REPORT OF THE ROYAL COMMISSION to inquire into and report upon the CAUSE OF THE ACCIDENT which occurred to the SCAFFOLDING on the D.I.C. BUILDING on 8 MAY 1957

Presented to the House of Representatives by Command of His Excellency

BY AUTHORITY:
R. E. OWEN, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1957

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Royal Commission to Inquire Into the D.I.C. Scaffolding Accident

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ELIZABETH THE SECOND, by the Grace of God of the United Kingdom, New Zealand and Her Other Realms and Territories Queen, Head of the Commonwealth, Defender of the Faith:

To Our Trusty and Well-beloved the Honourable SIR ARTHUR TYNDALL, K.T., C.M.G., of Wellington, Judge of the Court of Arbitration; CONRAD WILSON HAMANN, A.C.S.E., M.I.C.E., M.I.STRUCT.E., of Christchurch, Consulting Engineer; and DONALD STUART GORE MARCHBANKS, M.I.C.E., M.N.Z.I.E., of Wellington, Chief Engineer to the Wellington Harbour Board:

WHEREAS it is deemed expedient that inquiry should be made into the cause of the accident which occurred to the scaffolding on the D.I.C. Building in Wellington on 8 May 1957, and matters incidental thereto:

Now know ye, that We, reposing trust and confidence in your integrity, knowledge, and ability, hereby appoint you, the said

SIR ARTHUR TYNDALL,
CONRAD WILSON HAMANN, and
DONALD STUART GORE MARCHBANKS

to be a Commission to inquire into and report upon the following matters:

(a) The cause of the accident;

(b) The type and structure of the scaffolding used, and its suitability for the class of work for which it was erected, having particular regard to the safety of the workers and the public, and whether it complied with all existing statutes and regulations relating thereto;

(c) The competence of the persons responsible for the erection and dismantling of the scaffolding;

(d) The efficiency and adequacy of the inspection of the scaffolding by the person or persons responsible for that inspection;

(e) The administration of the Scaffolding and Excavation Act 1922 and of the regulations made under that Act;

(f) Suggestions for the prevention as far as possible of similar accidents in the future;

and generally to inquire into and report upon such other matters arising thereout as may come to your notice in the course of the inquiry and which you consider should be investigated, and to report upon any matters related to the accident or the inquiry which you consider should be brought to the attention of the Government, and in particular to report your opinion whether any additional legislation is necessary and, if so, the scope of the same, and whether the regulations included in the existing law provide for reasonable and proper safeguards against similar accidents, or whether any amendments or additions to them are required:

And We hereby appoint you, the said

SIR ARTHUR TYNDALL

to be the Chairman of the Commission:

And for the better enabling you to carry these presents into effect you are hereby authorised and empowered to make and conduct any inquiry under these presents at such time and place as you deem expedient, with power to adjourn from time to time and from place to

place as you think fit, and so that these presents shall continue in force and the inquiry may at any time and place be resumed although not regularly adjourned from time to time or from place to place:

And you are hereby strictly charged and directed that you shall not at any time publish or otherwise disclose save to His Excellency the Governor-General, in pursuance of these presents or by His Excellency's direction, the contents of any report so made or to be made by you, or any evidence or information obtained by you in the exercise of the powers hereby conferred upon you, except such evidence or information as is received in the course of a sitting open to the public:

And it is hereby declared that the powers hereby conferred shall be exercisable notwithstanding the absence at any time of any one of the members hereby appointed so long as the Chairman, or a member deputed by the Chairman to act in his stead, and one other member are present and concur in the exercise of the powers:

And we further ordain that you have liberty to report your proceedings and findings under this Our Commission from time to time if you shall judge it expedient so to do:

And, using all due diligence, you are required to report to His Excellency the Governor-General in writing under your hands and seals not later than the 30th day of September 1957, your findings and opinions on the matters aforesaid, together with such recommendations as you think fit to make in respect thereof:

And, lastly, it is hereby declared that these presents are issued under the authority of the Letters Patent of His late Majesty King George the Fifth dated the 11th day of May 1917, and under the authority of and subject to the provisions of the Commissions of Inquiry Act 1908, and by and with the advice and consent of the Executive Council of New Zealand.

In witness whereof We have caused this Our Commission to be issued and the Seal of New Zealand to be hereunto affixed at Wellington this 15th day of May 1957.

Witness Our Trusty and Well-beloved Sir Charles Willoughby Moke Norrie, Knight Grand Cross of Our Most Distinguished Order of Saint Michael and Saint George, Knight Grand Cross of Our Royal Victorian Order, Companion of Our Most Honourable Order of the Bath, Companion of Our Distinguished Service Order, upon whom has been conferred Our Decoration of the Military Cross and Bar, Lieutenant-General on the retired list of Our Army, Governor-General and Commander-in-Chief in and over New Zealand, acting by and with the advice and consent of the Executive Council of New Zealand.

C. W. M. NORRIE, Governor-General.

By His Excellency's Command—

J. R. MARSHALL, For the Minister of Labour.

Approved in Council—

[L.S.] T. J. SHERRARD, Clerk of the Executive Council.

Royal Commission to Inquire Into and Report Upon the Cause of the Accident Which Occurred to the Scaffolding on the D.I.C. Building on 8 May 1957

TO HIS EXCELLENCY THE GOVERNOR-GENERAL OF NEW ZEALAND:

MAY IT PLEASE YOUR EXCELLENCY,—

We, the undersigned Commissioners appointed by Warrant dated the 15th day of May 1957, have the honour to present to Your Excellency our report under the following terms of reference stated in that Warrant:

(a) The cause of the accident;

(b) The type and structure of the scaffolding used, and its suitability for the class of work for which it was erected, having particular regard to the safety of the workers and the public, and whether it complied with all existing statutes and regulations relating thereto;

(c) The competence of the persons responsible for the erection and dismantling of the scaffolding;

(d) The efficiency and adequacy of the inspection of the scaffolding by the person or persons responsible for that inspection;

(e) The administration of the Scaffolding and Excavation Act 1922 and of the regulations made under that Act;

(f) Suggestions for the prevention as far as possible of similar accidents in the future;

and generally to inquire into and report upon such other matters arising thereout as may come to your notice in the course of the inquiry and which you consider should be investigated, and to report upon any matters related to the accident or the inquiry which you consider should be brought to the attention of the Government, and in particular to report your opinion whether any additional legislation is necessary and, if so, the scope of the same, and whether the regulations included in the existing law provide for reasonable and proper safeguards against similar accidents, or whether any amendments or additions to them are required.

We have the honour to be,

Your Excellency's most obedient servants,

A. TYNDALL, Chairman.

C. W. HAMANN, Member.

D. S. G. MARCHBANKS, Member.

Dated at Wellington this 25th day of September 1957.

THE INQUIRY

1. By advertisement in the press, all persons who desired to give evidence at the inquiry were invited to communicate with the secretary, and did so.

2. A preliminary sitting was held in the Arbitration Court at Wellington on 4 June 1957 when counsel, agents, and interested parties met the Commission. It was decided that the inquiry should be conducted in two parts, which were referred to during the hearing as Division I and Division II.

3. Division I embraced matters (a), (b), (c), and (d) of the order of reference since they appeared to relate specifically to the D.I.C. scaffolding collapse.

4. Division II comprises references (e) and (f) and other general matters mentioned in the order of reference. These were considered to be of wider scope than the matters to be dealt with in Division I, and several counsel asked that they be excused from attendance before the Commission while evidence on these matters was being taken. During the sittings of the Commission, therefore, evidence and submissions were heard on each division separately; but because our subsequent deliberations have indicated a greater relevance of reference (e) to Division I than to Division II, we have grouped our observations on (e), in this report, with those on (a), (b), (c), and (d) of the order of reference.

5. Arrangements were made for public sittings to commence in Wellington on 17 June 1957, and these sittings terminated on 27 August 1957. During this period the Commission sat on thirty-nine days.

6. The following counsel and agents represented the several interested parties:

For Division I:

Mr W. R. Birks and Mr H. G. Duncan for the Department of Labour.
Mr E. D. Blundell and Mr I. L. Mackay for Certified Concrete Ltd.
Mr G. C. Kent and Mr G. C. Thornton for Mr C. H. Hensley, Scaffolding Inspector.
Mr D. W. Virtue, Mr L. G. Rose, and Mr G. S. Orr for Steel and Moss Ltd.
Mr N. A. Morrison and Mr B. R. Boon for D.I.C. Ltd.
Mr A. B. Thomson for the Wellington City Corporation.
Mr W. M. Sommerville for the New Zealand Master Builders' Federation.
Mr P. M. Butler for the New Zealand Federation of Labour.
Mr W. G. Molineux for the:
New Zealand (Except Otago and Southland) Carpenters and Joiners and Joiners' Machinists Industrial Union of Workers;
New Zealand (Except Otago and Southland) Plasterers and Related Trades Industrial Union of Workers; and
New Zealand (Except Northern Industrial District) Bricklayers and Related Trades Industrial Union of Workers.
Mr J. H. Thompson for the New Zealand Plumbers, Gasfitters, and Related Trades Industrial Union of Workers.
Mr R. Adams for the Wellington Amalgamated Society of Painters, Decorators, Display and Poster Artists Industrial Union of Workers.

