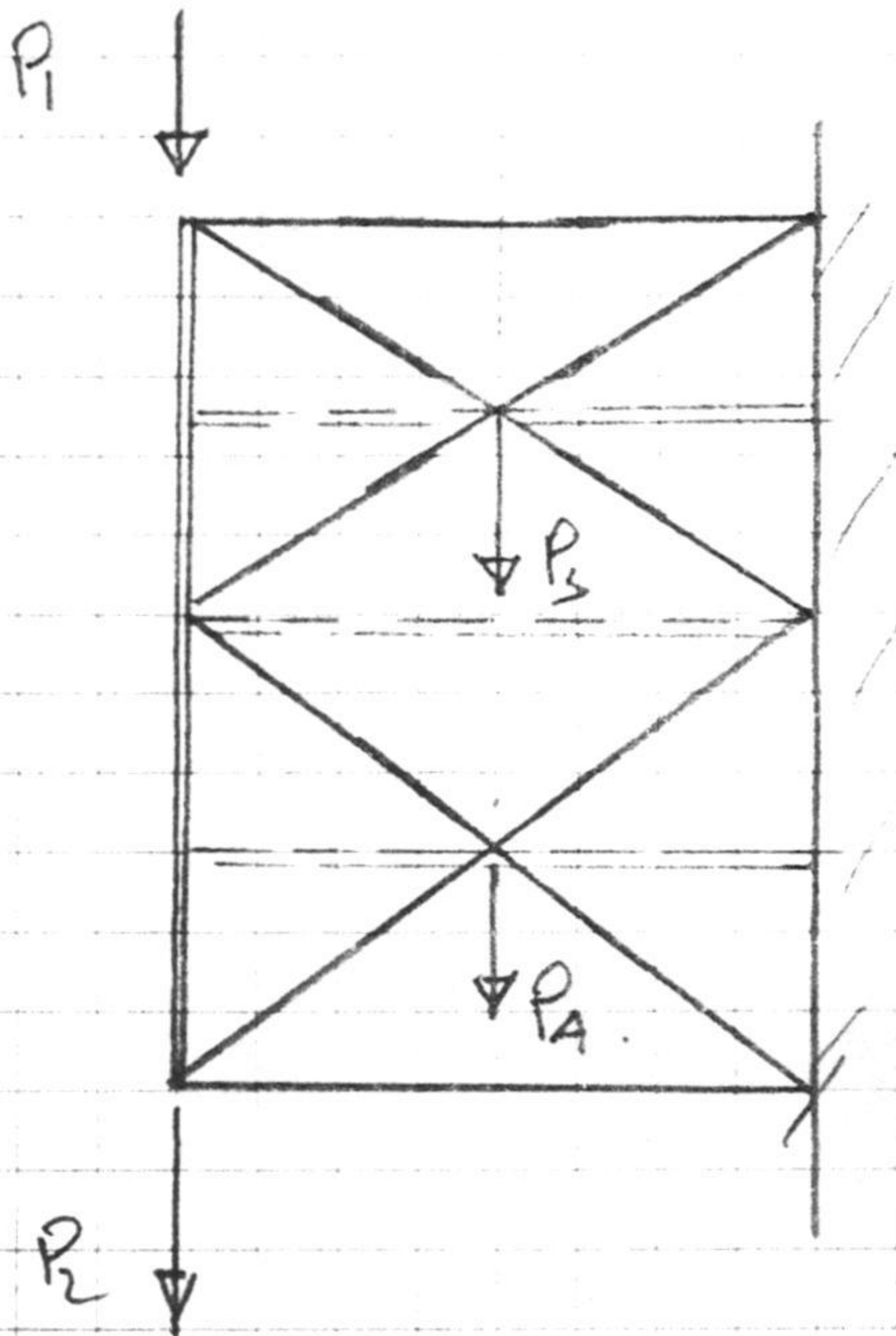
The first 10 years of the 21st century are the first 10 years of the 21st century.

1868

P/a
MJO.
10/86.

North South E' Quake

Note use 2nd floor E' Quake loads to maximum design.



$$P_1 = P_2 = \text{wall ①} \frac{470}{2} \times 0.1 = 23.5$$

$$+ \text{walls ② \& ③} \frac{492}{4} \times 0.1 = 12.3$$

$$+ \text{floor } \frac{(322 + 161 + 290)}{14.8} \times \frac{14.8}{4} \times \frac{0.1}{2} = 9.7$$

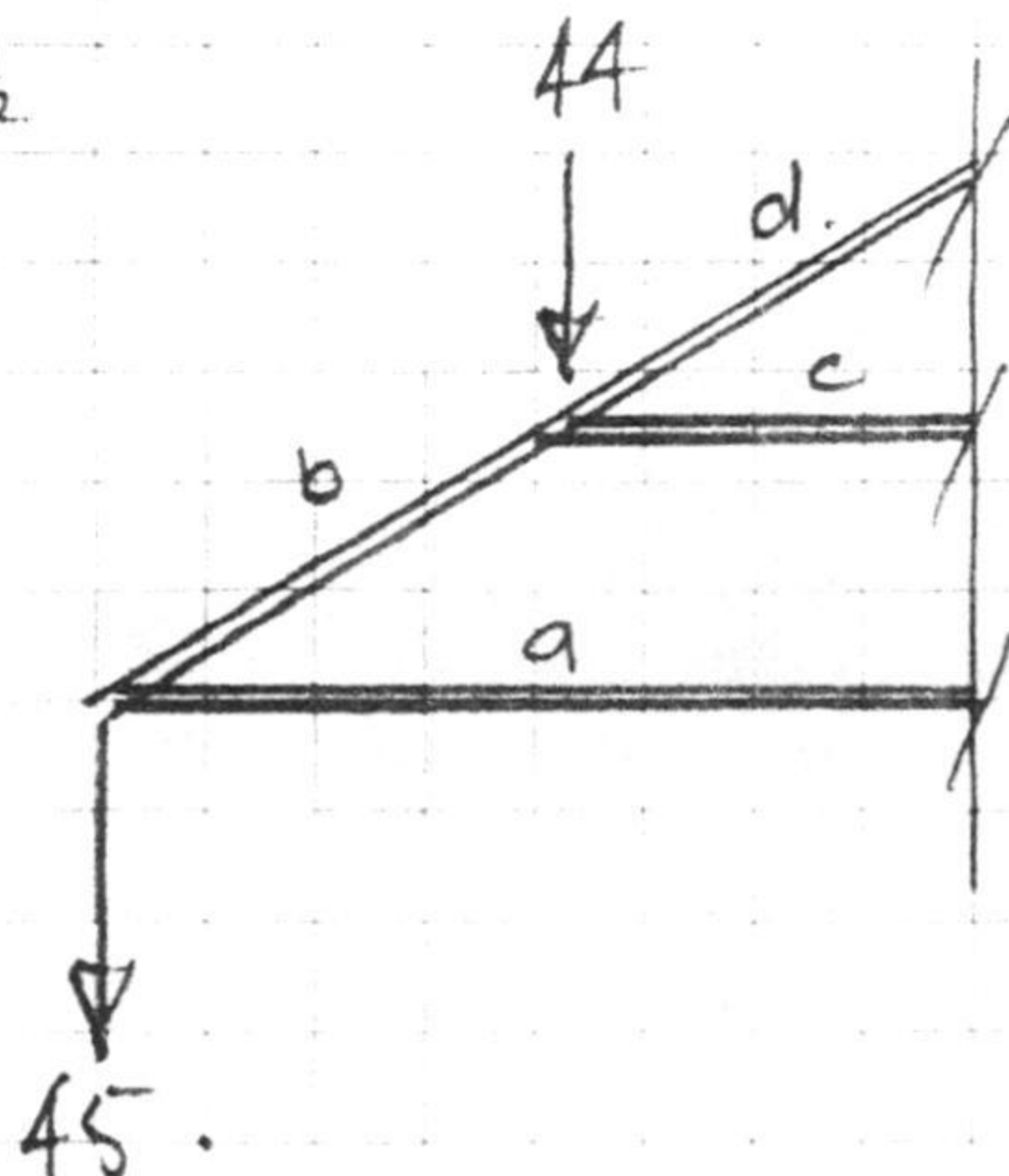
$$\therefore = 45 \text{ kN.}$$

$$P_3 = P_4 = \text{Walls ② \& ③} \frac{12.3 \times 2}{9.7 \times 2} = 24.6$$

$$= 19.4$$

$$\underline{44.0 \text{ kN.}}$$

$$(4.75^2 + 3.42^2)^{\frac{1}{2}} = 8.17$$



Member.

Force.

a
b
c
d.

70
69

83
165



Figure 1. A diagram illustrating the concept of a square grid. The grid is composed of several horizontal and vertical lines, creating a series of smaller squares within the larger square. The lines are of varying thickness, and the overall appearance is that of a hand-drawn or printed schematic.

$$T = 83 \text{ kN} \quad A = \frac{83}{2} = 415 \text{ mm}^2 \quad 50 \times 10 \text{ PL}$$

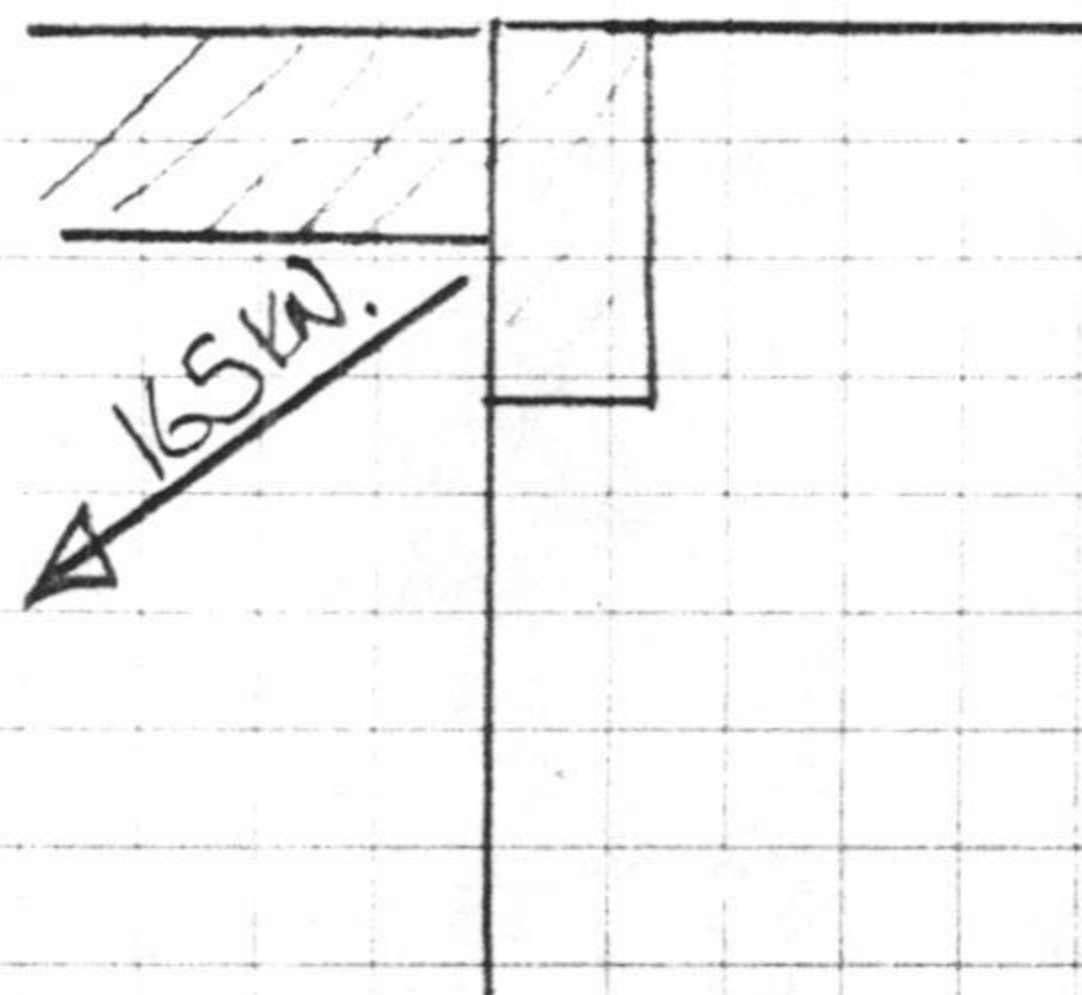
$$T = 165 \text{ kN} \quad 100 \times 10 \text{ PL}$$

$$C = 70 \text{ kN}$$

$$F_{ac} = 10.65 \text{ MPa} \quad A = 6572$$

Use 150x100 blocking.

Reactions

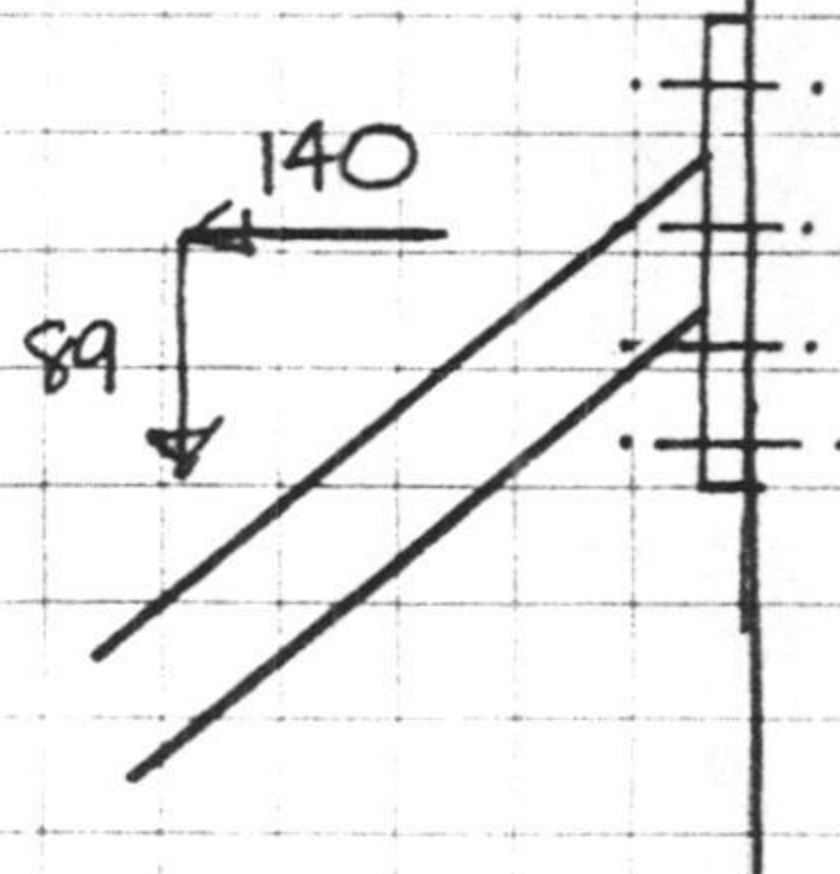


Welding

Using 8 mm FW
need $\frac{165}{0.77}$

= 214 mm weld

Butt weld end
Plate



Say have 8 bolts

6 - M20 bolts

$$F_v = 18 \times 1.2 = 21.6 \text{ kN}$$

$$F_t = 35 \times 1.33 = 47$$

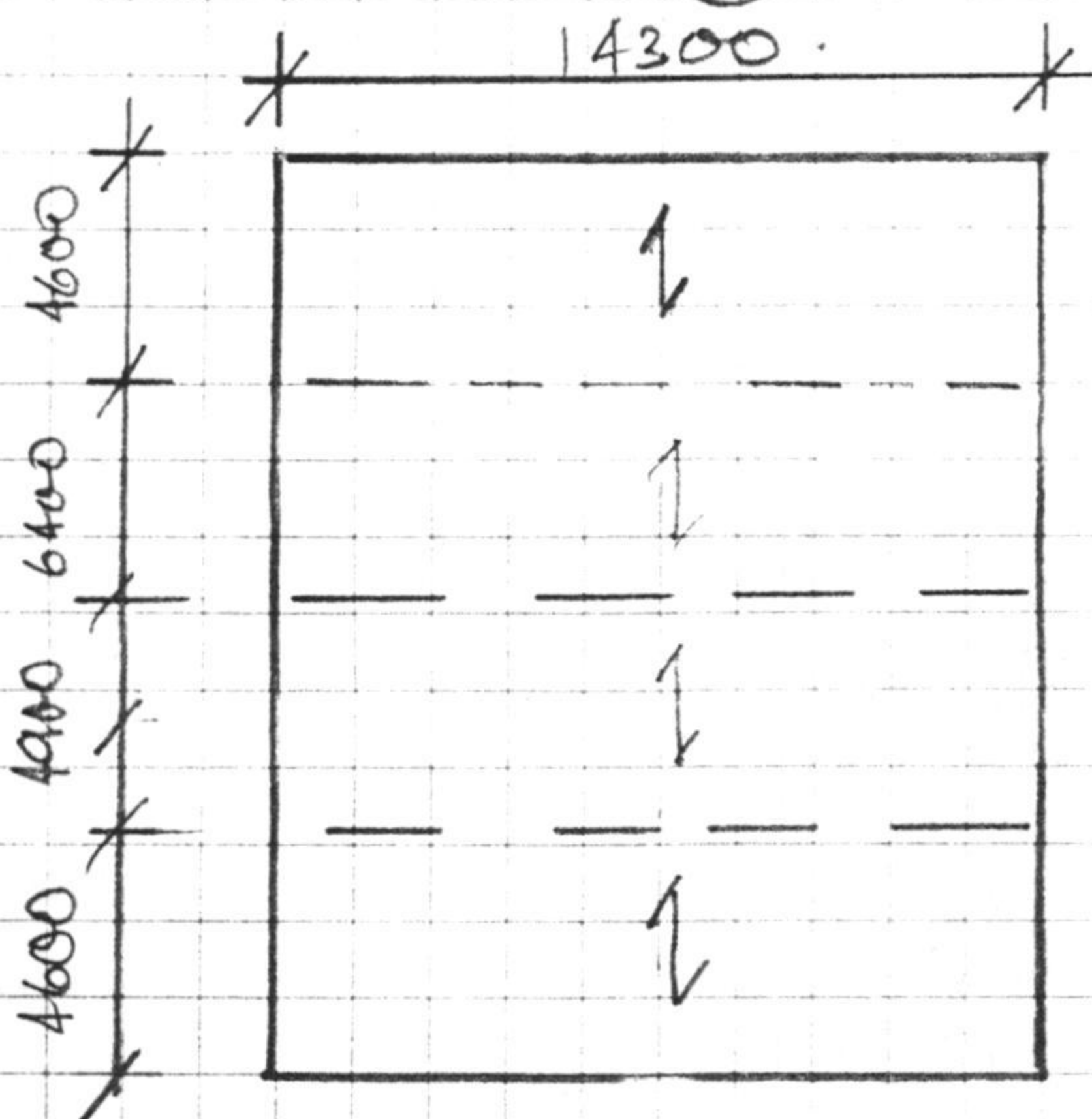
$$\left(\frac{89}{6 \times 21.6} \right)^2 + \left(\frac{140}{6 \times 47} \right)^2 = 0.847$$

\therefore OK

Use 200x150x10 PL
6 - M20 Bolts



100

Second Floor StrengtheningReplacement of Support Columns.

Dead:

| | | | |
|----------------|-------------------------------|---|----------|
| Particle Board | | = | 0.14 kPa |
| Roofboard | | = | 0.13 |
| flooring | 0.037×5 | = | 0.19 |
| joists | $0.35 \times 0.057 \times 45$ | = | 0.27 |
| ceiling | 2×0.13 | = | 0.26 |
| | Σ | = | 0.98 kPa |

Live: = 3.0 kPa

Consider using a pair of beams:

Max. $W = 3.98 \times \left(\frac{6.4 + 4.9}{2} \right) + 2 \times 1 = 24.5 \text{ kN/m.}$
 (Σ load = 350 kN)

Try ~~2~~ 2x S30UB92's

$Z = 2080 \times 2 \text{ cm}^3$
 $I = 554 \text{ E6 mm}^4 \times 2$
 $r_y = 45.1$
 $r_z = 34.1$

1. The first part of the paper is devoted to a discussion of the various methods of determining the rate of reaction.

| Time (min) | Concentration (M) |
|------------|-------------------|
| 0 | 0.100 |
| 10 | 0.080 |
| 20 | 0.060 |
| 30 | 0.040 |
| 40 | 0.020 |
| 50 | 0.010 |
| 60 | 0.005 |
| 70 | 0.002 |
| 80 | 0.001 |
| 90 | 0.000 |

2. The second part of the paper is devoted to a discussion of the various methods of determining the rate of reaction.

3. The third part of the paper is devoted to a discussion of the various methods of determining the rate of reaction.

4. The fourth part of the paper is devoted to a discussion of the various methods of determining the rate of reaction.

5. The fifth part of the paper is devoted to a discussion of the various methods of determining the rate of reaction.

labrally restrain @ 2920 mm

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

$$f_b = \frac{626}{2 \times 2080} = 150 \text{ MPa}$$

$$\delta_{live} = \frac{5 \times 3 \times 5.65 \times 14300^4}{384 \times E \times I \times 2 \times 554 \text{ EG}}$$

$$= 39.7 \text{ mm} = 0.0028 L \left(\frac{L}{360} \right)$$

$$\delta_{tot} = 0.0028 \times \frac{24.5}{3 \times 5.65} = 0.004 L \left(\frac{L}{250} \right)$$

If restrict δ_{live} to 25 mm

$$\text{Require } I = \frac{5 \times 3 \times 5.65 \times 14.3^3}{2 \times 0.337} \times \frac{572}{500}$$

$$= 841 \text{ cm}^4 \text{ EG mm}^4$$

610 UB 113.

Use 610 UB 125.

$$\delta_{live} = \frac{841}{985 \times 25} = 21.3 \text{ mm}$$

$$\times \frac{5.65}{5.65} = 20.8 \text{ mm}$$

100 mm long by 20 thick flange R.

$$\text{Swick Beamy} = 126 + 2.26 \times 100 + 20 \times 3.92$$

$$= 126 + 226 + 78 = 430 \text{ KN}$$

Consider removing replacing East col. of middle row.

$$\text{span} = 7.0 \text{ m}$$

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

310 UB 46.

$$f_b = \frac{150}{0.648 \times 2} = 116 \text{ MPa}$$



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SMITH LEUCHARS LTD

CIVIL, STRUCTURAL AND EARTHQUAKE ENGINEERS

JOB No 1868

PAGE P/13

JOB

BY MYD

DATE 10/86

$$I_{live} = \frac{5 \times 3 \times 5.65 \times 7000^4}{384 \times 2.1 \times 10^6 \times 2 \times 99.5 \times 10^6}$$

$$= 12.7 \text{ mm} \quad (= .00181 L) \quad \left(\frac{L}{570} \right)$$

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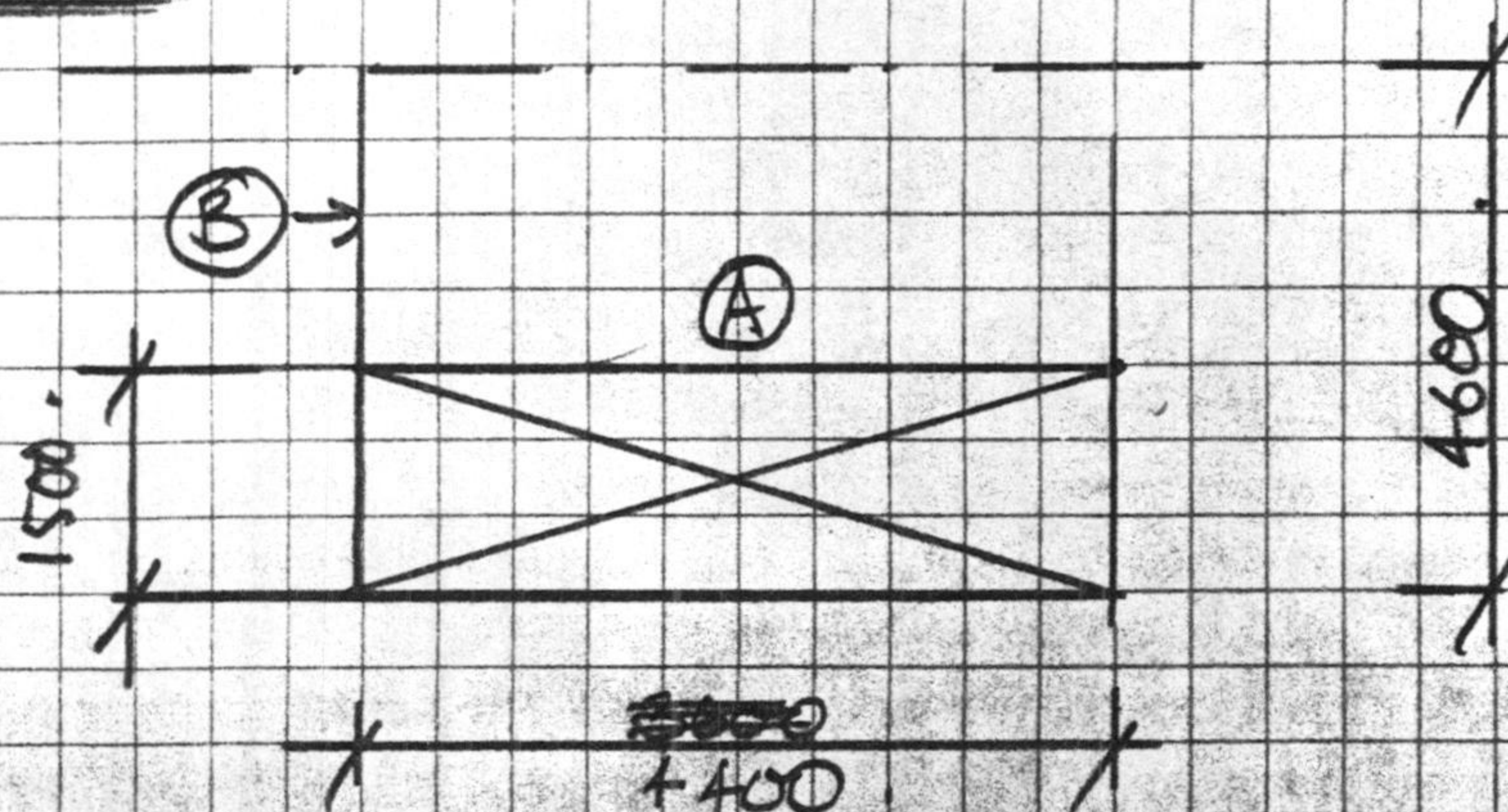
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2nd Floor Bracing

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

Stair Trim



Trim Beam (A):

Dead: Floor $1 \times \frac{3.1}{2} = 1.6 \text{ kN/m}$
 Partition $1.5 \times 3.5 = 1.75$
 Total Dead = 3.35 kN/m

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

Load = 7.95 kN/m

M = 19.2 kNm

Try 300×100 green galval.

Z = 1354 cm^3

I = 199.1 E6 mm^4

F_{cr} = $6 \times 1.25 = 7.5 \text{ MPa}$

E = 8000 MPa

f_{cr} = $\frac{17.7}{1.354} = 13 \text{ MPa}$

Try Steel.

F_{oc} = 150 MPa

Z = 118 cm^3

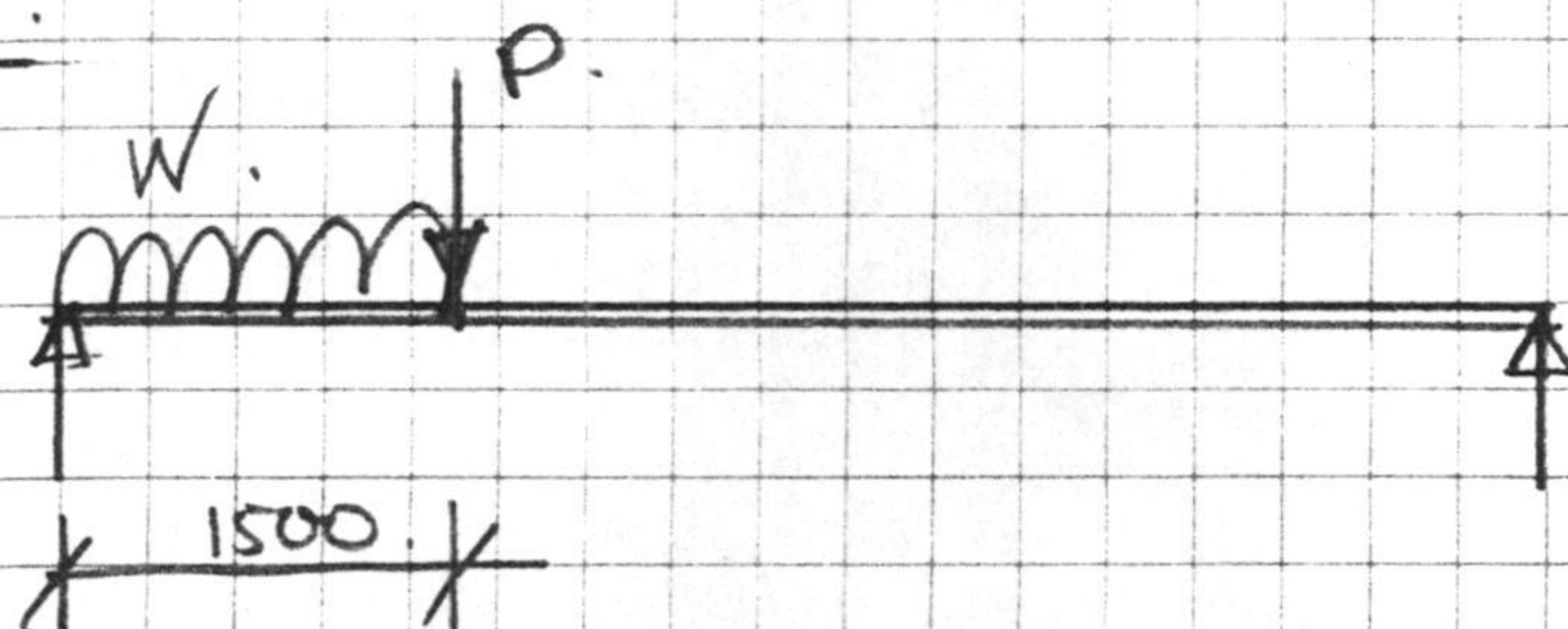
178 x 76 MSF

| Section 1: Introduction | |
|---|---------------------------|
| This document provides a comprehensive overview of the project's objectives and scope. | |
| The primary goal is to develop a robust system that meets the requirements of the client. | |
| The project is organized into several key phases, each with specific deliverables. | |
| The following table outlines the project schedule and milestones. | |
| Project Schedule and Milestones | |
| Milestone | Estimated Completion Date |
| Phase 1: Requirements Gathering | Q3 2023 |
| Phase 2: System Design | Q4 2023 |
| Phase 3: Development | Q1 2024 |
| Phase 4: Testing | Q2 2024 |
| Phase 5: Deployment | Q3 2024 |
| The project is currently on track and will be completed by the end of the year. | |
| For more details, please refer to the attached documents. | |
| Thank you for your interest in this project. | |

$$\text{Live } \delta = \frac{.5 \times 6.9 \times 3600^4}{384 \times 2.1 \times 10^5 \times 13.6 \times 10^6} = 5.4 \text{ mm.}$$

$$= .0015 \text{ L.}$$

Beam (B).



$$P = \frac{7.95 \times 4.4}{10.95 \times \frac{3.1}{2}} = 17.5 \text{ KN}$$

$$W = \text{stairs}$$

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

$$R_L = \frac{17.5 \times 3.1 + 9.8 \times 1.5 \times 3.85}{4.6}$$

$$= 25.6 \text{ KN. } 26 \text{ KN}$$

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

$$= 27 \text{ KNm.}$$

$$\text{requi } Z = \frac{27}{.15} = 182 \text{ cm}^3$$

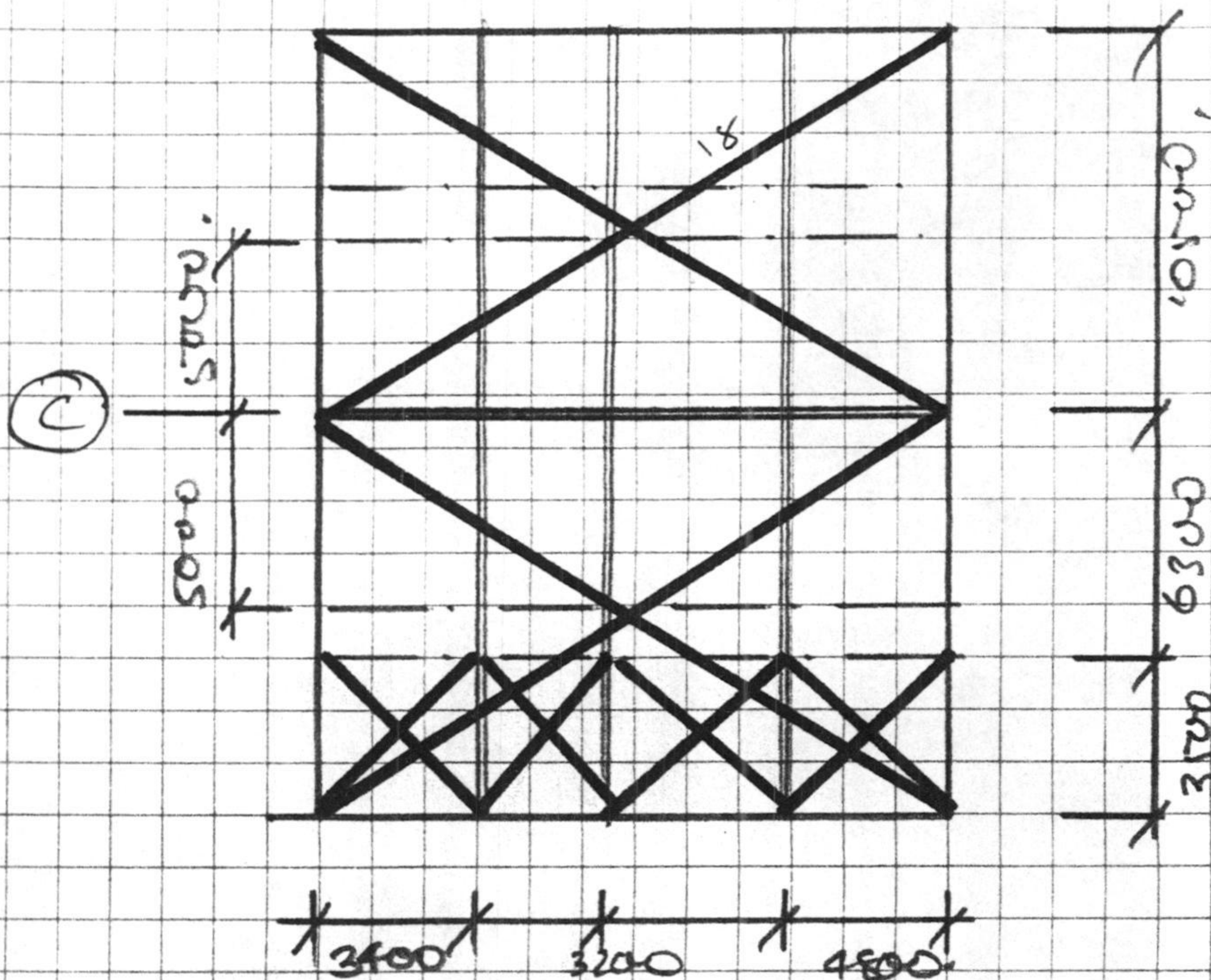
Use 203 x 76 MS L.