For Division II:

Mr W. R. Birks and Mr H. G. Duncan for the Department of Labour.

Mr I. L. Mackay for Certified Concrete Ltd.

Mr S. G. Stephenson for the New Zealand Master Builders' Federation.

Mr P. M. Butler for the New Zealand Federation of Labour.

Mr W. G. Molineux for the:

New Zealand (Except Otago and Southland) Carpenters and Joiners and Joiners' Machinists Industrial Union of Workers;

New Zealand (Except Otago and Southland) Plasterers and Related Trades Industrial Union of Workers; and

New Zealand (Except Northern Industrial District) Bricklayers and Related Trades Industrial Union of Workers.

Mr R. Adams for the Wellington Amalgamated Society of Painters, Decorators, Display and Poster Artists Industrial Union of Workers.

7. Fifty-five witnesses, as detailed in the Appendix attached hereto and marked A, were called and examined. In addition, correspondence from citizens was received and considered.

8. Exhibits which were produced are detailed in Appendix B.

9. Depositions of the various witnesses, together with a record of formal submissions and addresses by counsel and other representatives, are recorded in the bound volumes No. 1 to No. 10 and the volume of submissions accompanying this report. The record of proceedings totals 3,240 pages.

Glossary of Terms

10. For the purposes of this report we have deemed it advisable in the interests of clarity to incorporate, as Appendix C, a glossary of terms which are used in the findings and in the technical comments.

11. We wish to state also that, in framing this report, we have treated the whole of the scaffolding on the Lambton Quay frontage of the D.I.C. building as one structure. We have done this because of the importance claimed by Certified Concrete Ltd. for the ties or anchorages which linked the structure with the two central columns of the building, and the reliance placed by the firm upon them to ensure stability and rigidity of the scaffolding as a whole, it being contended that the anchorages constituted effective and efficient substitutes for the more usual forms of diagonal bracing.

12. From time to time, therefore, we refer to the scaffolding at the date of the collapse as a partially dismantled structure for the reasons that the number of decks at the northern portion had been reduced, and that the longitudinal bracing effect on the upper section of the southern portion had been eliminated by the corresponding dismantling of some of the central anchorages – whatever their value may have been.

NARRATIVE OF EVENTS

The Disaster

13. On the afternoon of 8 May 1957, at about 2.35 p.m., part of a tubular steel scaffolding erected on a verandah of the D.I.C. Building, Lambton Quay, Wellington, collapsed on to the footpath and street. It was tragic enough that two people were killed and some nine injured,

but it was fortunate that the mishap occurred at the time it did as this building is situated in one of the main shopping areas which is normally crowded during the lunch-hour period and again later by afternoon shoppers.

14. Some bystanders in Lambton Quay commented that, when the scaffold collapsed, the sound was similar to that of a jet engine. As the superstructure crumbled, people ran from beneath the verandah, and as the tangled mass descended, some workmen were seen to be riding down with it, whilst others ran along platforms to safety on that part of the scaffold which did not fall. There was a rush of bystanders to help those of the injured who were immediately accessible and to search for others amongst the debris. In a short space of time ambulances and police were on the scene, a mobile crane and a fork lift were mustered and put to work; and the search for the injured completed as the debris was cleared away with the assistance of many voluntary workers.

D.I.C. Building

15. The D.I.C. Building is a large departmental store, varying from three to seven storeys in height. It extends from Brandon Street to Panama Street in Lambton Quay and has frontages on all three streets. It is right in the heart of the city of Wellington on a very busy thoroughfare. A site plan is shown in drawing No. 1, Appendix D.

16. The higher portion of the building, including the whole of the Lambton Quay frontage, is a steel-framed structure with reinforced concrete floors and walls, which was added to an older structure and opened for business in February 1929. The two bottom floors are used for a retail store and the upper floors for offices. There is a verandah of suspended type extending fully round the three frontages of the building on Brandon Street, Lambton Quay, and Panama Street. A front elevation of the D.I.C. Building, showing the scaffold in the state in which it stood at the time of the disaster, is shown in drawing No. 2, Appendix E.

Purpose of Scaffold

17. The D.I.C. Ltd. had, through its architect, arranged for the firm of Steel and Moss Ltd. to carry out general maintenance work on the face of the building. This consisted of the removal of the scroll work at the tops of the fluted piers, repairs to the flashing of the roof and to the parapets, and repairs to copper plaques, etc. The contractor had also to stop up cracks in the plaster face of the building and perform a number of other minor services.

18. The scaffolding was erected by Certified Concrete Ltd. under contract with Steel and Moss Ltd. Certified Concrete Ltd. is a firm which engages in the hire and erection of tubular steel scaffolding.

19. The D.I.C. Ltd. took advantage of the erected scaffold to arrange a separate contract with the firm of W. H. Firth and Co. Ltd. for the painting of the steel frames of the windows. Steel and Moss Ltd. let subcontracts for the plastering and glazing.

20. In discussions between Steel and Moss Ltd. and Certified Concrete Ltd. it was agreed that a light maintenance type scaffold should be provided. It was also decided that, because of the nature of the work, the erection, servicing, and dismantling of the scaffolding was to be

carried out in progressive stages, and the provision of scaffolding was to be kept ahead of the maintenance work being performed by Steel and Moss Ltd.

21. It was further agreed between the two firms that Steel and Moss Ltd. would provide the planks for the scaffold and the anchors or strongbacks for the ties which were to be installed to hold the scaffold to the building, and that Certified Concrete Ltd., would provide the sole plates on which the scaffold was to be supported. At an early stage in the contract for the erection of the scaffolding the practice developed for Steel and Moss' workmen not only to place the strongbacks, but also to tie the tubular framework of the scaffold to them at points indicated by the scaffolders. It was stated in evidence that the scaffolders made a visual inspection of all ties so installed.

Statutory Notice to Inspector

22. Section 5 of the Scaffolding and Excavation Act 1922 provides that no person shall begin the erection of any scaffolding without having first notified the inspector of scaffolding of the time he intends to begin such work. Certified Concrete Ltd. gave notice in writing on 12 October 1956 to the Wellington District Office of the Department of Labour of its intention to erect scaffolding on the D.I.C. Building. This notice was received by the District Office on 15 October 1956, and was acknowledged on the same day. Later, but prior to the actual erection of the scaffold, the senior inspector of scaffolding of the Wellington District Office, Mr C. H. Hensley, had discussions with Mr E. H. Turksma, the Wellington works manager of Certified Concrete Ltd., who dealt with all scaffolding matters on behalf of that firm. During these discussions it was agreed that the width of the scaffold should be reduced from the permissible maximum of 5 ft. to 3 ft. We understand that the reduction was arranged in consideration of the fact that the scaffold was being erected on a verandah.

Sequence of Erection

23. As already mentioned, the scaffolding was erected in progressive stages, the first section being set up on the three-storey part of the D.I.C. Building in Brandon Street. This was started on 17 October 1956 and completed on 19 October 1956. The scaffolding of the remaining higher portion of the building in Brandon Street was carried out during the period from 5 to 23 November 1956. This section of scaffold was about 140 ft. long and comprised thirteen decks, the standards being placed at intervals of approximately 9 ft.

24. About this time the D.I.C. Ltd. took advantage of the fact that scaffolding materials were available to have a frame erected over the main entrance to the building in Lambton Quay for the purpose of supporting Christmas decorations. This scaffolding was three decks high, and was erected on 28 and 29 November 1956. It was later incorporated as part of the scaffolding which extended over the whole of the Lambton Quay frontage.

25. The scaffold on the three-storey portion of the building in Brandon Street was dismantled on 18 December 1956. Some of the dismantled material from this scaffold was stacked on the verandah itself, and some was taken away. The evidence given by different witnesses concerning the amount stacked and the amount removed was very conflicting.

26. The remainder of the scaffolding materials from the three-storey portion of the building in Brandon Street was used to erect the splay at the corner of Lambton Quay and Brandon Street, and to connect the splay with the portion of scaffold previously erected above the dome in Lambton Quay for carrying the Christmas decorations.

27. The dismantling of the higher section of the scaffolding on the Brandon Street frontage was carried out on 11, 12, 18, and 28 February 1957 and on 1, 5, 12, 13, and 14 March 1957. On 13 February 1957 further erection on the Lambton Quay face of the building was commenced, and was continued on 14, 18, and 28 February and on 1, 6, 12, 13, 19, 25, and 26 March. The completed scaffold was approximately 172 ft. long and 84 ft. high, and it had thirteen decks.

28. The scaffold on the Lambton Quay frontage was assembled from material transferred from the Brandon Street frontage, supplemented by additional material brought on to the job. Some of the dismantled material had been temporarily stacked on that portion of the scaffold in Brandon Street which remained standing, but again the evidence as to the quantity so stacked was very conflicting.

29. The evidence indicates that, between 3 and 16 April, deck 13 on the northern portion of the Lambton Quay scaffold was dismantled and the material used to complete deck 13 on the central portion, while yet later it was again transferred to complete deck 13 on the southern portion. The critical phase in the dismantling and stacking of dismantled materials, which culminated in the collapse, commenced on Monday, 6 May 1957. By this time most of the maintenance work on the Lambton Quay face of the building, except for some painting and other minor work in the last two panels of the southern portion, was completed, and the erection of scaffolding was about to commence on the Panama Street face of the building.