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The document also outlines the responsibilities of individuals involved in the process, including the need for transparency and accountability.

The second part of the document provides a detailed overview of the various methods used to collect and analyze data. It describes the different types of data sources, such as surveys, interviews, and focus groups, and explains how this information is used to identify trends and patterns. The document also discusses the challenges associated with data collection and analysis, such as ensuring the reliability and validity of the data.

The third part of the document focuses on the development of effective communication strategies. It discusses the importance of clear and concise communication and provides guidelines for writing reports and presentations. The document also outlines the different channels through which information can be disseminated, such as newsletters, websites, and social media.

The fourth part of the document discusses the importance of ongoing evaluation and improvement. It emphasizes that the effectiveness of any program or initiative can only be determined through regular assessment and feedback. The document also outlines the different methods used to evaluate performance, such as self-assessments, peer reviews, and external audits.

Roof BracingEast - West

Load Grid (C)

$$K_x = \frac{5401}{4008} = .133$$

$$P = .133 \times (2.5 \times .24 \times 22 + \frac{3.5}{2} \times .36 \times 22) \times 5 = 18 \text{ kN}$$

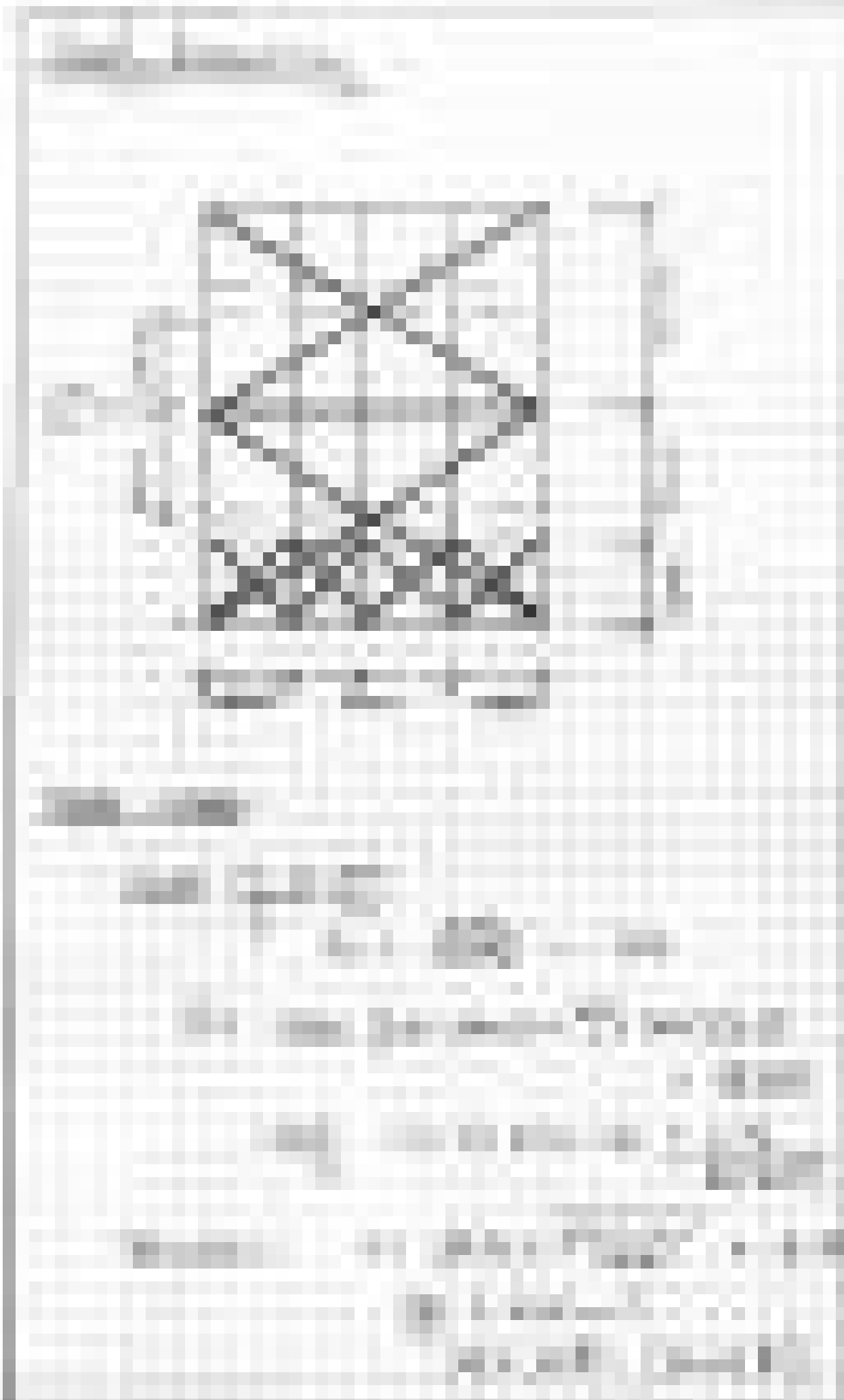
$$+ \text{roof} \quad 1.2 \times 5 \times 14.8 \times .133 = 11.8$$

$$\underline{29.8 \text{ kN}}$$

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

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

$$25 \times 10 \text{ PL } (50 \times 5 \text{ PL})$$



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(a) $T = 52.4 \times \frac{\sqrt{4.8^2 + 3.5^2}}{3.5} = 88.6$
 $A = \frac{88.6}{.2} = 443$
 50x10 R

(b) use 50x10R also.

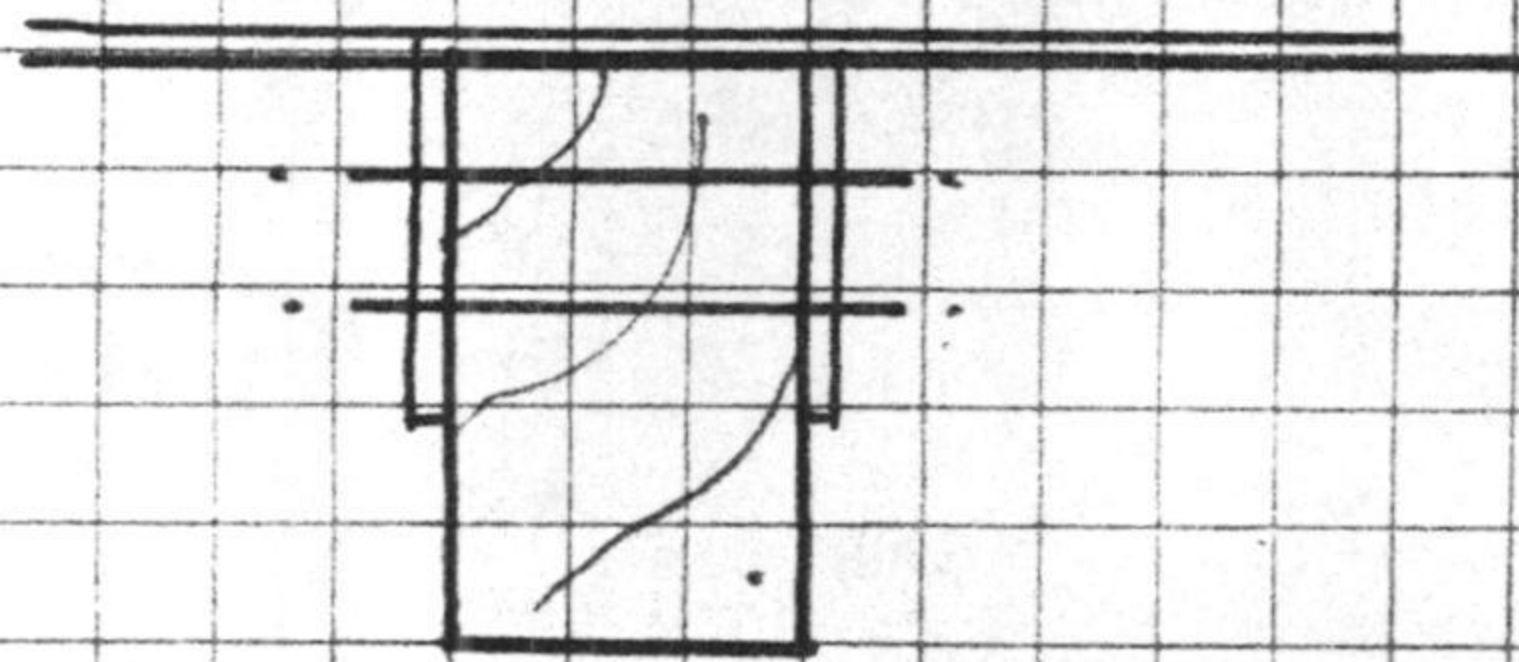
Truss bottom chords to take compression.

Max Tie/Spur load.

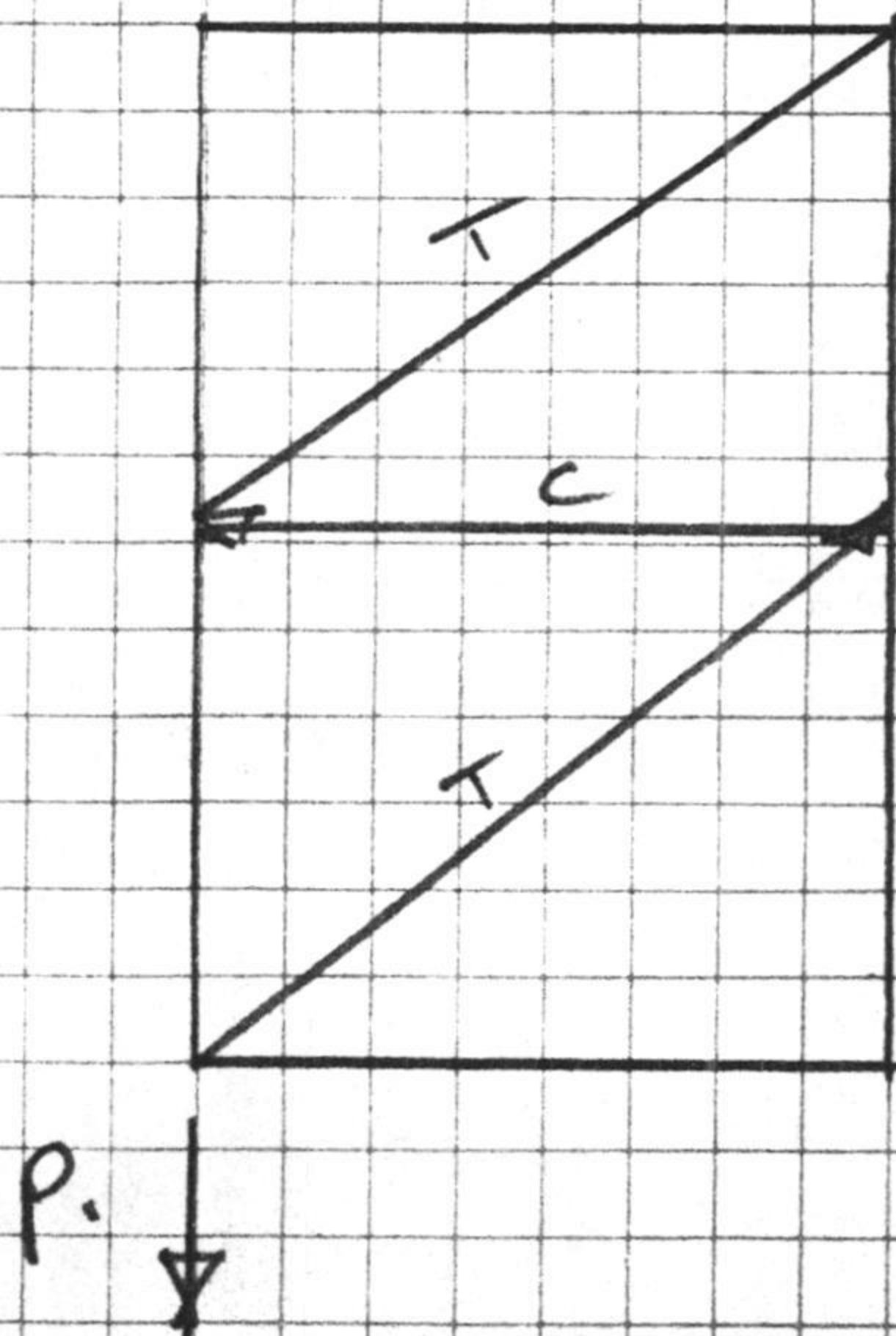
$= 34.3 - 52.4 - 43 = 117 \text{ kN}$

or $59.6 - 35 = 24.6 \text{ kN}$

Require 2-M20 bolts.



Main Bracing



$P = 59.6 + \frac{18}{5} \times 21.5$
 $= 137 \text{ kN}$

$T = \frac{137}{2} \times \frac{18}{10.5}$
 $= 117 \text{ kN}$

$A = \frac{117}{.2} = 587 \text{ mm}^2$
 60x10 R

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$$C = 117 \times \frac{14.8}{18} = 95 \text{ KN}$$