30. The original intention was to dismantle each upper deck of the northern and central portions of the scaffold, some twelve bays in all, and progressively stack the materials from at least the nine upper decks in the southernmost two bays of the remaining southern portion. However, because maintenance workers were still working on the last two bays of that portion, the material was stacked in the fourth and fifth bays from the southern end.

31. On Monday, 6 May, part of deck 12, decks 11, 10, and 10A (a short intermediate deck erected for a special purpose) of the northern and central portions were dismantled and stacked on decks 11, 10, and 9 of the southern portion. On Tuesday afternoon, deck 9, and on the morning of Wednesday, 8 May, decks 8, 7, and 6 were correspondingly dealt with. After lunch on Wednesday two scaffolders working from deck 4 were dismantling deck 5, and at approximately 2.35 p.m. the scaffolding and three panels of the verandah beneath the portion loaded with dismantled materials collapsed.

Workmen on Scaffold at Time of Collapse

32. At the time of the collapse there were seven persons working on the scaffold: two scaffolders employed by Certified Concrete Ltd.; three maintenance workers employed by Steel and Moss Ltd.; and two painting apprentices employed by W. H. Firth and Co. Ltd.

33. As mentioned above, the two scaffolders, Messrs J. R. W. Kristensen and J. Nutter, were standing on deck 4, dismantling deck 5. Kristensen was immediately south of the dome at or close to the southernmost fluted central column, while Nutter, who was removing planks from deck 5 and laying them on deck 4, was working by standard number 13 which was opposite the second plain pier to the north of the main Lambton Quay entrance to the building.

34. The three employees of Steel and Moss Ltd. were engaged on the final cleaning of the southern portion of the face of the building at deck 5. Mr B. C. Moss, junior, was cleaning the southernmost fluted pier from a plank on cantilevered putlogs between the building and the inner ledger, while Mr R. Hawkins was cleaning the southernmost plain pier near standard number 2. Mr K. I. McLeod was in the process of climbing the scaffold to start work. He had reached the first deck between standards number 4 and number 5 and, at the time of the collapse, had placed his hand on the ledger above preparatory to climbing further up the scaffold.

35. The two painting apprentices employed by W. H. Firth and Co. Ltd., Messrs R. R. Houston and L. C. Goodall, were both working on deck 10 painting the metal window frames. Goodall was painting the lower frames of the third set of windows from the southern end of the Lambton Quay face near standard number 6 at the fifth floor of the building, and Houston appears to have been doing similar work at a point further south.

DIVISION I

ORDER OF REFERENCE (a): The cause of the accident.

36. We find that the cause of the accident was the collapse of a portion of the scaffolding due to serious overloading imposed on two of its bays. In addition to the weight of the structure itself and the normal loading involved in the continued use of the scaffolding by workers engaged on maintenance work, the two bays in question were called upon to carry an additional load aggregating about 8 tons. This additional load consisted of scaffolding materials that had been dismantled from their former position on the northern and central portions of the Lambton Quay face of the D.I.C. Building. These materials, comprising steel tubes and fittings, in the main had been stacked on seven decks of two bays in the remaining southern portion of the scaffolding. The intention of the scaffolders had been that the dismantled materials should later be carried round the corner of the building, and reassembled at their corresponding levels to form a scaffolding on the Panama Street face.

37. Although the scaffolding contractor, Certified Concrete Ltd., freely admitted that it had stacked the dismantled materials (originally stated by the contractor to weigh 6·4 tons) in the manner described above, and that this extra load had caused the collapse, it was argued on its behalf that the suspended verandah on which the scaffolding had been erected had been structurally defective. The company contended further that, had the verandah not been defective, the collapse would not have occurred in spite of the overload.

38. It does not appear to us that the verandah was structurally of a standard lower than could reasonably have been expected. On the evidence placed before us, much of which was of a conflicting nature, it is impossible to determine the precise nature of the collapse, and the exact sequence of the several things that happened from the moment the collapse started until the scaffold and verandah had come to rest.

39. In view of the admission of the scaffolding contractor, subsequently confirmed by evidence, that overloading with dismantled materials caused the collapse, it would seem that, so far as question (a) of the order of reference is concerned, little importance should be attached to the issue as to whether the scaffold or the verandah gave way first. Nevertheless, as some of the parties devoted a great deal of time and attention during the hearings to this matter, we deem it incumbent upon us to record our own conclusions.

40. In reaching these conclusions we have been disposed in general to give more weight to the convincing evidence of certain eye witnesses of the mishap than to theoretical reconstruction of what may have happened, such reconstruction being based in some instances upon evidence less comprehensive than that which ultimately was made available to the commission.

41. In our opinion, the evidence of eye witnesses on balance supports the proposition that initial collapse occurred in the framework of the tubular scaffolding, and that the collapse of the verandah was the inevitable consequence of the impact of the falling scaffolding upon it.

42. At the same time we cannot escape the conclusion that the overload had caused some elastic deflection or other yielding of the oregon joists of the verandah, and that this movement may have aggravated the conditions which we think led to the collapse. On the other hand we do not accept the theory that the oregon joists carrying the main load of the scaffolding collapsed by being pushed down past the flanges of the rolled steel joists which supported them, or that a standard of the scaffold punctured the verandah. We believe that the scaffolding itself was in a highly unstable condition, and that the first major failure was the buckling of the heavily loaded and poorly restrained standards. This allowed the crumbling framework of the scaffolding to drop down, subjecting the hangers supporting the steel joists of the verandah to impact which in turn caused the wrought-iron bolts connecting the hangers to the verandah joists to fail. Three panels of the verandah then collapsed to the pavement.

43. We find nothing in the behaviour of the verandah which is inconsistent with its original design and construction; in other words it was adequate in strength to carry any loading which it would normally have been expected to carry. Its condition at the time of collapse was, for all reasonable and practical purposes, sound.

44. So far as the scaffold itself is concerned, we find that, in the zone in which the extra loading had been placed, the tubular steel standards (columns) of the scaffold had been meagrely braced against buckling. There was a deal of evidence from eye witnesses that failure had seemed to start in the scaffolding itself in the zone just referred to; two workmen engaged on the scaffolding at the time of the mishap testified to seeing standards buckle at a very early stage. It is impossible that the critical standards could have buckled if their support, i.e., the verandah, had previously given way, because without the resistance of the verandah there could have been no forces in the standards to cause buckling.

45. We consider that the magnitude of the loads on, and the laterally unsupported lengths of, the critical standards were such as to be in accord with the submission that buckling in those standards initiated collapse. In brief, we consider that the scaffold failed first of all and that its failure caused, and was followed by, the general collapse of the verandah, although we also consider that the deflection or other yielding of the timber joists of the verandah which were stressed well beyond their safe limit possibly did trigger the initial failure of the standards.

ORDER OF REFERENCE (b): The type and structure of the scaffolding used, and its suitability for the class of work for which it was erected, having particular regard to the safety of the workers and the public, and whether it complied with all existing statutes and regulations relating thereto.

Type, Structure, and Suitability of Scaffolding

46. The scaffolding was erected of steel tubular members, most of which were of the close jointed or split type, while some were seamless. The tubes were of varying age and condition. The different fittings used for coupling the tubular members were of several types manufactured of steel by the London and Midland Steel Scaffolding Co. Ltd. and known under the generic proprietary name of "Burton's Patent".

47. Subject to later qualifying comment, we consider that the type and standard of the scaffolding as originally erected was suitable for the class of maintenance work for which it was intended. Prior to 6 May 1957 the structure was reasonably adequate and safe for the loads which it was called upon to bear, although its factor of safety would have been somewhat greater if certain requirements had been more carefully observed.

48. At the time of the collapse on 8 May 1957 the scaffolding was being dismantled, but a portion was still being used at the southern end by painters and other workers engaged on maintenance work. Apart from the heavy additional loading of dismantled scaffolding, the structure at the southern end on 8 May was, to some extent, less stable than it was prior to 6 May, mainly because of the removal above the fifth deck of the anchorages – whatever their value may have been – at the central columns of the D.I.C. Building. But we do not think that this reduction in stability was sufficient to cause collapse of the structure under the use to which it had been put or was being put by maintenance workers alone.

Compliance of the Scaffolding with Existing Statutes and Regulations Relating Thereto

49. The remainder of the partially dismantled scaffolding was a framework being used for the support of workmen engaged in building work, and was therefore scaffolding within the meaning of the Scaffolding and Excavation Act 1922. It was being dismantled and simultaneously it was being used by maintenance workers. There is no specific reference in the Act to the dismantling of scaffolding, and it would appear that, if the framework had not been supporting maintenance workers on 8 May 1957, the scaffolding and the dismantling operations of the scaffolders would not have been covered by the statute.

50. We are asked whether the scaffolding itself complied with all existing statutes and regulations relating thereto. Submissions made to us did not indicate that there is any statute relating to scaffolding other than the Scaffolding and Excavation Act 1922. We cannot discover in this statute any requirements with which a scaffolding as a structure must comply. It seems to be contemplated by section 17 of the Act that such requirements should be prescribed by regulations. The Scaffolding Regulations 1935 (Serial No. 1952/70), in dealing with scaffolding in particular, however, prescribe requirements for scaffolding erected of timber only, and therefore do not relate to scaffolding erected of steel tubular members.