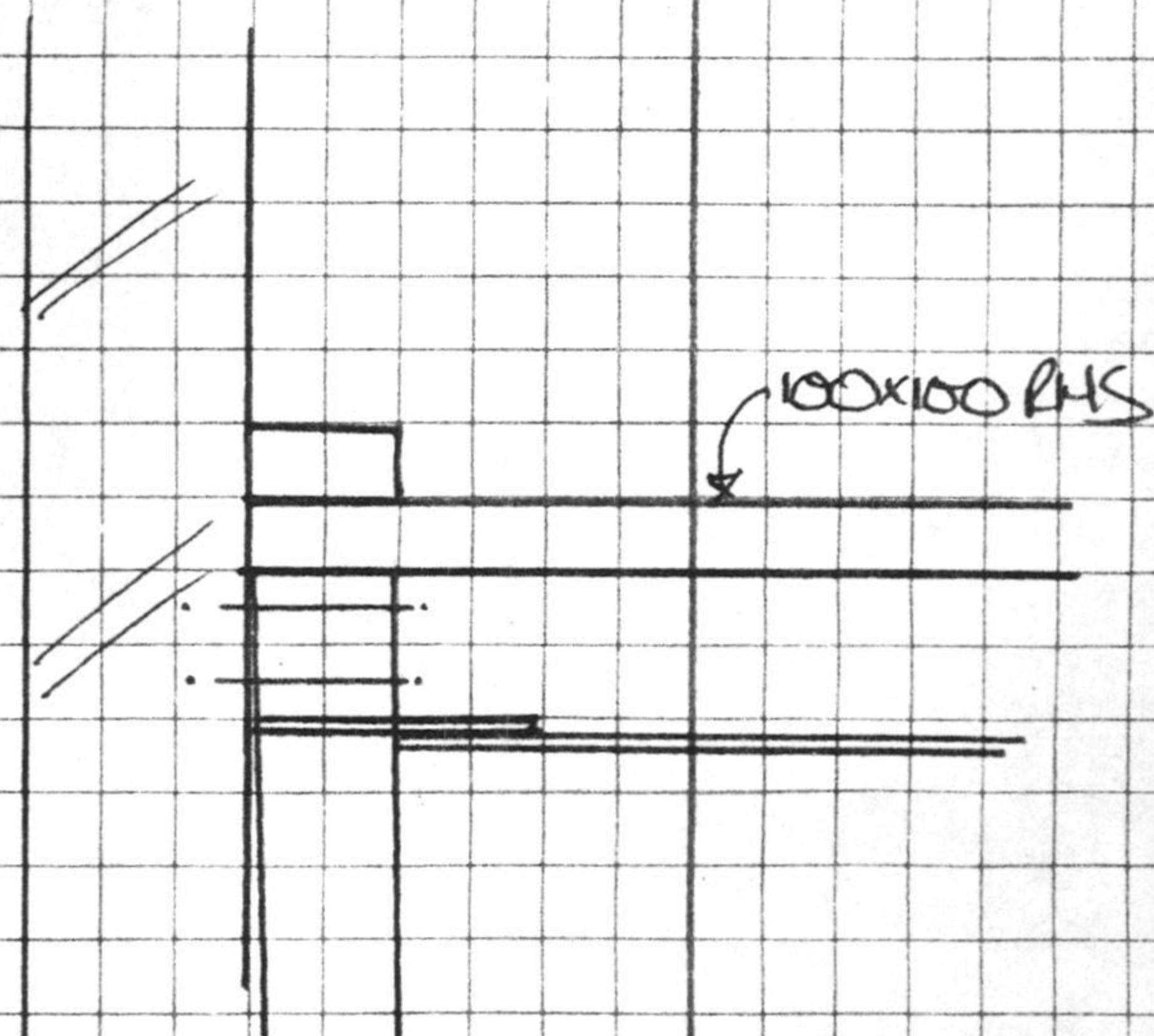
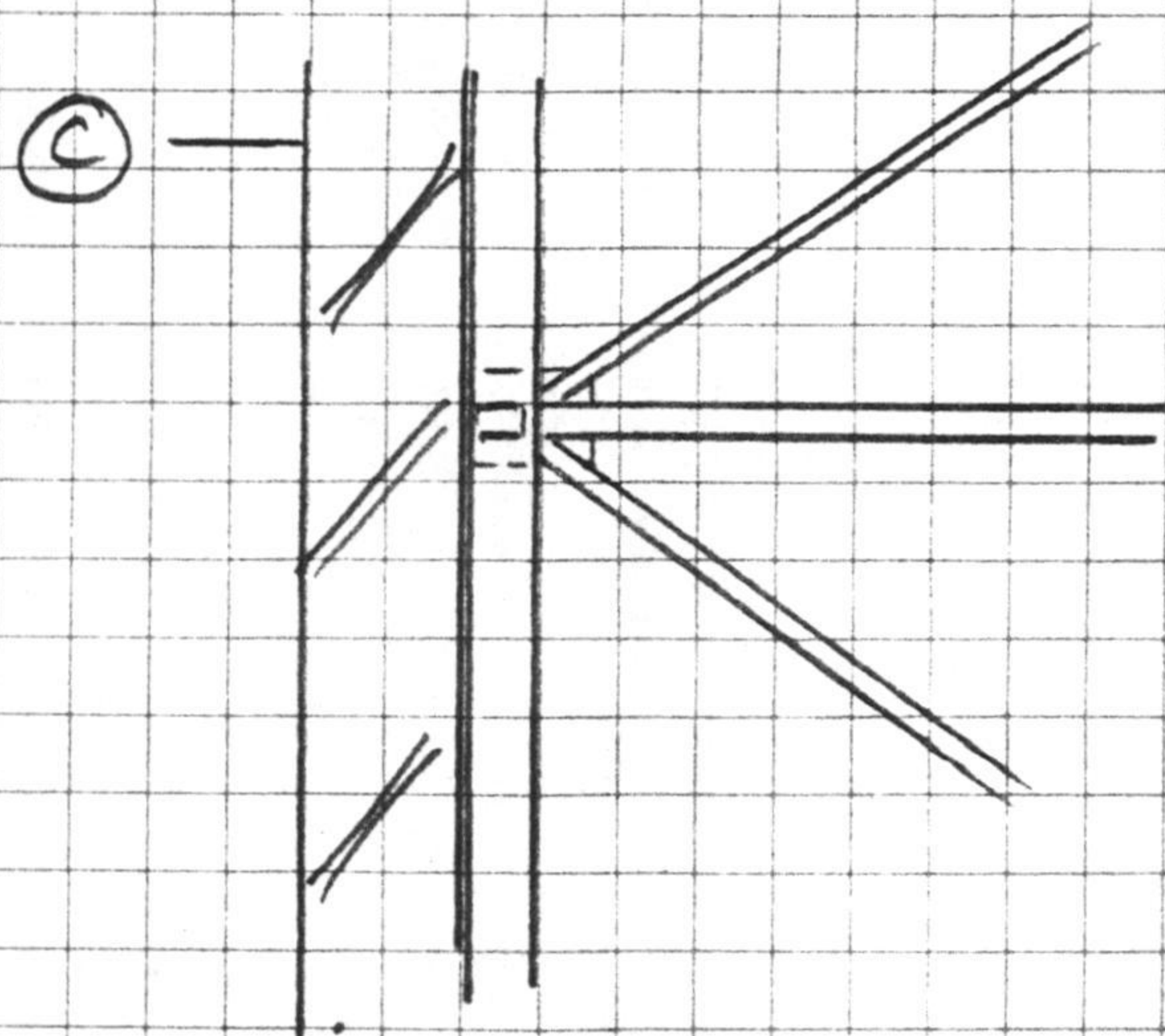
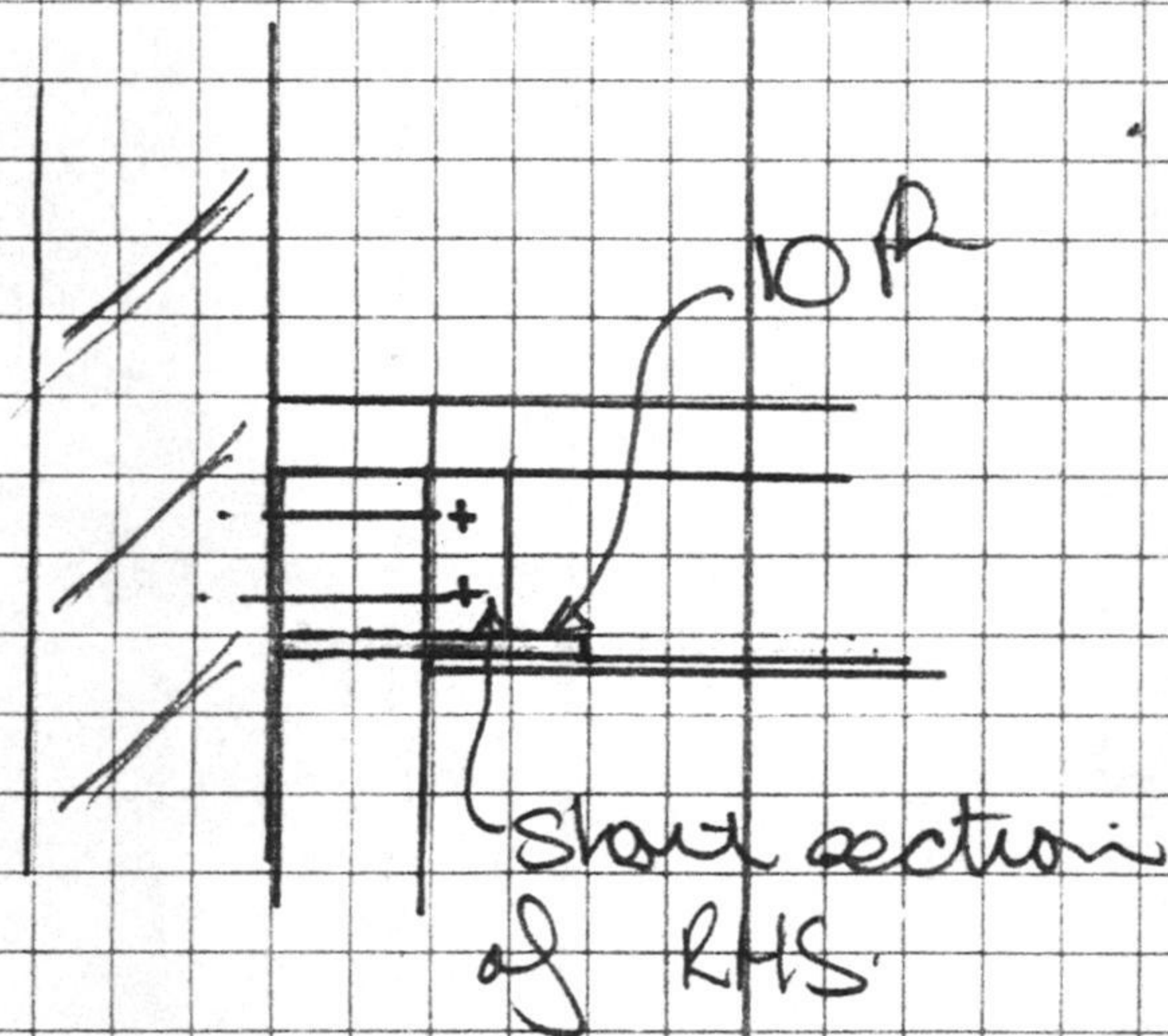
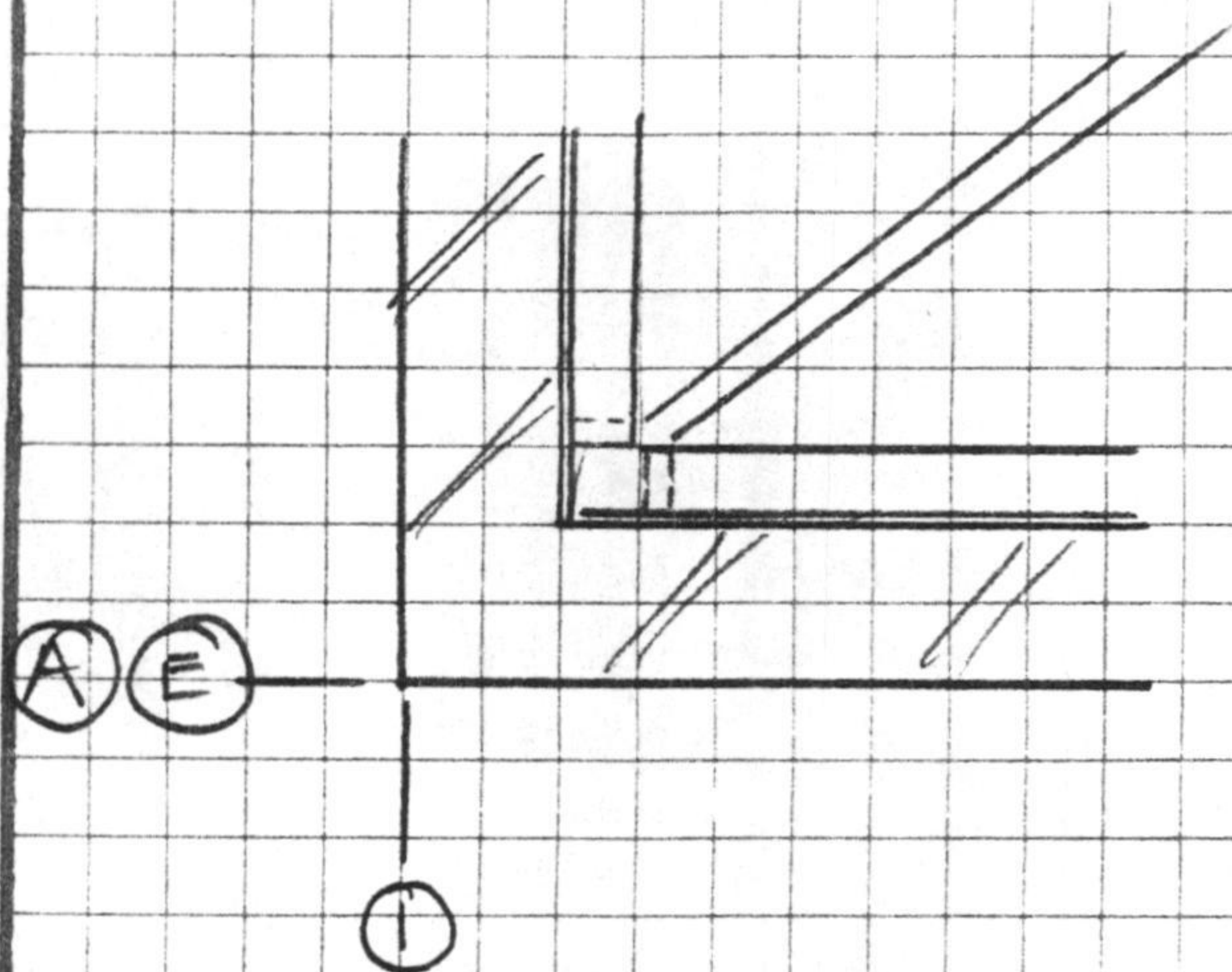
Try 100x100x4 RHS.

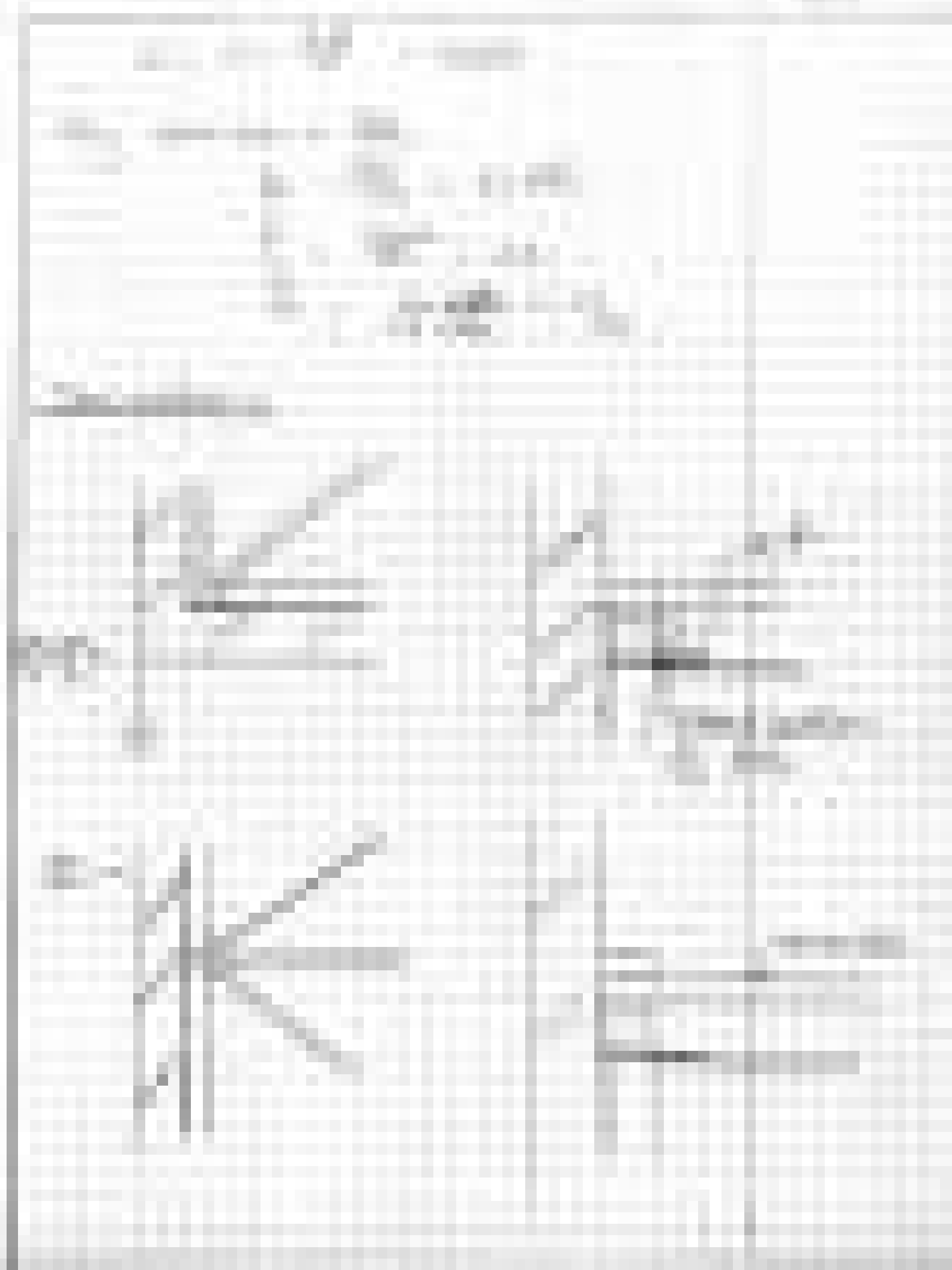
$$f_{ac} = \frac{95}{1.53} = 62 \text{ MPa.}$$