51. No other regulations relating to such structures have been brought to our notice, consequently the question of whether the scaffolding as a structure complied with existing statutes and regulations does not arise.

Footnote: It is true the Department of Labour had issued directives to its inspectors on the matter of metal scaffolding; but it would appear that they were neither mandatory nor legally enforceable. Moreover, the directives were incomplete and in some important respects ambiguous. The D.I.C. scaffold complied in main principles with the requirements of one or other of the two directives, but there were departures in respect of some important details.

ORDER OF REFERENCE (c): The competence of the persons responsible for the erection and dismantling of the scaffolding.

52. Certified Concrete Ltd. was responsible for the erection and dismantling of the scaffold. Within the organisation there were persons with ample professional knowledge and ability, and also practical scaffolders of adequate skill and experience who could, and should, have formed a composite staff fully competent to erect, maintain, and dismantle the scaffolding with complete safety to the workers and the public.

53. The internal administration of the company, however, was at fault in that the professional and manual skills available were not combined or co-ordinated, and the allocation of responsibility amongst the members of the staff most directly associated with the scaffolding was not clearly defined or understood by them.

54. We have found that the primary cause of the collapse of the scaffolding was the serious overloading of portion of the structure with dismantled scaffolding materials.

55. While the stacking of such materials on the scaffold was authorised by a responsible officer of the company, no specific directions were given to the scaffolders as to the maximum quantities that should be so stacked or the distribution of the materials. These vital questions were wrongly left to the judgment of the scaffolders, who were definitely not competent by virtue either of their knowledge or their experience to accept such a responsibility. Further, the evidence has led us to form the opinion that the responsible officer who authorised the stacking of the dismantled material, a practice by the way claimed by the company to be normal procedure in its scaffolding operations, did not appreciate the cumulative weights of the dismantled materials involved, the effects of the loading of those materials on limited areas of the partially dismantled scaffolding, or its safe carrying capacity.

56. We would add that the scaffolders were remunerated on a piecework basis, and we consider that the supervision of their operations was gravely inadequate.

ORDER OF REFERENCE (d): The efficiency and adequacy of the inspection of the scaffolding by the person or persons responsible for that inspection.

57. The person responsible for the inspection of the scaffolding was the senior scaffolding inspector for the Wellington area, who is an officer of the Department of Labour. Between 23 October 1956 and 4 April 1957 the inspector made eleven formal inspections, but he did not always go up on the scaffold to make these inspections. As the structure was situated on a main thoroughfare of the city of Wellington, he had the opportunity of additional visual observation on many occasions as he passed up and down Lambton Quay. No inspection was made of the scaffolding after the commencement of dismantling work on 6 May 1957.

58. We are of the opinion that the number of inspections made was adequate, but had an inspection been made between 6 and 8 May it is just possible that as an indirect result the collapse may have been averted.

59. Section 5 of the Scaffolding and Excavation Act 1922, however, does not require notice to be given to the inspector of the dismantling or altering of a scaffolding. Indeed, as we have already pointed out, neither the dismantling of a scaffold, nor the operations of scaffolders engaged thereon, appear to be subject to the Act. Consequently, the absence of any inspection during the vital dismantling operation cannot be criticised. Even if an inspection had been made, the only action which in our view the inspector was strictly entitled to take was to instruct that the maintenance workmen, but not the scaffolders, should be withdrawn from the scaffold.

60. We doubt whether he had any real legal authority to stop the dismantling of the scaffold, or give directions to the scaffolders as to the manner of dismantling. Therefore it appears questionable whether he was under any obligation to concern himself with the safety of either the public or the scaffolders themselves during dismantling operations.

61. As to the efficiency of the inspection, we have already indicated that there are no requirements in the statute or regulations with which such a steel tubular scaffolding as a structure should comply. An attempt was made by the Department of Labour to meet this deficiency by issuing circulars to its inspectors of scaffolding giving information as to certain proprietary types of metal tubular scaffolding which had been "approved" by the Department, and setting out the conditions under which each type could be used.

62. A consolidating circular was issued in May 1950, and a further similar circular incorporating important changes was issued in October 1956. During the sittings of the Commission these documents were referred to as the 1950 and 1956 directives, and we propose to continue this method of identification. We have commented briefly on the directives in the footnote to our observations under order of reference (b).

63. The erection of the initial section of the D.I.C. scaffolding on Brandon Street was commenced about the time of the issue of the 1956 directive.

64. It is not at all clear whether the conditions set out in the directives were intended to constitute mandatory minimum requirements. The evidence of several inspectors indicates that the directives were in

practice treated as rough guides only, and that each inspector had full discretion to allow, and did allow, departures from the conditions prescribed. Moreover, the directives in some respects are ambiguous or lack clarity. The D.I.C. scaffold on Lambton Quay in a number of ways did not meet those conditions which are clear and understandable in the directives.

65. The attitude of the inspector was that the departures from the directives were not material to the stability and strength of the scaffolding. We are of the opinion that closer compliance with the directives would have ensured a safer and more satisfactory structure, and therefore we consider that the efficiency of the inspection could reasonably have been greater than it was.

66. Nevertheless, we express the definite opinion that had the scaffolding been erected to comply with all the requirements of the departmental directives, and had the inspection been fully efficient and completely adequate within the limits of jurisdiction of inspectors under the statute, the load imposed on the structure was so great that its collapse would not have been avoided.

ORDER OF REFERENCE (e): The administration of the Scaffolding and Excavation Act 1922 and of the regulations made under that Act.

67. We interpret this term of our reference as relating specifically to the D.I.C. accident. The general administration of the Act and regulations will be discussed at length later in this report.

68. The collapse of the D.I.C. scaffold was due to overloading of the partially dismantled structure with dismantled materials. We have already mentioned that neither the dismantling of a scaffold, nor the operations of scaffolders engaged thereon, appear to be subject to the Act and regulations.

69. Therefore, so far as the D.I.C. collapse itself is concerned, there is no justification for any particular comment on the administration of the Act under this term of reference.

DETAILED ANALYSIS OF THE CAUSE OF THE ACCIDENT

Collapse Due to Overload

70. The primary cause of the collapse was the serious overloading of two bays of the scaffold. This was admitted by Certified Concrete Ltd., and concurred in by all other parties who appeared at the inquiry.

Extent of Scaffold

71. Drawing No. 2, attached as Appendix E to the report, gives an elevation of the Lambton Quay face of the D.I.C. Building, and shows the scaffold as it was about 2.30 p.m. on 8 May 1957, that is, just before the collapse.

72. For identification, pairs of standards are numbered S. 1, S. 2, etc.; decks L. 1, L. 2, etc.; and the hangers which supported the verandah H. 1, H. 2, etc.

Extent of the Damage

73. Photograph Exhibit No. 13, attached as Appendix F, gives a view of the building after the scaffolding had collapsed and was still lying on top of the damaged verandah.

74. The upper decks of the collapsed scaffold had extended a distance of some 58 ft. northward from the south end and the lower decks had continued fully along the Lambton Quay frontage. A length of some 77 ft. of the lower decks collapsed, i.e., from the southern end almost to the centre of the main entrance of the building. Three sections of the verandah, totalling a length of about 47 ft., fell down on to the pavement.

75. Photograph Exhibit No. 4, attached as Appendix G, is a view of the frontage of the D.I.C. Building after the damaged scaffolding and verandah had been cleared away, and on it has been drawn the scaffold as it existed just prior to the collapse.

Weight of Stacked Material

76. The dismantled scaffolding material was stacked in the positions shown on drawing No. 2 on decks L. 5 to L. 11 inclusive, and nearly all the weight of this material came on to standards S. 6, S. 5, and S. 4. This information was given in evidence by scaffolders employed by Certified Concrete Ltd., and was broadly confirmed by a photograph fortuitously taken only 1 hour and 45 minutes before the collapse occurred.

77. Prior to the hearing, engineers engaged by various interested parties had conferred, and had endeavoured to arrive at the weight of dismantled material stacked on the undismantled portion of the scaffold, but during the inquiry, as more information emerged, it became evident that the original assessments of weight were incorrect. After an independent check by the Commission, and a further conference during the sittings, the conclusion was reached that the extra weight of stacked material was about 8 tons, and that the load in each pair of standards due to the weight of the scaffold itself was 3,100 lb.

Conflicting Theories

78. Although the primary cause of the collapse is quite evident, and was not disputed, interested parties brought forward various theories on the sequence of events and on what actually happened to cause the collapse. In all, twenty-one eye witnesses gave evidence, and in considering the question of whether the verandah or the scaffold went first, much importance must be attached to their testimonies. A considerable amount of technical evidence was also given, and this is reviewed later.