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

$$F_{ac} = 56 \text{ MPa} \times 1.33 = 74 \text{ MPa} \therefore \text{OK}$$

Connections





**WORKS DEPARTMENT
CHECKING & COMMENTS FORM
Structural Branch to Building Branch**

Code

3

8943

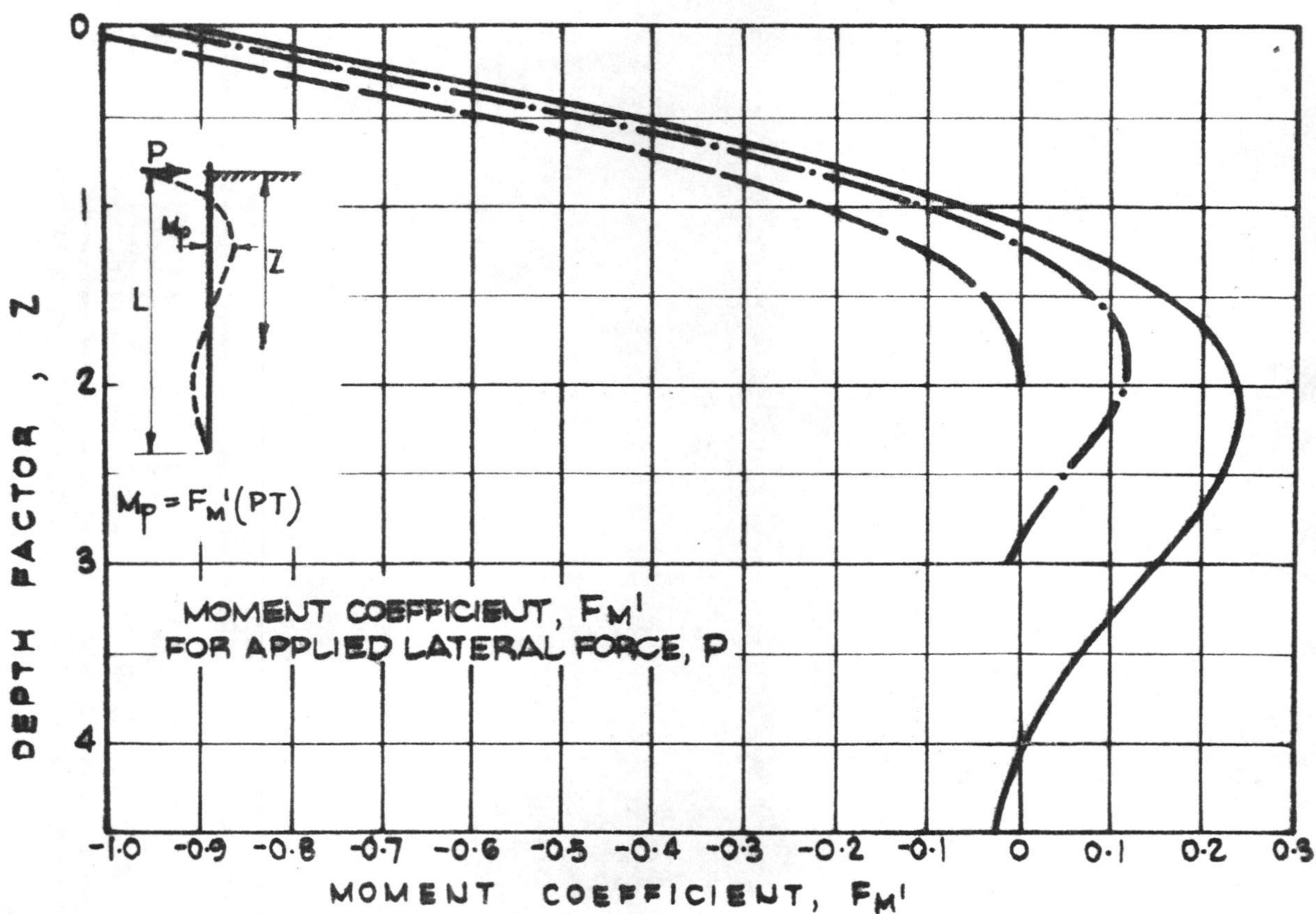
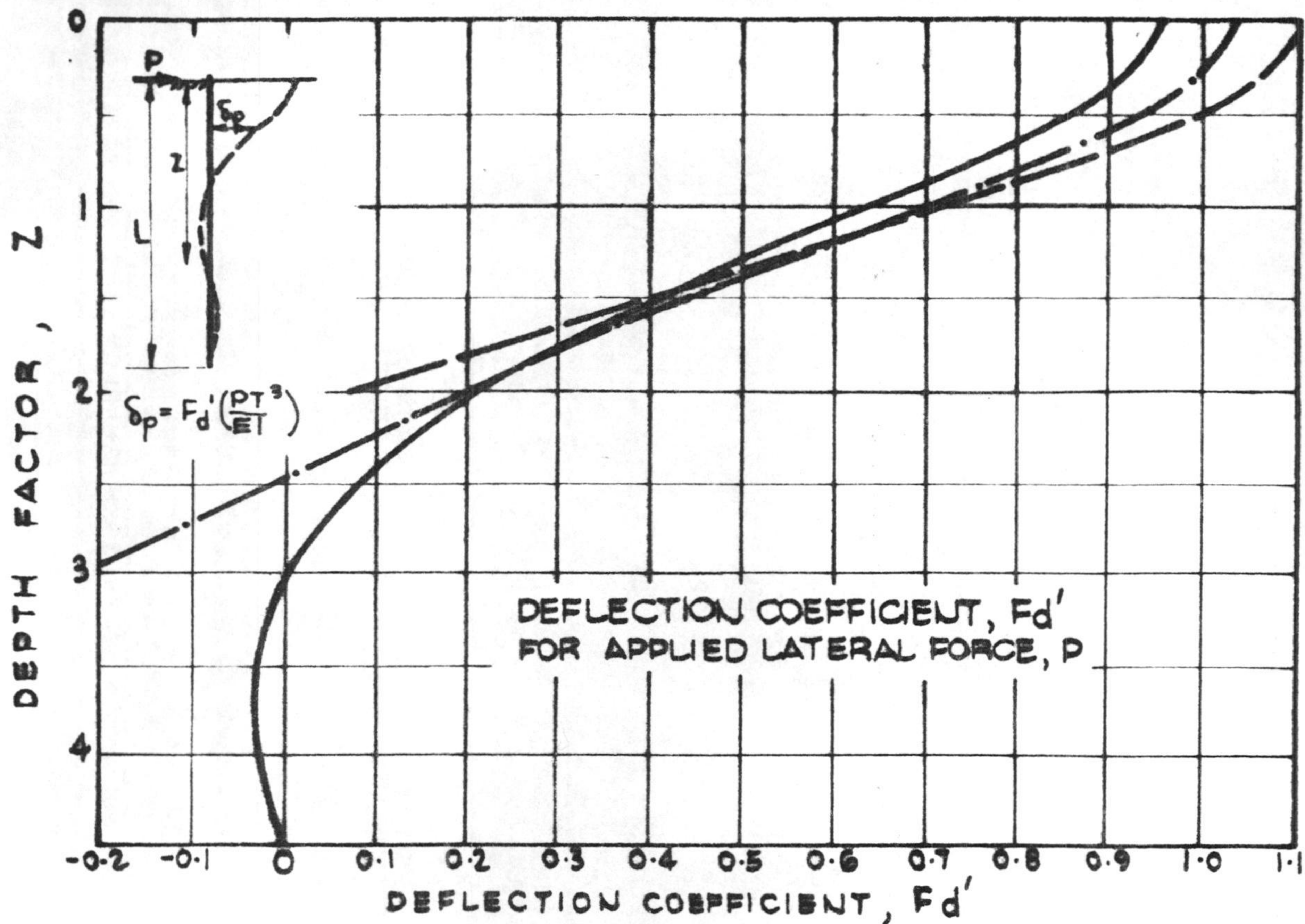
| | | | | | |
|---------------------|--|---------------------------|--|-----------|--|
| 695 | | Stage 1 Piling | | 1 6.11.86 | |
| NATURE OF WORK | | Extension to Club Rooms | | 2 | |
| NAME OF OWNER | | Wilton Working Men's Club | | 3 7.11.86 | |
| ADDRESS OF NEW WORK | | 111-117 Cuba St | | 1 7.11.86 | |
| CONSULTING ENGINEER | | Smith Leachars | | 2 | |
| ARCHITECT | | Keith Wilson | | 3 | |
| BUILDER | | | | 1 | |
| | | | | 2 | |
| PROPOSAL | | Signature | | Date | |
| | | REFERRED BACK | | | |
| | | ACCEPTED | | 10.11.86 | |

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.

Bin 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

DATE

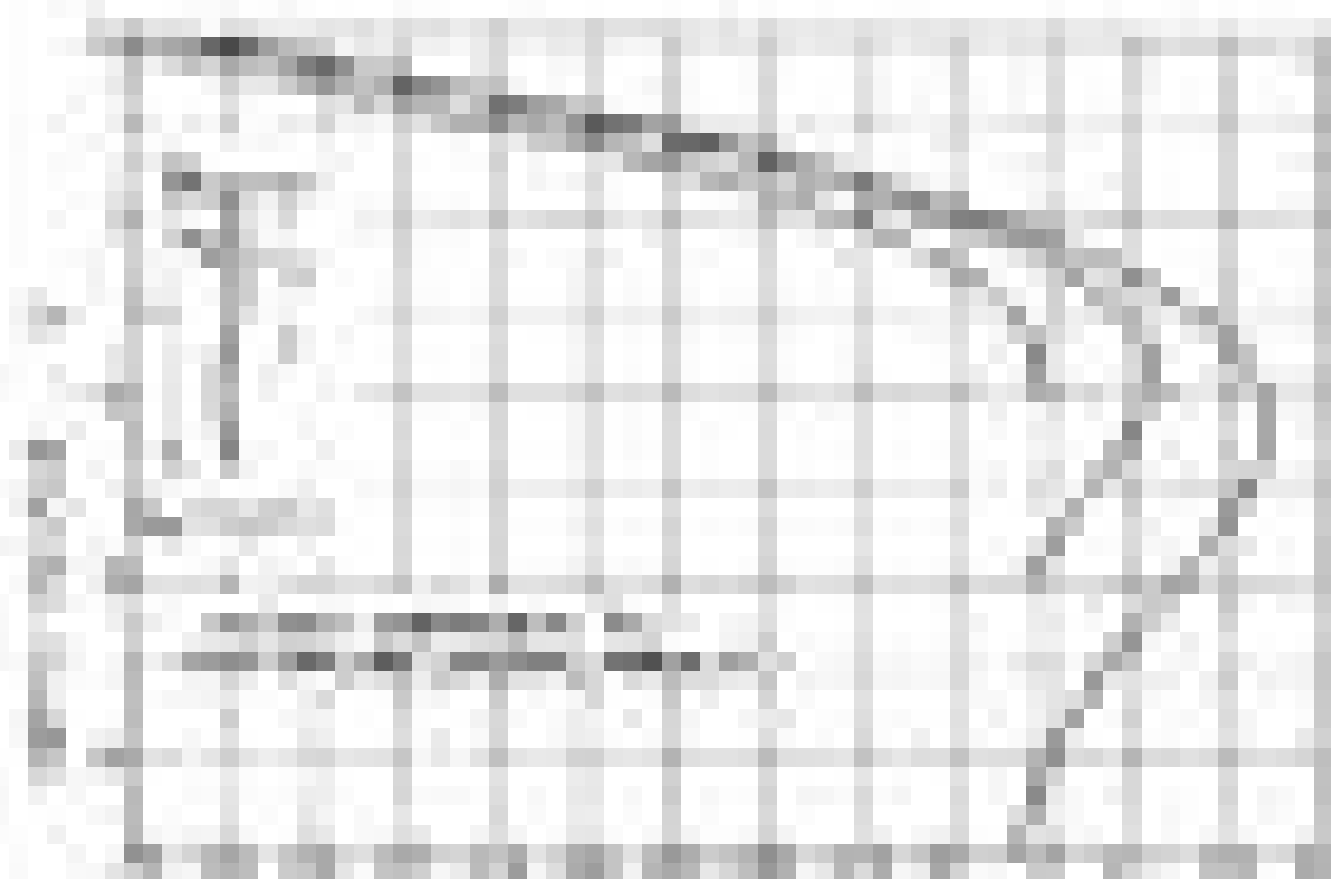
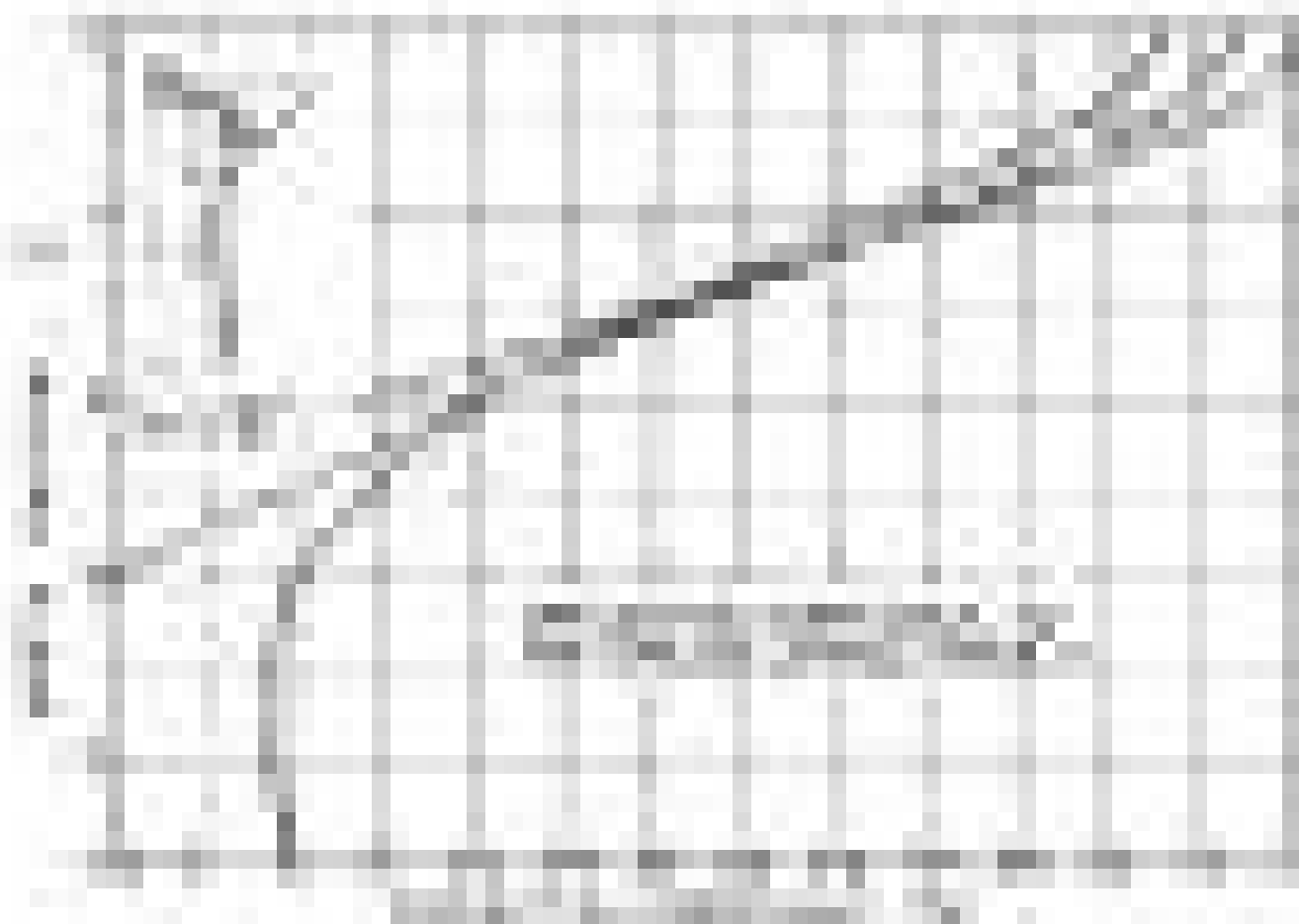
CHECKED

BY

LOCATION

CLIENT

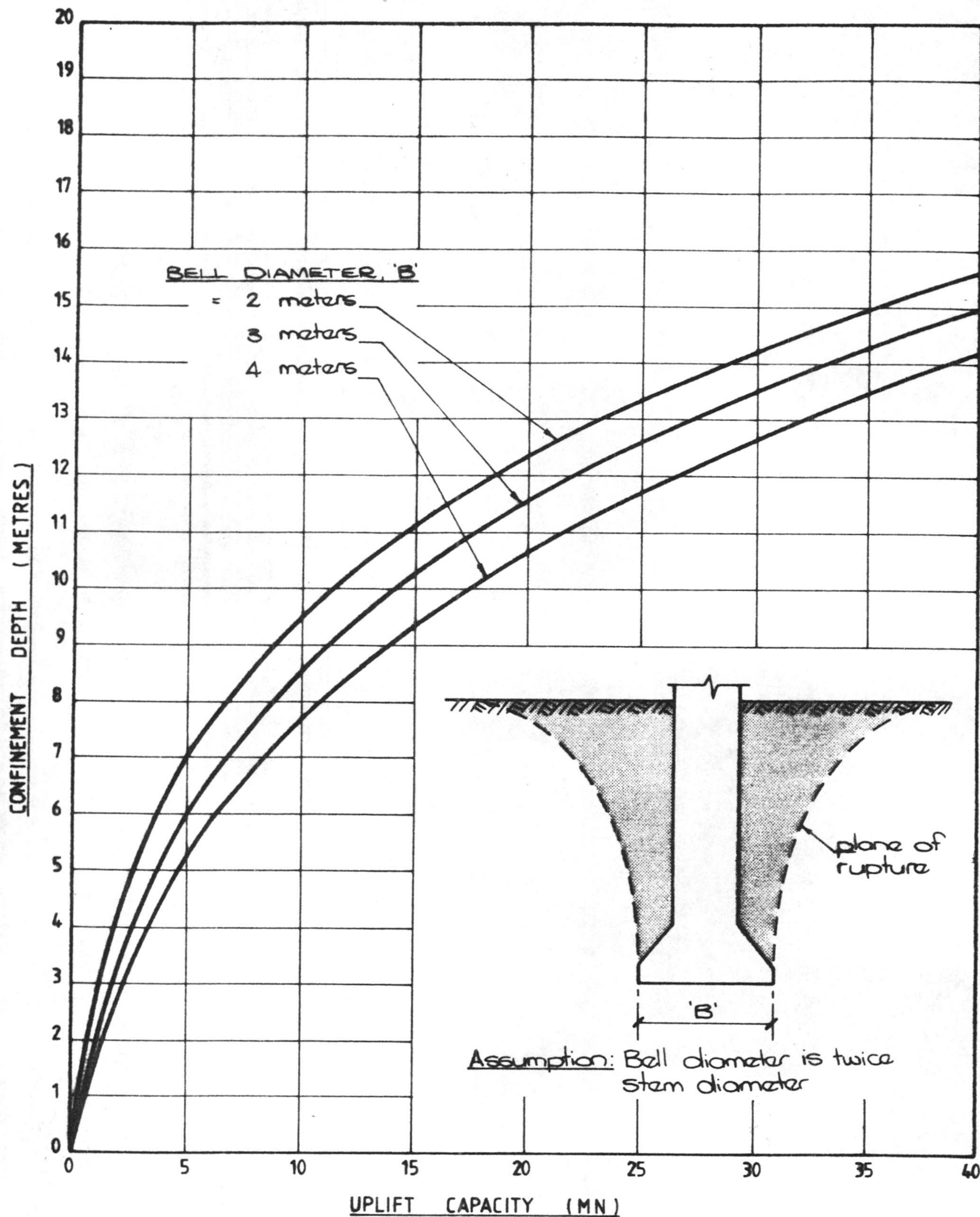
JOB



Graph the parabola $y = 2x^2 - 12x + 14$.

Graph the parabola $y = -x^2 + 6x - 8$.