Eye Witnesses

79. Of the twenty-one eye witnesses, six were on the footpath in Lambton Quay outside the D.I.C. Building, and some were actually under the section of the verandah which collapsed. Seven others were on the scaffold, and eight, from safe distances away, saw the scaffold fall and were not endangered by it. Most of those in a position to see the scaffold

collapse agreed that it started to sink as a whole, subsiding in the form of a "V", of which the centre was about the middle of the most heavily loaded standards, that is, at about S. 5; they agreed also that it finished as a crumpled mass of steel tubes lying on top of the damaged sections of the verandah. There was no conclusive evidence that loose tubes or other parts fell off the scaffolding as it came down.

80. We find that the evidence of eye witnesses predominantly supports the theory that the verandah had not collapsed before the scaffold commenced to fail. By this we mean that when the scaffold had started to collapse the verandah was virtually intact, and people were still able to walk about below it. Complete collapse of the verandah did not occur until later. This view is strongly supported by the evidence of Mrs V. Anderson and Mr E. A. Stevenson who, from a building across Lambton Quay opposite the D.I.C. frontage, saw people moving on the footpath beneath the verandah after the scaffold had started to collapse, and by the evidence given by Mr K. I. McLeod, an employee of Steel and Moss Ltd.

81. The witness McLeod had been on deck 1 between standards 4 and 5, intending to climb up the scaffolding to resume his work at a higher level. Standing on the outer ledger of deck 1 he had one hand above his head holding on to the outer ledger of deck 2. He felt the scaffold sway, and reached up with his other hand to grab the ledger but missed it, lost his balance, and fell on to the verandah. He was most emphatic that, when he landed on the verandah, it had not fallen, and that scaffolding fell on top of and round him as he lay on his back. Later he found himself lying in a tangle of tubes on top of the verandah in its collapsed position, but he did not recollect the actual falling of the verandah.

Verandah

82. A detailed drawing showing the construction of the verandah in the collapsed region is shown in drawing No. 3, Appendix H.

83. The width of the verandah from the face of the building is approximately 12 ft., and the height above the footpath to the top at the outer edge is about 11 ft. 6 in.

84. The verandah is divided into panels averaging about 16 ft. long, although the panel lengths in the region of the collapse were 13 ft. 5½ in. between hangers H. 5 and H. 4; 17 ft. between H. 4 and H. 3; and 15 ft. 5 in. between H. 3 and H. 2.

85. The ends of the panels were carried on 7 in. x 3½ in. rolled steel joists at right angles to the face of the building, each joist being effectively set into the building at one end and supported at the outer end by a wrought-iron bolt which attached it to a wrought-iron hanger. The hangers were inclined from the ends of the joists at an angle of about 42 degrees to the horizontal, and each hanger was secured to the building by a bolt through a special boss fixed higher on the face of the building.

86. The panels comprised a framework of nine oregon joists running parallel to the face of the building, covered with ¾ in. dressed T. and G. oregon sarking, which in turn was covered with malthoid sheets, asphalt, and stone chips. The under side of the verandah was lined with pressed steel decorative sheeting. (See Section B-B, drawing No. 3, Appendix H.)

87. The oregon joists in the panels were spaced at about 1 ft. 5 in. centres, and varied in depth from 8 in. for the joist nearest the face of the building to 11½ in. for the joist nearest the verandah fascia. The thickness of the joists varied indiscriminately from 1¾ in. to 2⅛ in. They were supported at their ends on 3 in. x 2 in. timber plates bolted to the webs of the steel joists, the ends of the timber joists being notched 3½ in. deep for a length of 2 in. to sit on the 3 in. x 2 in. plates. Second notches, more or less of "V" shape, were also cut in most joists near the top of each end in order to house the top flanges of the steel joists. (See Section B-B, drawing No. 3.)

The Scaffolding

88. The scaffolding erected on the verandah on the Lambton Quay face was eighteen bays in length (totalling about 172 ft.) and it was thirteen decks high. The decks on the average were spaced at approximately 6 ft. 5½ in. apart vertically and the total height from the verandah to the top deck was about 84 ft.

89. The scaffolding was built of steel tubular members most of which were of the close jointed or split type, although some tubes were seamless. The main vertical members (standards) and the main horizontal members (ledgers) were fastened together by double couplers of which two types were used, and the putlogs (transverse members carrying the planks or decking) were secured to the ledgers by special putlog couplings. All tubular scaffolding materials had been manufactured by the London and Midland Steel Scaffolding Co. Ltd., and were known under the proprietary name of "Burton's Patent". The tubes had an outside diameter of $1^{29}/_{32}$ in., some being number six and some number seven British Imperial Standard Wire Gauge in thickness.

90. All scaffolding tubes and couplings were the property of Certified Concrete Ltd.; they were of varying ages. The company stated in evidence that all materials had been ordered to comply with British Standard 1139 : 1951, and the Railways Department's tests on tubes and fittings taken from the collapsed scaffold confirmed that they did so comply.

91. In Lambton Quay the spacing of the pairs of standards parallel to the face of the building was approximately 10 ft., the inner row of standards being about 1 ft. 10 in. from the face of the building; the space between the two rows of standards was about 3 ft. 2 in. The area of each bay in plan was therefore 10 ft. x 3 ft. 2 in., or 31·6 sq. ft.

92. The bottom of the standards rested on two lines of timber sole plates supplied by Certified Concrete Ltd. and laid parallel to the building, one line being for the inner row of standards and the other for the outer row. The plates were generally of 6 in. x 2 in. timbers stated to be *pinus insignis* and were not fastened to each other or to the verandah. They were usually long enough each to take two standards. The bottoms of the standards were not fastened or secured to the sole plates; but evidence was given, supported later by the results of tests, that the loads on the scaffold pressed the bottom end of the standards into the timber sufficiently to hold the standards in position on the sole plate.

93. On the northern and southern portions of the Lambton Quay face the scaffold was attached to the building by wire ties. The positions of these on the scaffolding as it existed just prior to the collapse are shown on drawing No. 2 (Appendix E). The scaffold was also restrained at right angles to the building by projecting lengths of some of the putlogs which were thus made to bear on the face of the building. However, no evidence was given as to the positions of these projected putlogs.

94. Each tie consisted usually of a length of No. 10 gauge black wire which was looped round a 4 in. x 2 in. timber strongback placed across a fanlight opening in the building. The two ends of the wire extended through the fanlight opening, and were tied to the scaffolding, usually to the nearest ledger. The two strands were then twitched to tighten the ties until the scaffold was pulled into line and until the projecting putlogs were bearing on the face of the building. (See drawing No. 4, Appendix J.)

95. On the northern and southern portions, the scaffolding was also restrained to some extent against longitudinal movement by the housing of projected putlogs on either side of the fluted piers where a face of 3 in. or 4 in. of concrete existed between the reveal and the window frame; the projecting putlogs were placed against the short faces at the sides of the windows and against the side returns of the piers.

96. In the central portion of the Lambton Quay face the scaffold was anchored to the two main columns. At each deck level and parallel to the scaffold a tube was placed horizontally behind flutings of the columns. Three other tubes, virtually extended putlogs, coupled each of those horizontal tubes to the ledgers of the scaffold. In addition, at each deck two extended putlogs were fitted into the side recesses between the main columns and the returned faces of the main wall. These putlogs were intended to give support to the scaffold against movement parallel to the face of the building. The positions of the putlogs connecting the scaffold to the central columns are shown on drawing No. 2.

97. The scaffolding planks supplied by Steel and Moss Ltd. were of new oregon 1½ in. and 2 in. thick, and the firm placed and moved all planks to suit its work. Steel and Moss Ltd. also supplied and fixed across the window openings the 4 in. by 2 in. timber strongbacks round which the wire ties were looped. It was intended that Certified Concrete Ltd. would fix these wire ties; but at an early stage in the erection of the scaffold the practice developed by which Steel and Moss' men, unknown to their employers or the management of Certified Concrete Ltd., took over this work and fixed the ties under the direction of the scaffolders.

98. The sequence of erection of the scaffold has already been given in the narrative. Up to 6 May 1957, that is, up to the time before a start was made with the dismantling of any scaffolding on the northern and central portions of the Lambton Quay face, the scaffold had received some horizontal support from the central columns.

99. In evidence given on behalf of Certified Concrete Ltd. the efficacy of the support at the central columns was stressed, and indeed was used as an argument to justify the absence of any form of longitudinal diagonal bracing.

100. On 8 May, the day of the disaster, the scaffolding on the northern and central portions of the building, with the connections to the central columns, had been dismantled down to deck 5, and this left the southern portion above deck 5, which had a length of six bays, i.e., about 58 ft., and a height of eight lifts, i.e., about 52 ft., to depend only on the wire ties for its lateral support.

101. In the course of giving his evidence, Mr Cormack, general manager of Certified Concrete Ltd., expressed surprise that longitudinal diagonal bracing had not been used as a matter of good practice, although he still considered that the scaffolding was quite adequate without it.

102. Further comments on the details of the scaffold, and on whether it did or did not comply with the requirements of the directives issued by the Department of Labour, are offered later.

The Use of the Verandah to Support the Scaffolding

103. Evidence was given by Mr E. H. Turksma, the Wellington works manager for Certified Concrete Ltd., that before erection of the D.I.C. scaffolding commenced he made an inspection of the verandah, walked about and jumped on it and, without knowing the details of its construction, decided it could safely carry a tubular steel scaffold. He stated he was influenced by the good type of hanger, by his not finding any signs of deterioration, and by his knowledge of similar verandahs in the city. Mainly to anticipate the stacking of some scaffolding materials on the front of the verandah during the course of the scaffolders' work, Mr Turksma decided to tom up the outer end of the rolled steel joists from the pavement as an additional safeguard.