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

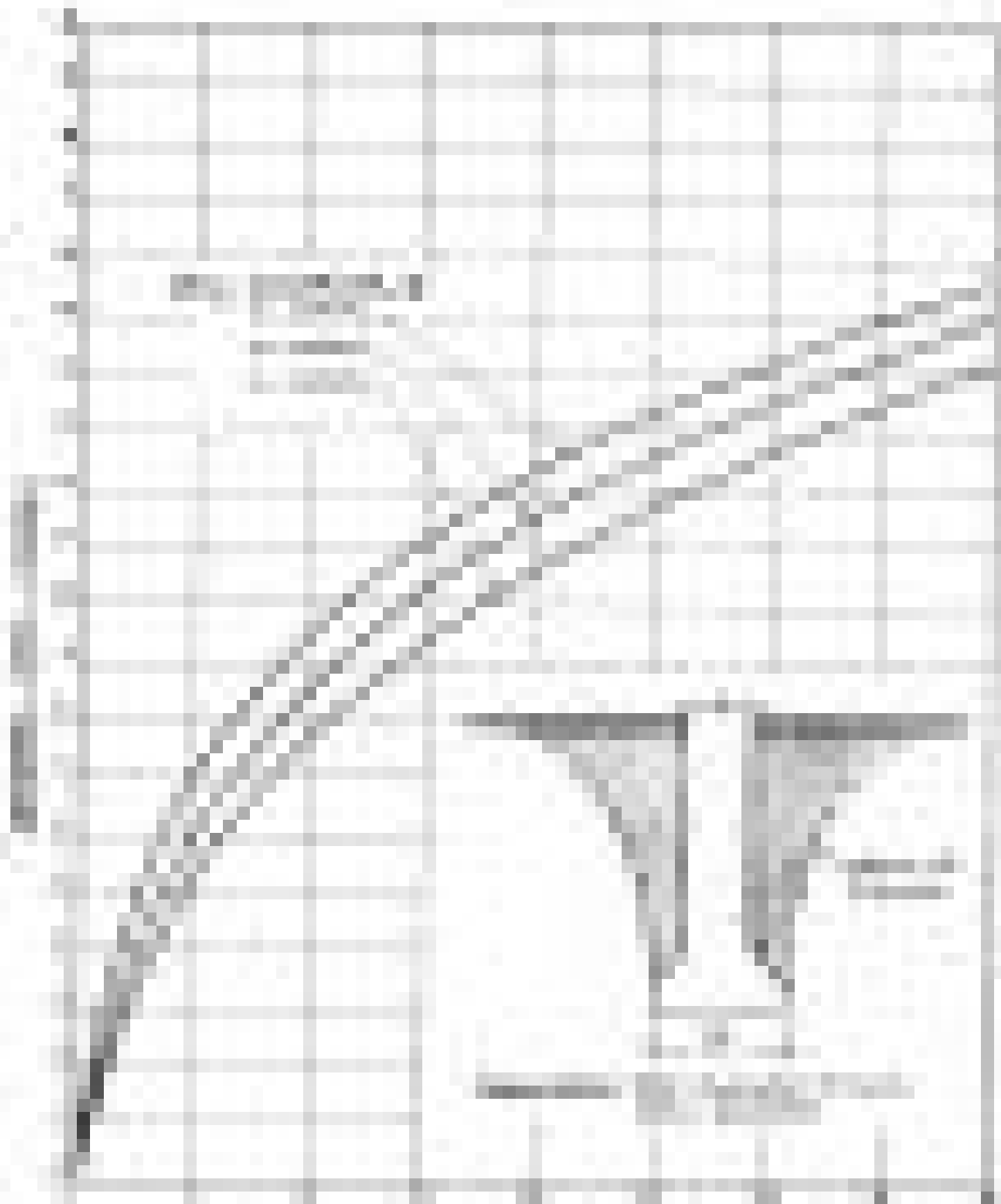


ULTIMATE UPLIFT CAPACITIES FOR BELLED PILES

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

BRICKELL MOSS RAINES & STEVENS LTD.

PLATE 4



Time

Value

DATE

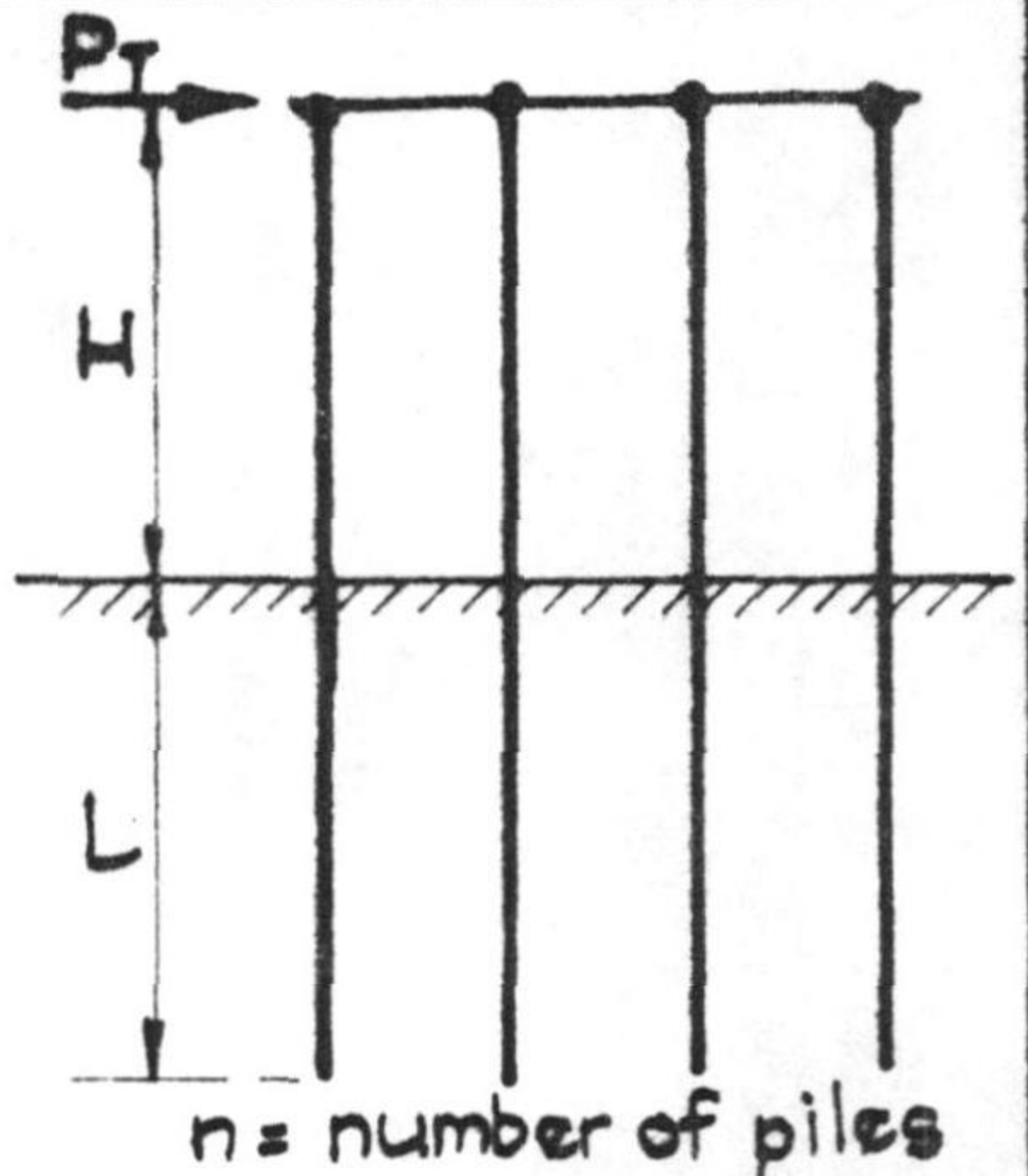

CHECKED

BY

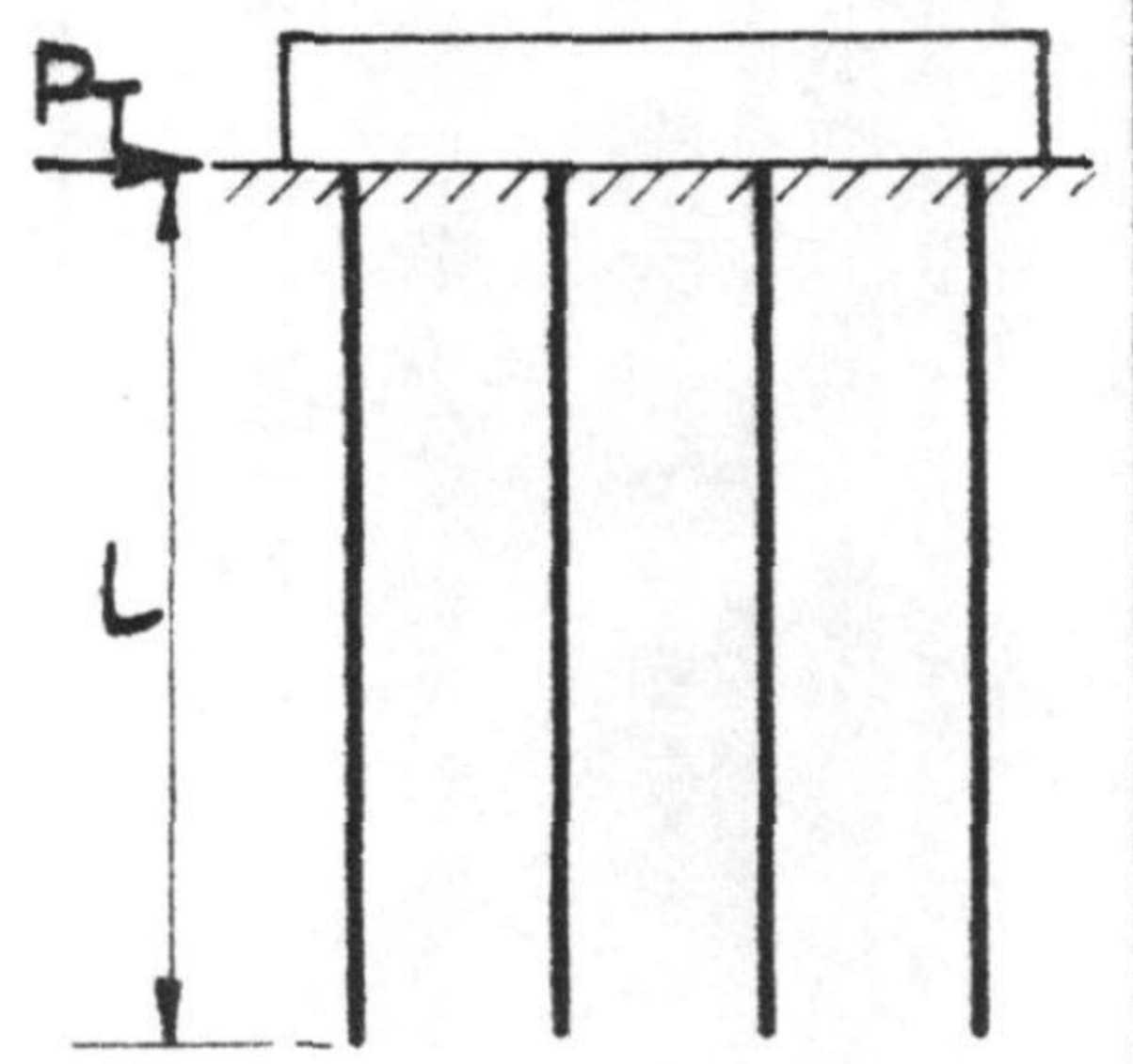

LOCATION

CLIENT

JOB

| CONDITION | LOAD AT GROUND LINE | DESIGN PROCEDURE |
|--|--|--|
|  <p>$n = \text{number of piles}$</p> | <p>For each pile</p> $P = \frac{P_T}{n}$ $M = PH$  <p>DEFLECTED POSITION</p> | <ol style="list-style-type: none"> 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

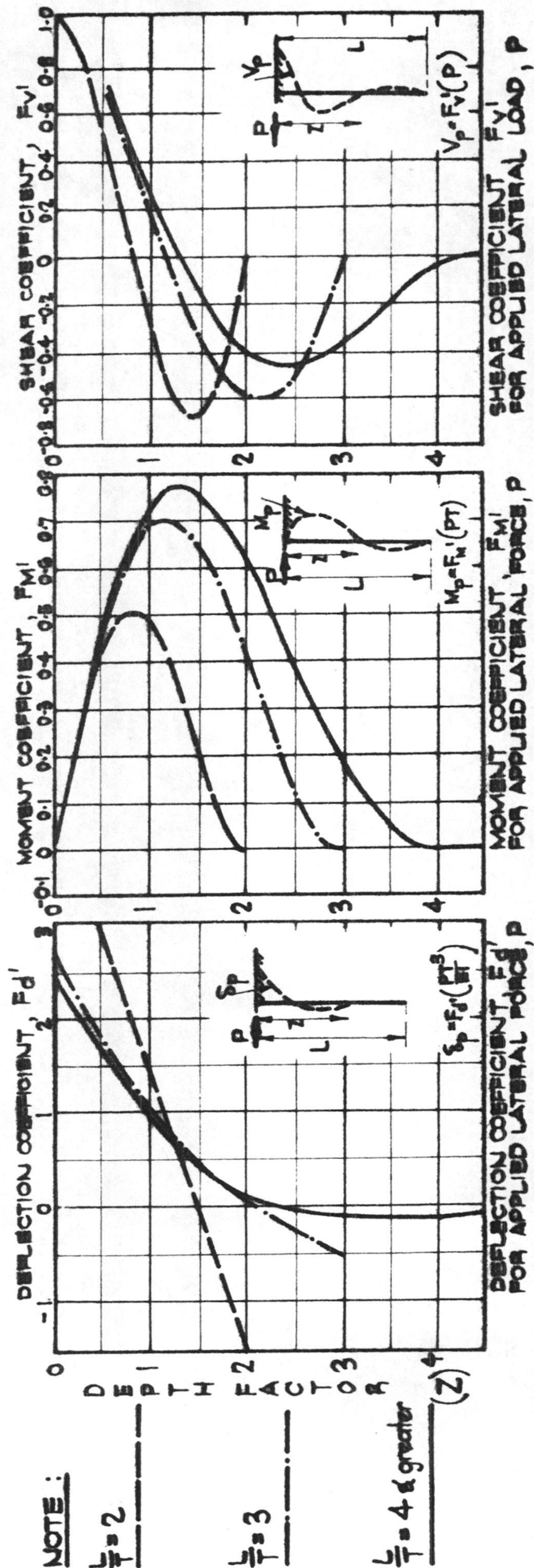
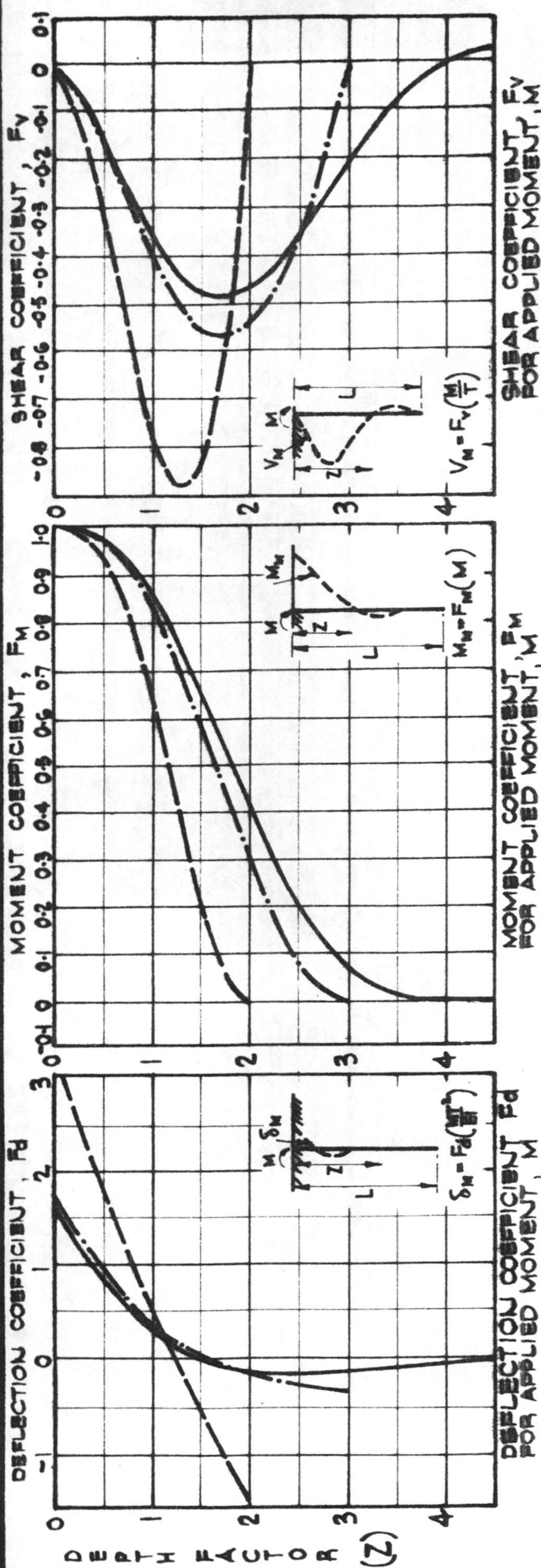
| | | |
|---|--|---|
|  |  | <ol style="list-style-type: none"> 1. Proceed as in step 1, case 1. 2. Compute deflection and moment at desired depths, using coefficients F_d', F_M' and formulae of Plate 3C 3. Maximum shear occurs at top of pile and equals $P = \frac{P_T}{n}$ in each pile. |
|---|--|---|

CASE 2. PILES WITH RIGID CAP AT GROUND SURFACE

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

DESIGN PROCEDURE FOR Laterally Loaded PILES

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



NOTE:

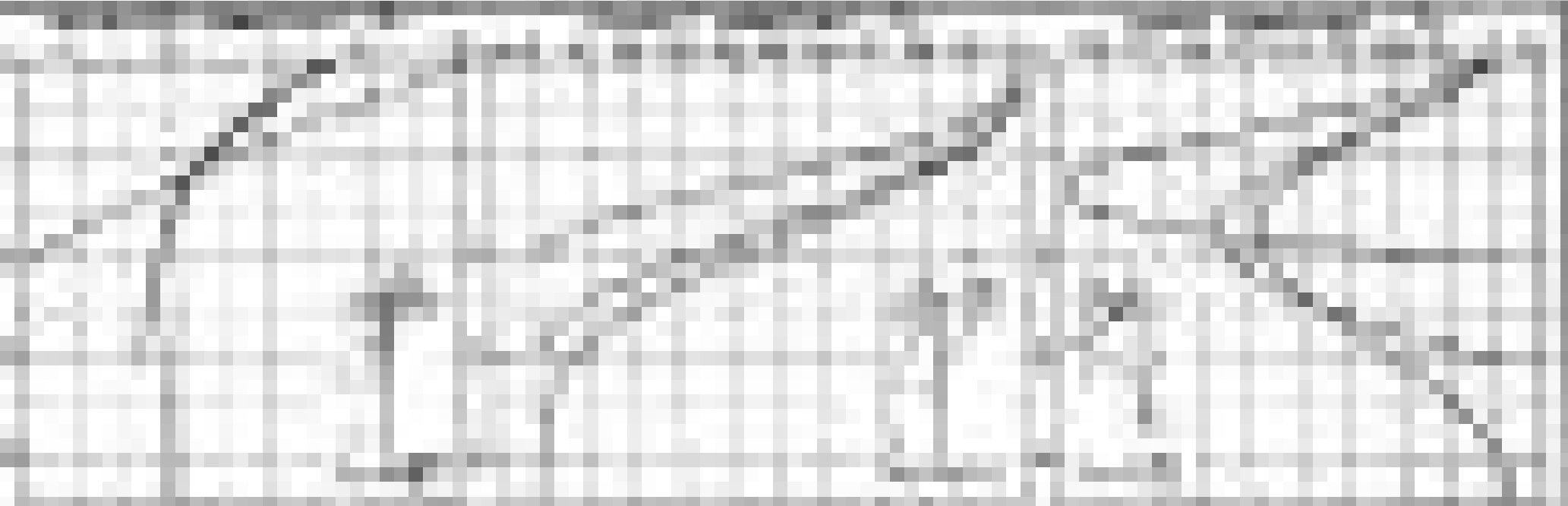
$\frac{L}{T} = 2$

$\frac{L}{T} = 3$

$\frac{L}{T} = 4$ & greater

DESIGN PROCEDURE FOR Laterally Loaded PILES

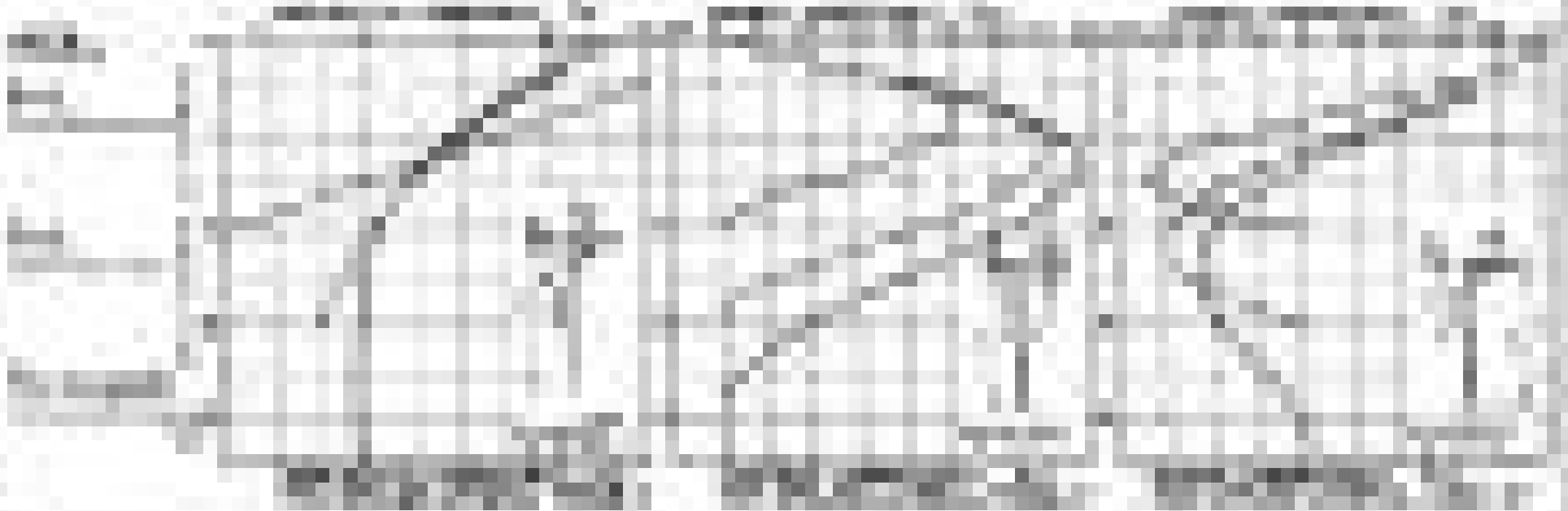
CASE 1 : FLEXIBLE CAP OR HINGED END CONDITION



Period 1 to 10

Value 0 to 10

Line 1



Period 1 to 10

Value 0 to 10

Line 2

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

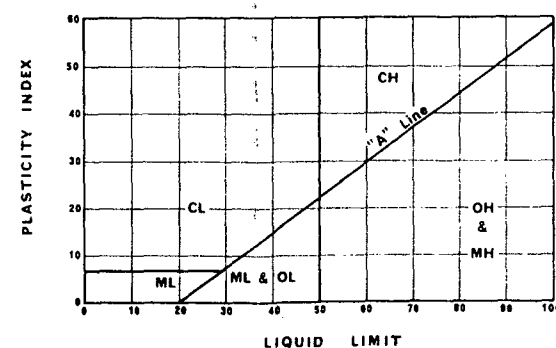
| | | |
|------------|---|---|
| Very Soft | - | squeezes between fingers |
| Soft | - | easily moulded by fingers |
| Firm | - | moulded by strong finger pressure |
| Stiff | - | dented |
| Very Stiff | - | dented only slightly by finger pressure |
| Hard | - | dented only slightly by pencil point.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

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. |
| Slipside | Smooth, polished sometimes striated planar structures resulting from insitu movement. |

| MAJOR DIVISIONS | SYMBOL | TYPICAL NAMES |
|---|-----------|---|
| COARSE GRAINED SOILS (More than 1/2 of soil > 0.06 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. |
| | SW | Well graded sands or gravelly sands, little or no fines. |
| | SP | Poorly graded sands or gravelly sands, little or no fines. |
| FINE GRAINED SOILS (More than 1/2 of soil < 0.06 mm) | SM | Silty sands, sand-silt mixtures. |
| | SC | Clayey sands, sand-clay mixtures. |
| | ML | Inorganic silts and very fine 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. |
| | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. |
| HIGHLY ORGANIC SOIL | CH | Inorganic clays of high plasticity, fat clays. |
| | OH | Organic clays of medium to high plasticity, organic silty clays, organic silts. |
| | Pt | Peat and other highly organic soils. |

DEFINITIONS OF DESCRIPTIVE TERMS

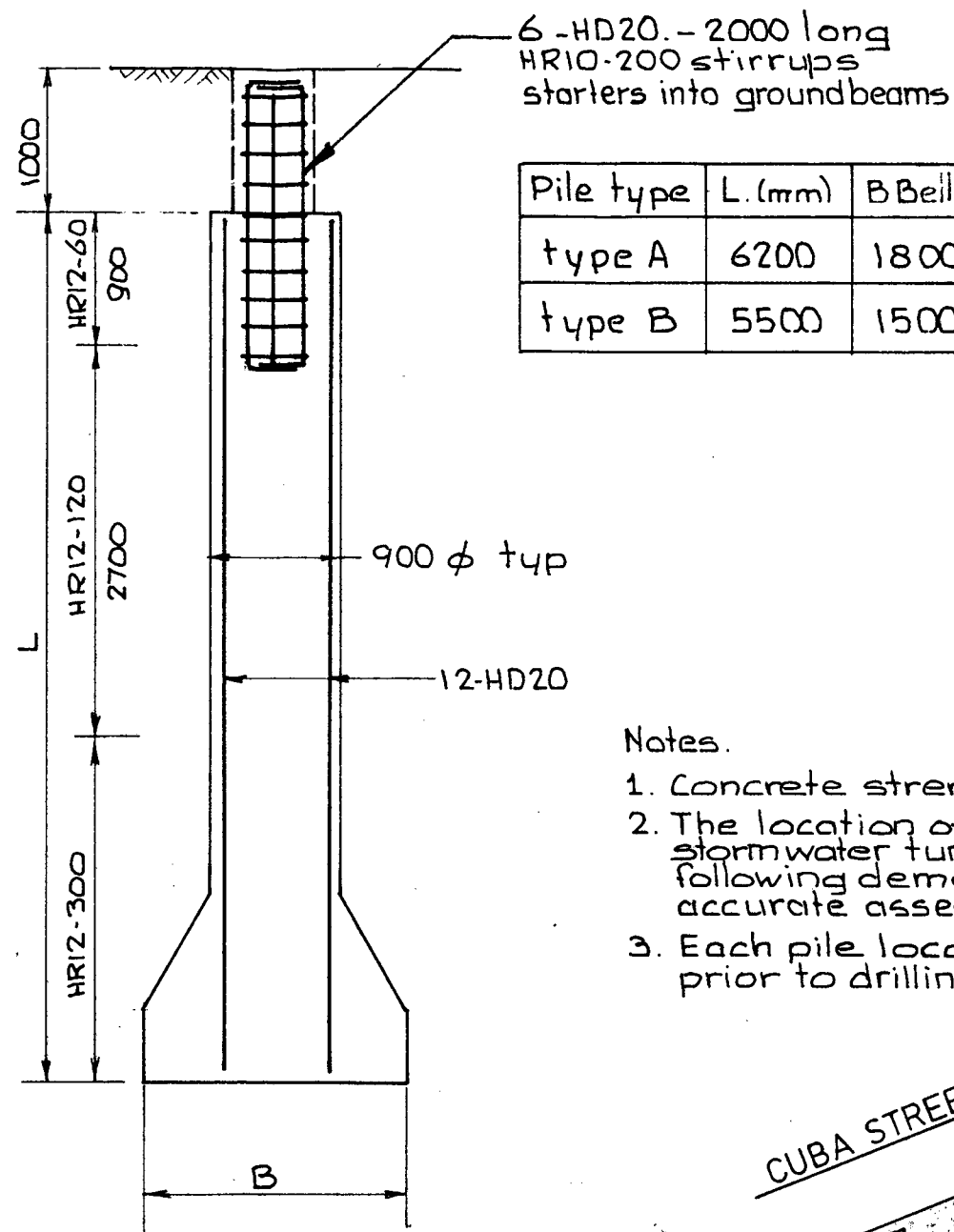
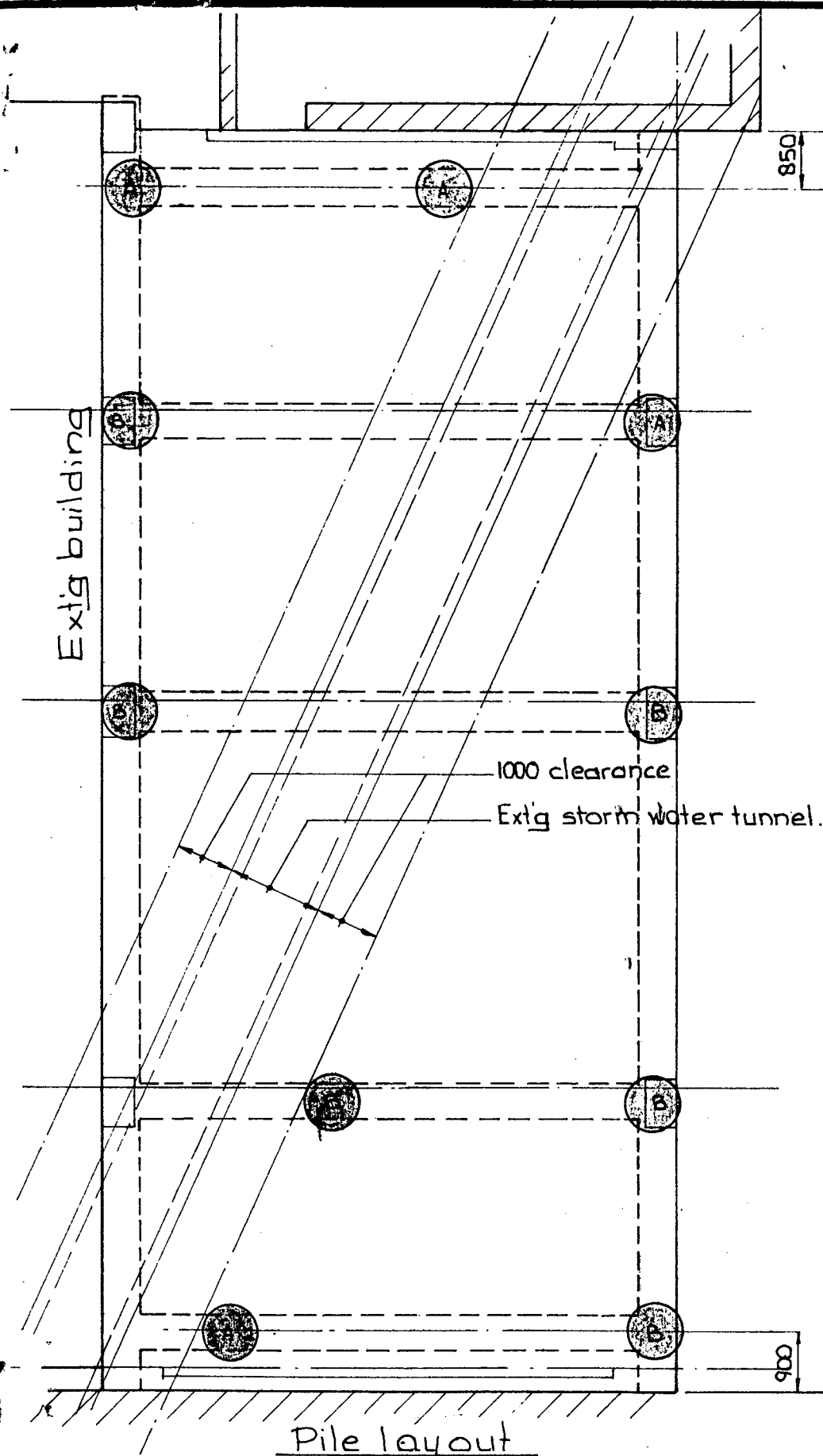


PLASTICITY CHART

CLASSIFICATION CHART

(Unified Soil Classification System)

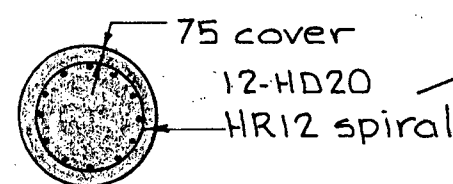
METHOD OF
SOIL CLASSIFICATION



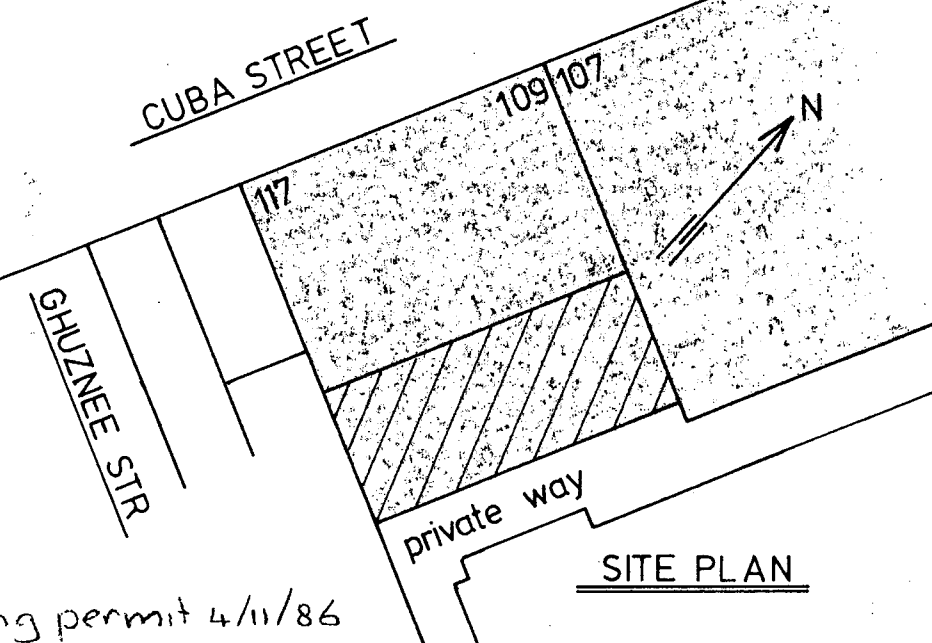
| Pile type | L. (mm) | B Bell ϕ |
|-----------|---------|---------------|
| type A | 6200 | 1800 |
| type B | 5500 | 1500 |

Notes.

1. Concrete strength to be 25 MPa @ 28 days
2. The location of the piles adjacent to the storm water 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.



Typ pile section
All piles 900 ϕ



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.

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Wellington.
Ph 739-175, PO Box 10-153

Provisional piling

SCALE 1:100 1:50

DATE Oct '86.