104. We have stated already our conclusions that the verandah was in good condition, and that it could, and did, take the normal loads imposed on it by the scaffolding; but we nevertheless express concern that a decision on the carrying capacity of this verandah was made so lightly.

105. The tomming of the outer end of the rolled steel joists was a sensible action in that such tomming would act as a safety measure against overloading of the outer portion of the verandah with stacked material. But tomming would not and did not help the oregon joists which were relatively the weaker members in the structure of the verandah. However, when the scaffolding collapsed on to the verandah, and the hangers failed, the toms (even if they had stayed in position) were quite inadequate to take the loads that would have come on them and they did not prevent the collapse of the verandah.

106. A question upon which little or no expert opinion was offered, but upon which the Commission feels it should comment, is whether the disaster would have been prevented if toms had been placed below the verandah under the standards of the scaffolding.

107. It is possible that, had toms been provided and secured below the verandah at the points where the scaffolding standards rested, general collapse of the verandah under the impact of the falling scaffold would not have occurred, although much damage to the verandah would, we think, have been inevitable. We do not consider, however, that such additional toms would have prevented the collapse of the scaffold itself since it was already in a highly unstable state and as indicated by the expressed intentions of the scaffolders would have been called upon to carry further extra load had it not collapsed when it did.

SUITABILITY OF THE D.I.C. SCAFFOLDING

108. Work on the Brandon Street face of the D.I.C. Building was completed without any trouble, and so comments on suitability will be restricted to the scaffolding on the Lambton Quay frontage.

109. It has been stated already that the Scaffolding Regulations contain no reference to metal scaffolding as commonly used, but that the Department of Labour had instructed its inspectors that such scaffolding could be used if it complied with the directives.

110. The erection of the D.I.C. scaffolding was started a short time before the 1956 directive was issued, and the inspector of scaffolding, rightly or wrongly, decided it should comply only with the 1950 directive. In most respects the scaffold complied with either one or other of the directives, but in some respects it complied with neither.

Materials

111. The tubes and fittings generally complied with British Standard 1139: 1951 Metal Scaffolding. A considerable percentage of the tubes were of the type known as close jointed, that is, the split type. Although this type of tube complies with B.S. 1139, it was not allowed under the 1956 directive, but special approval subject to its use with Burton's couplers was given by the Department of Labour to Certified Concrete Ltd. upon representations by the company after the issue of the directive. Some tubes were of six and some of seven British Imperial Standard Wire Gauge in thickness. The 1950 directive allows six S.W.G. only; the 1956 directive requires a minimum of eight S.W.G. There was no evidence that the tubes and couplers were not in reasonably good order.

112. We find that the materials were suitable for the scaffold.

Spacing of Standards

113. The maximum spacing of the standards on the Lambton Quay scaffold was 10 ft. The maximum spacing allowed for a plasterers' scaffold is 10 ft. in the 1950 directive, and 8 ft. in the 1956 directive. However, the 1956 directive allows a 9 ft. spacing for painters and for light work if the inspector approves.

114. The D.I.C. scaffold was really a maintenance scaffold, that is, a scaffold for light work, and we do not consider the 10 ft. spacing was, in the circumstances, excessive.

Maximum Lift Between Decks

115. The lifts between decks averaged 6 ft. 5½ in., while the maximum possibly reached 7 ft. The maximum allowed under the 1950 directive is 6 ft. and, under the 1956 directive, 6 ft. 6 in.

Maximum Spacing of Putlogs

116. The maximum spacing of the putlogs allowed in both directives is 4 ft. On the D.I.C. scaffold one putlog was fixed at each pair of standards, and one midway between each pair; thus the maximum spacing was 5 ft. The limitation of 4 ft. spacing was fixed for a maximum span of 5 ft. for the putlogs, using planks 8 in. x 1½ in. In the D.I.C. scaffold the maximum span of the putlogs was 2 ft. 10 in., and both 1½ in. and 2 in. planks were used.

117. Although the requirement of the directives was not complied with, we do not regard the 5 ft. spacing as excessive in the circumstances.

Joints in Standards and Putlogs

118. Both directives require joints in standards to be not more than 9 in. from a ledger, and joints in ledgers to be not more than 2 ft. 6 in. from a standard. Photographs produced at the inquiry showed that these conditions were not observed.

Coupling Bolts

119. Evidence was given that on two occasions slackness of the coupling bolts was found. There was no adequate check of coupling bolts whilst the scaffolding was in use.

Bracing

120. Both directives require scaffolding to be securely and rigidly braced in all directions to form a rigid structure. Certified Concrete Ltd. relied for bracing on the fixing of the scaffold to the central columns of the building, and on the combined effect of the wire ties and the bearing of the ends of the extended putlogs on the face of the building. As has been stated already, the tying of the scaffold to the central columns must have afforded some restraint to the scaffold in the longitudinal direction but, at the time of the collapse, the fixings at the central columns had been removed down to deck 5, thus leaving the upper section of the southern portion of the scaffold virtually unbraced longitudinally. The combined effect of the ties and putlogs would have been sufficient to support the scaffold adequately in a direction at right angles to the building had there been more ties and had they been more uniformly distributed.

121. On the afternoon of Monday, 6 May, and again on Tuesday, 7 May, it was noticed that a window, which had been used for access to the scaffolding from an office between standards S. 5 and S. 4 on the sixth floor of the building, could not be opened. It was then found that a putlog, which previously had been clear of the window, prevented it from opening. On 6 and 7 May, parts of deck 12 and decks 11, 10, and 10A on the northern and central portions of the building were dismantled and the fixings to the central columns at these decks were removed. The movement of the putlog at the window may have been an indication of movement of the whole of the southern portion of the scaffolding which, in turn, could have been due to the removal of the lateral support at the central columns.

122. Employees of Steel and Moss Ltd. were uneasy and asked the scaffolders if it was safe to continue loading the scaffold as they were doing. The scaffolders assured them it was, and said that small movements in a scaffold were not unusual.

123. We must conclude that, to conform with the directives and good practice, the scaffolding should have been more adequately braced by the use of longitudinal diagonal bracing and by more ties or bracing in the direction at right angles to the building. However, we stress that the provision of such extra bracing would not have prevented the collapse of the scaffold under the very severe load that was imposed on it. We are also of the opinion that, if the scaffold had been subjected only to

the working loads for which it was intended, it would not have collapsed due to deficiencies in the bracing; but its margin of safety would have been less than was desirable.

Adequacy and Spacing of Ties

124. The 1950 directive requires all standards of steel tubular scaffolding to be secured to the walls by tie wires at a spacing not more than 15ft. vertically and 20ft. horizontally.

125. The 1956 directive requires a scaffold to be secured to the wall at every alternate ledger by means of wire ties or reveal pins or in any other manner as may be directed by the inspector. The distance between such ties is not to exceed 200 sq. ft. of wall area, which we interpret to mean one tie to every 200 sq. ft.

126. In the southern portion of the Lambton Quay face, the scaffold between S. 7 and S. 1, and between the verandah and L. 13, was about 58 ft. long and 84 ft. high, a total area of 4,872 sq. ft. In this area there were twenty-nine wire ties, that is, an average of one tie to 168 sq. ft. The greatest horizontal distance between ties was about 23 ft., and the greatest vertical distance between rows of ties about 15 ft. From drawing No. 2, Appendix E, which shows the position of the ties, it will be seen that they were generally secured to ledgers, and that there were no ties above deck 3 between standards S. 4 and S. 5.

127. The 1950 directive was not complied with in that all standards were not secured by ties, and the maximum horizontal spacing between ties of 20 ft. was exceeded by 3 ft. However, the average area of scaffolding per tie was less than the maximum allowed by the directive.

128. The scaffold was secured to the building at every alternate ledger and in this respect met the requirements of the 1956 directive, but while the average area per tie was 168 sq. ft., because of their distribution some ties were supporting areas of scaffolding much greater than 200 sq. ft., the maximum allowed in the directive.

129. Again we conclude that, even with the ties spaced as they were, the scaffold would have carried the normal loads to which it would be subjected by the work done on the building with some margin of safety. However, we consider that the requirements regarding ties in both directives are not sufficiently explicit, because they allow ties to be badly distributed on the face of the scaffold, leaving some standards with very little support.

130. It would seem that, in planning the scaffolding, Certified Concrete Ltd. set out the standards from the Brandon Street end of the Lambton Quay front at 10ft. centres, the maximum spacing permitted in the 1950 directive, with little thought about the position of the ties, and then placed the ties at convenient window openings and attached them to the ledgers of the scaffold at the nearest points. It would have made a much more workmanlike job to have sited the standards to suit the windows at which ties could be fixed so that each standard could be tied, although this procedure may have required more standards.

131. Tests carried out by the Railways Department showed that twisted-wire ties taken from the scaffold broke at a load of 1,277lbs. The strongbacks across the windows did not fail and there was not sufficient evidence to warrant a finding that the ties were not adequately secured to the scaffolding. We conclude that the individual ties and the strongbacks were, in themselves, satisfactory.

Loading of the Scaffold

132. The maximum uniform distributed load allowed over the area of one "scaffolding platform" of steel tubular scaffolding is 35 lb. per square foot in the 1950 directive, and 28 lb. per square foot in the 1956 directive. The maximum concentrated load allowed to be applied to any bay of such a scaffold is 400 lb. in the 1950 directive, and 335 lb. in the 1956 document. Evidence was given that the Department of Labour regarded one "scaffolding platform" as the area of one bay in plan, but this interpretation was strongly disputed and considered unreasonable and unworkable by Certified Concrete Ltd.

133. Evidence was also given that representatives of Steel and Moss Ltd. and the inspector of scaffolding discussed the loads that should be allowed on the scaffold and, although no definite weights were established, it is clear that Steel and Moss Ltd. were most careful to avoid accumulation of broken plaster or other materials on the decks, and there is no indication that the maximum loads permitted by the Department of Labour's interpretation of the 1950 directive were exceeded.

134. The weight of about 8 tons of stacked scaffolding materials was spread over seven decks (L. 5 to L. 11 inclusive) of two bays (S. 6 to S. 5 and S. 5 to S. 4) of the scaffold. The area of each bay in plan is about 31·6 sq. ft. so that the total area on which scaffolding material was stacked was about 442 sq. ft. This gives an average loading of 40 lb. per square foot on seven decks in each of two bays (the distribution of which may or may not have been reasonably uniform), or of 280 lb. per square foot of "scaffolding platform" if the Department's definition of "scaffolding platform" is accepted. Thus the load of the scaffolding materials was eight times the maximum uniform distributed load allowed by the 1950 directive, and ten times the maximum allowed by the 1956 directive.

135. The total weight of stacked material regarded as an equally distributed load on the two loaded bays of the scaffold amounted to over 8,800 lb. per bay. At this stage it is of interest to examine the total maximum distributed load which would be allowed on each bay of such a scaffold under regulations which operate in Western Germany, New South Wales, and Western Australia.

136. We have mentioned elsewhere that the 1956 directive, according to the Department of Labour, allows a total distributed load of 885 lb. on one bay of the D.I.C. scaffolding. Certain other witnesses contended that the directive allowed a total distributed load of 11,502 lb.

137. In Western Germany the allowable distributed load per bay would be 1,164 lb., in New South Wales, 632 lb., and in Western Australia, 2,844 lb.

138. It will be seen that the load of 8,800 lb. per bay imposed on the scaffold was far in excess of the loads which would be allowed in the three countries named.

139. It would appear that the uniform loads of 35 lb. and 28 lb. per square foot specified respectively in the two directives were fixed to avoid overloading the ledgers and the putlogs, and to limit the load on the couplers to guard against slipping. We do not think they were determined by a consideration of the safe load which could be carried by the standards.

140. The 1950 directive allows a maximum spacing of standards of 10 ft., and a maximum putlog spacing of 5 ft., that is, a maximum area of one deck in one bay of 50 sq. ft. With a uniform load of 35 lb. per square foot the live load to be carried on each standard would be 875 lb.

141. According to B.S. 1139 and B.S. 449 the safe loads that may be imposed on seamless tube standards of seven-gauge material and of various lengths, assuming them to be held in position at both ends but not restrained in direction, are as follows:

Distance Between Effective Ties or Supports	*Safe Load*
	lb.
6 feet	6,900
12 feet	5,050
18 feet	1,000

The above figures show that so far as the standards alone are concerned the limitation of the specified uniform load to one deck per bay is quite unnecessary and unreasonable provided the standards are adequately supported.

142. The two scaffolders, Messrs Kristensen and Nutter, stated in giving evidence that as a safeguard against the slipping of a ledger extra couplers were placed on the standards below the couplers connecting the ledgers to the standards in the bays carrying the stacked material. They also described how the long dismantled tubes were stacked to form a trough in which couplers and short tubes, such as putlogs, were placed. They both asserted that, in doing these things, they followed their usual practice, and that loose scaffolding materials had been stacked on scaffolding on other buildings.

143. From this evidence we conclude that Certified Concrete Ltd. had stacked dismantled materials on scaffolds on previous jobs, but we cannot find any satisfactory explanation of why the inspector of scaffolding should not have seen such a practice in operation before. Messrs Kristensen and Nutter also admitted quite frankly that, if the scaffolding had not collapsed, they would have continued stacking materials down to deck 3.

Base Plates

144. Base plates are not mentioned in the 1950 directive, but are required on all standards by the 1956 directive. No base plates were used on the D.I.C. scaffold.

145. The functions of base plates are to reduce the possibility of the bottom of the standard slipping sideways, and to spread the load of the standard over a greater area.

146. Certified Concrete Ltd. claimed that, if softwood sole plates are used, it is better not to use base plates, as the end of the standard will then sink into the timber and thus be prevented from slipping.

147. There was no evidence that the bases of any standards had slipped, or that any sole plates were split or damaged by the standards, and although we are of the opinion that it is good practice for base plates to be used, we do not consider that their absence on the D.I.C. scaffold in any way contributed to the collapse.

Fender Boards

148. Subclause (6) of regulation 15 of the Scaffolding Regulations requires fender boards not less than 1 in. thick to be carried to the height of any loose material that may be stacked on any working stage. While the regulation applies primarily to timber scaffolding, the provision concerning fender boards is applicable to any type of scaffold.

149. The 1950 directive does not mention fender boards, but the 1956 directive states that fender boards shall extend from the floor of a working platform to the height of the material stacked thereon, and in no case shall be less than 6 in. x 1 in.

150. To prevent materials falling, Steel and Moss Ltd. was most careful to enclose with fabric the space round the piers from which they were removing defective plaster, and we consider that the precautions adopted by the firm's employees on this particular operation were adequate; but nowhere else on the scaffolding do fender boards appear to have been installed or adequate precautions taken against materials falling.

151. Evidence was given by Mr L. A. Heath that at 12.45 p.m. on the day of the accident, when he was in the centre of Lambton Quay about 20 ft. north of Panama Street, he heard something which he judged to be metal falling from the scaffolding to the verandah. There was no one working on the scaffold at the time. No other evidence about materials actually falling from the scaffolding about the time of the collapse was given, but we consider that the omission of fender boards, whether or not it constituted a breach of the regulations or the directives, showed a disregard of a usual safety precaution.

Summary

152. Apart from the overloading of the stacked material, the foregoing examination of the scaffolding indicates that either:

(a) The inspector on his own responsibility allowed deviations from the directives; or

(b) The persons responsible for the erection of the scaffolding interpreted the directives in a loose way, and the inspection was not thorough enough to detect deviations from the directives.

153. In concluding this section of our report we desire to repeat that, while the scaffolding departed in some instances from the requirements of the directives and could not be regarded as a good job, it would not have collapsed if it had not been for the excessive stacking of scaffolding materials upon it.

THEORIES ON MECHANICS OF COLLAPSE

Preamble

154. Two main lines of argument were followed during the hearing of technical evidence. Neither school of thought questioned the assertion that the scaffold had been overloaded and that the overload had caused the collapse. But there were differences of opinion on the mechanical behaviours of the several structural elements involved.

155. This is understandable since, in the absence of a scientific record of just what did happen made at the time it was happening, reconstruction of events must depend largely on the results of working back from theoretical principles. Even before theory can be applied, certain assumptions must be made of the physical conditions existing just before the collapse – and evidence on those conditions was meagre enough and had to be amended as our investigations proceeded.

156. On the one hand it was contended that a pair of standards gave way or crumpled under the load and that everything else was consequential on that.

157. On the other hand the argument that the verandah collapsed and let the scaffold fall was adduced.

158. We have tried to maintain a clear distinction between the actions we have referred to as "failure" and those as "collapse". "Failure" has been used to mean some yielding of, or the development of a fault in a structural member, but not of such nature or extent as to destroy or even seriously to affect the load bearing capacity of the member. In these comments when using the word "collapse" we mean that a state has been reached when a member has so fractured or buckled that it has become incapable of carrying any load.

Various Theories of Expert Witnesses

159. Called by the Department of Labour, Mr E. E. Hendriksen, a qualified professional engineer, suggested a distribution of the extra weight of stacked materials of 25 to 30 per cent, 55·0 per cent, and 15 to 20 per cent to the pairs of standards S. 6, S. 5, and S. 4 respectively; but after further consideration he agreed that a distribution of 32½ per cent, 55 per cent, and 12½ per cent would have been quite a reasonable assumption.

160. He had not made an assessment of the extra load himself, but had accepted the figure of 6·4 tons (based mainly on data supplied by Certified Concrete Ltd.) which had been adopted by a conference of expert witnesses prior to the hearing. The witness submitted that, under the forces which had been set up in the several members of the scaffold due to the self weight of the framework and to the extra loading imposed, a state of elastic instability had been reached and that this may have persisted for some indefinite time before the collapse. Under continued loading the point was reached, however, at which, in the witness' contention, the pair of standards S. 5 started to buckle about the level of deck 5, and as a result of the movement which took place, something fell from about the height of deck 7, or higher, and struck hanger 3 and the bolt connecting it to the front of the verandah. The effect was to fracture the bolt after which the general collapse of the verandah and scaffold was progressive. He showed that the static forces that had been set up would, in themselves, have been insufficient to fracture the bolts which had secured the verandah to the hangers.