DRAWN JL

TRACED

DWG No

CHECKED

APPROVED *MD*

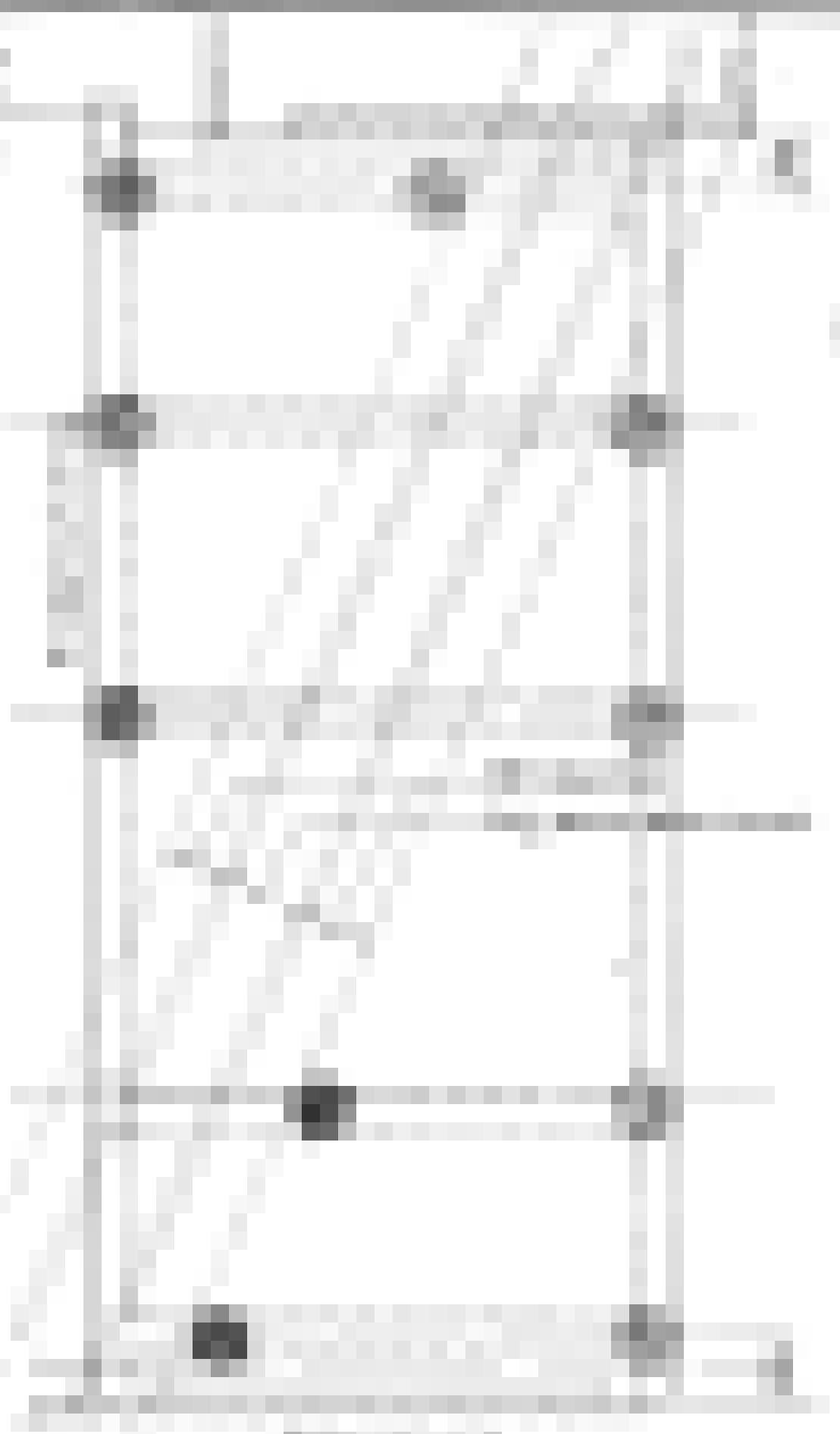
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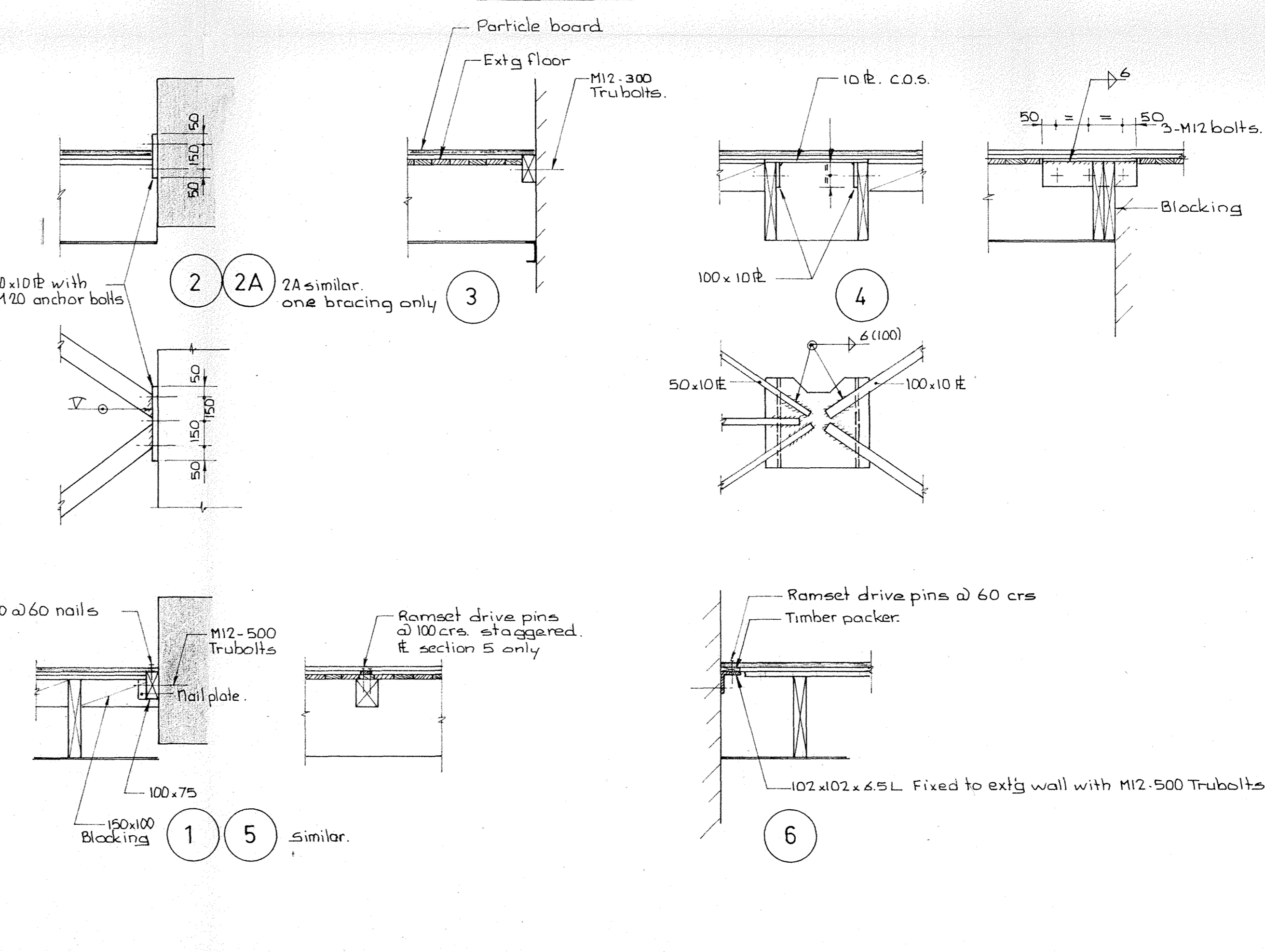
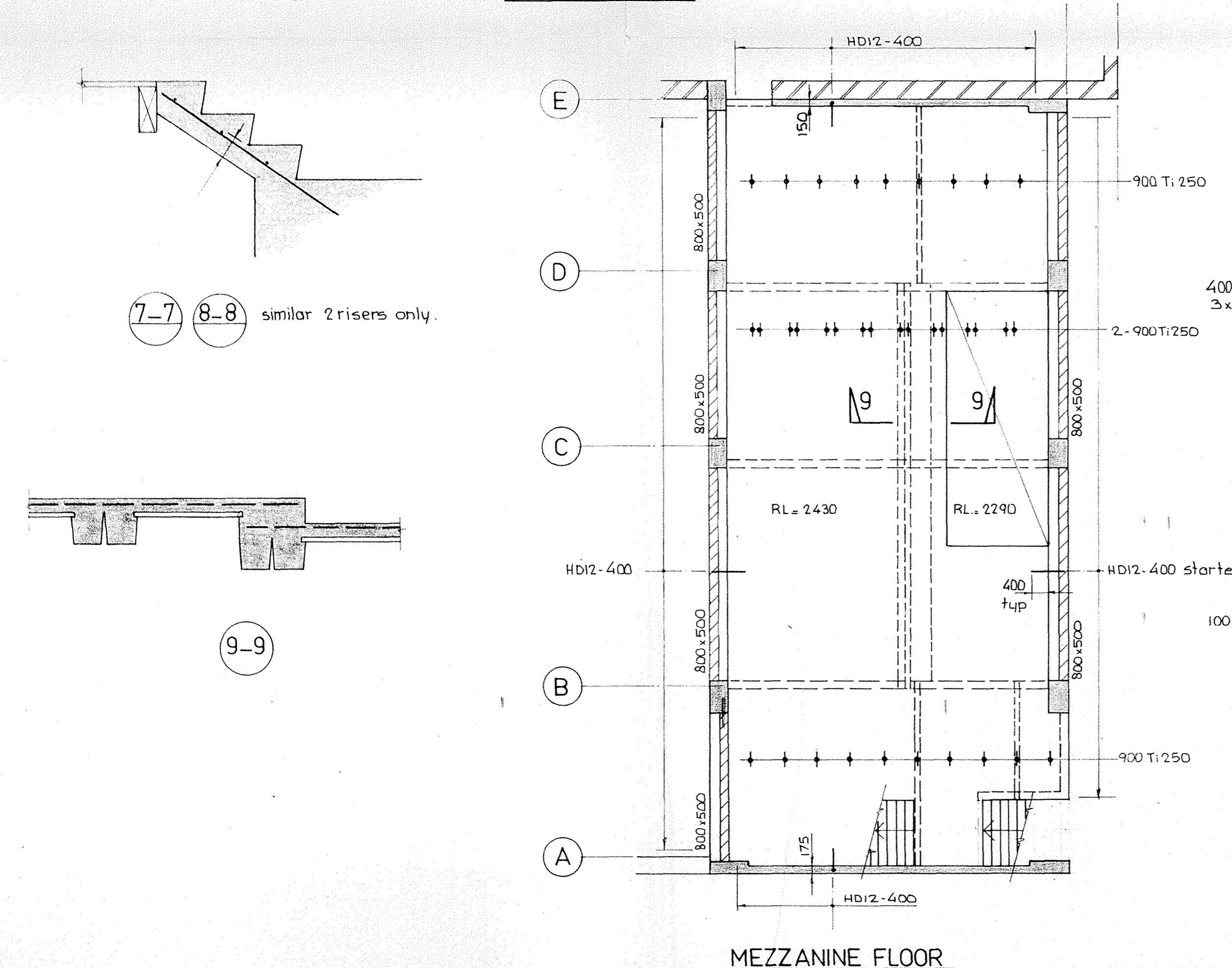
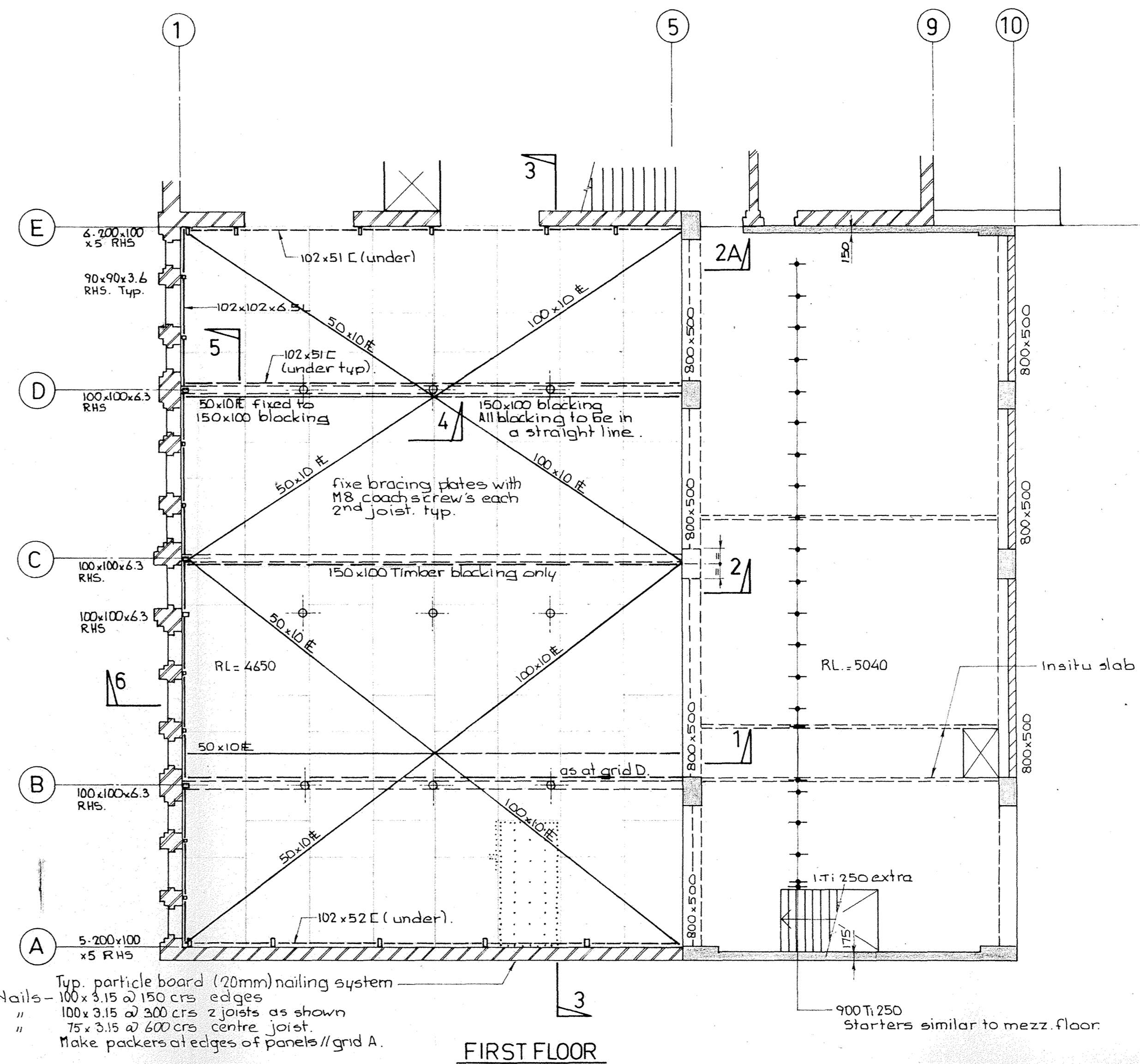
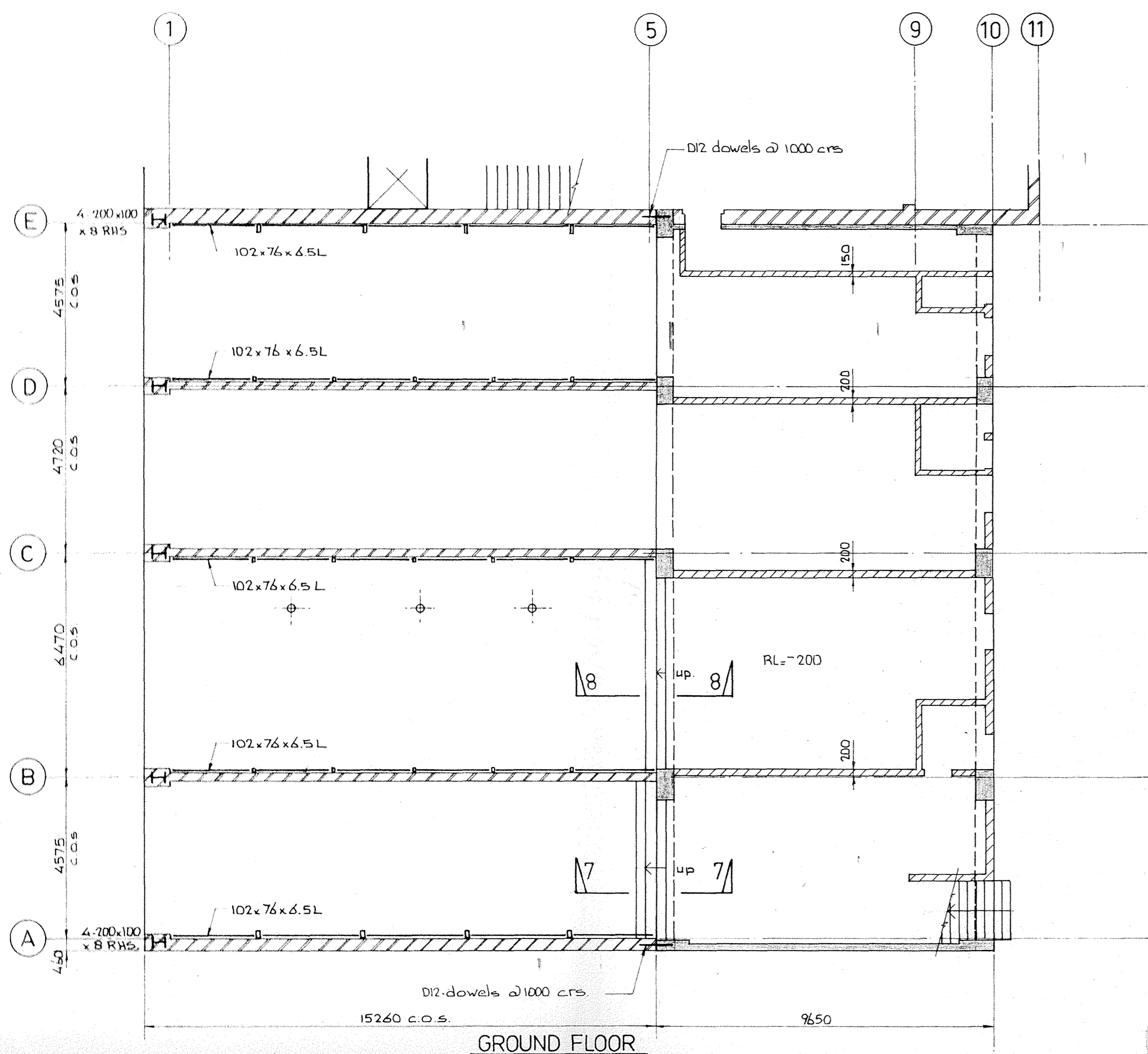
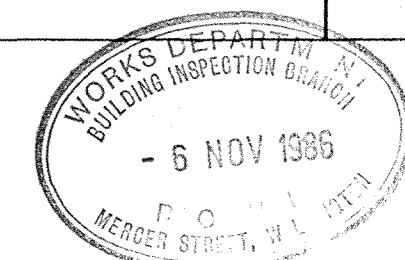
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| DATE Nov '86 | |