161. Mr Hendriksen had verified that the forces set up in the materials involved (e.g., hanger bolts, etc.), and the breaking strengths of those materials, had been consistent with his theory. Mr E. F. Hubbard, chemist, of the Hutt Railway Workshops Laboratory, conducted tests to that end and gave evidence on the results.

162. Mr Hendriksen did not give evidence on the detailed construction of the verandah panels nor on the capacity of the oregon joists to carry

the loads of the standards. He had assumed that as the standards buckled the joists must have carried the load imposed on them by the standards.

163. Called on behalf of the scaffolding contractor, a qualified professional engineer, Mr W. G. Morrison, and the general manager of Certified Concrete Ltd., Mr H. W. Cormack, who is also a qualified professional engineer, asserted that the loads in the standards had not been great enough to cause their buckling, but that the oregon verandah joists had contained defects which had allowed the verandah panels to collapse directly below the more heavily loaded standards. Mr Morrison, working back from an assumed direct or vertical load of 5,000 lb. in a standard, found, from a graph based on the Euler formula for crippling loads, that a tube 12 ft. 6 in. long with theoretically pin-jointed ends would be in a critical condition. He found that 12 ft. 6 in. was about the length of two lifts of the scaffold and, assuming that the standards were reasonably restrained in position by ties at the same intervals of 12 ft. 6 in., he contended that the interaction of ledgers and putlogs with the standards, particularly at the deck midway between those which were tied, would have raised the load-bearing limit of the standards. His approach was not one of exact calculation as he considered such a structure would have to be regarded as acting as a whole, with ultimate load capacity greater than specifications or normal design analyses would indicate.

164. As to the timber joists, Mr Morrison argued that longitudinal cracks had previously existed in them; that at one point where a storm-water pipe had passed through the roof there were signs of dry rot; and that the intrinsic resistance of the timber to shear loads was less than it should have been.

165. In support of the last contention he gave the results of some tests that he had conducted on timber actually taken from the verandah and on other new oregon timber. The calculated average ultimate longitudinal shearing stress under these bending tests was just under 400 lb. per square inch, whereas, he argued, designers had assumed the ultimate value in shear to be about 1,100 lb. per square inch. He suggested from this disparity that the margin of safety was much less than had been thought and he concluded that the timber was defective. It was subsequently shown that the 1,100 lb. per square inch value was based on tests in pure shear and certain results which Mr Hubbard later gave for such tests showed that, at an average of 1,025 lb. per square inch, the verandah joists were, in fact, up to standard.

166. However, on the assumption of the defects which he claimed had existed, Mr Morrison contended that the joists under the scaffold cracked and deflected to such an extent that they slipped off their end supports and consequently were pushed downwards. This allowed the scaffold to follow until it struck the hangers; then the suspending bolts were fractured and allowed the rest of the verandah structure and the scaffold above it to fall to the ground.

167. The evidence of eye witnesses of the collapse lent little support to the theory that the inner portion of the verandah had torn away from its supports at the outset. Under the consequential cross-examination by counsel and questioning by the Commission, Mr Morrison suggested as an alternative that, due to some upward impact on its base, the outer standard S. 5 had been lifted off its timber sole plate which had then been displaced sideways and the standard, in returning to the

verandah, had punctured the roofing and sarking and continued its downward movement. Mr Morrison maintained that thereafter actions of the same nature and sequence occurred as were postulated in his earlier theory. No reasonably acceptable explanation was offered for the assumed sudden initial upward movement of the standard.

168. Mr A. L. Andrews, a qualified professional engineer, called as an expert witness on behalf of the D.I.C. Ltd., contended that longitudinal shear cracks had probably developed in the verandah joists under the action of the extra loading, although those joists would not thereby have lost their capacities to resist load. Deflections would, however, have increased and have led to a redistribution of forces in the structure. He argued that there could have been no failure of the timber joists that would have been sufficient to let the verandah panels collapse since, to dislodge those panels from their supports, bending or flexure failure (transverse tearing and crushing of the fibres) would have had to occur, and there had been no evidence of that. He thought that most, if not all, of the new shear cracks which had been found in the salvaged joists could have been the consequential effects of later stages of the collapse.

169. He did not consider that any cracks which had existed in the timber joists before the collapse would have had significant influence on the subsequent behaviour of the structure. No such cracks existed in the heavily loaded ends of the joists under S. 5, and he could not accept that all five or six of the joists likely to be affected by S. 6 could have been so defective as not to have been able to support the smaller loading on that standard. The crack in the fifth joist must, indeed, have enhanced the resistance of the joist.

170. Mr Andrews submitted revised values for the extra load of scaffolding materials which had been stacked on the southern portion (bays S. 4–S. 5 and S. 5–S. 6), and for the self weight of the structure. He had arrived at these figures in consultation with the expert witness, Mr T. V. Clendon, together with a representative of Certified Concrete Ltd. He submitted that the load of stacked scaffolding materials was 8 tons, and that because the actual height of the scaffold was greater than the height which initially had been assumed, the self weight previously allowed had also to be increased. He computed the latter total weight per bay at 3,100 lb.

171. In his earlier submission he had argued that, depending on the actual degree of rigidity obtaining in the couplings as fastened on the scaffold, the crippling load of a pair of standards, if restrained at intervals of two lift heights, would lie between 10,800 and 11,600 lb. This assessment took into account what he considered to be a reasonable "spring constant" of the standard restraint. He pointed out that, where the stress in a strut exceeded that of the proportional limit of the material, the Euler formula for crippling loads gave an over-estimate of the maximum load that a strut could carry without buckling.

172. On the basis of Mr Hendriksen's assumption of load distribution Mr Andrews suggested that the total load on the pair of standards S. 5 became 12,600 lb., and he concluded that, although some yielding of the verandah joists had taken place, the collapse as such must have started by the buckling of these standards.

173. Mr T. V. Clendon, a qualified professional engineer, was called on behalf of the inspector of scaffolding. His views coincided in general with the theories advanced by Messrs Hendriksen and Andrews, namely,

that collapse had started in the buckling of standards S. 5, although he suggested originally that the region of such buckling would have been about the level of deck 3, whereas Mr Hendriksen had suggested deck 5, and Mr Andrews had not wished to pinpoint the spot. Mr Clendon considered that failure of a verandah joist had probably taken place, although this could not have caused the collapse since load would have been transferred immediately to neighbouring joists. He submitted that had the collapse of one or other of the oregon joists taken place some evidence of it would have appeared in the sarking; but his examination of the structure after the event disclosed no such supporting evidence.

Conclusion

174. After hearing the technical arguments which have just been summarised and after considering them in relation to the evidence of eye witnesses, mainly lay persons, we conclude that the scaffold collapsed first. We believe that standards S. 5 buckled under loads which may, indeed, have been even greater than those assumed to have existed at the moment of collapse. It is likely that the elastic deflection or other yielding of verandah joists under standards S. 4 and S. 6 caused those standards to shed some load on to the already critically loaded S. 5.

175. We consider that there is insufficient evidence to sustain the contention that the verandah collapsed first.

DIVISION II

ORDER OF REFERENCE (f): Suggestions for the prevention as far as possible of similar accidents in the future.

176. The inquiry disclosed that the main weakness in the general control of scaffolding is that the Scaffolding and Excavation Act 1922 is inadequate, ambiguous, and out of date, while the regulations made under the Act are even more unsatisfactory and lag far behind current practice in the building industry.

177. The woefully deficient nature of the legislation has, in our opinion, tended to engender administrative looseness in that the officers of the Department of Labour, including the inspectors of scaffolding, have been left largely to their own devices.

178. Our main broad suggestions therefore for the prevention as far as possible of similar accidents in the future are:

(a) An extension of the legislation to cover dismantling of scaffolds.
(b) A complete overhaul of the Act and the promulgation of an entirely new set of regulations recognising in particular the use of metal scaffolding and similar equipment.
(c) The appointment of a chief inspector of scaffolding.
(d) A progressive improvement in the qualifications of inspectors.
(e) The establishment of an administrative arrangement with the Ministry of Works under which inspectors will have the authority to obtain technical advice on structural problems from professional officers of that Department.
(f) The establishment of a proper system of certification of scaffolders.
(g) Reconstitution of the Scaffolding Examination Board to include a registered professional engineer experienced in structures.

GENERAL ADMINISTRATION OF THE SCAFFOLDING AND EXCAVATION ACT 1922 AND REGULATIONS

179. The Scaffolding and Excavation Act 1922 and the regulations made under the Act are administered in the Department of Labour. Within the organisation of the Department the administration is conducted by the Industrial Welfare Division, headed by the Chief Inspector of Factories, who is responsible to the Permanent Head of the Department, the Secretary of Labour. The Chief Inspector of Factories, so far as matters falling within the scope of the statute are concerned, is assisted by the Supervising Inspector of Factories.

180. There are seventeen full-time inspectors of scaffolding employed by the Department of Labour. These officers are stationed at different centres throughout the country and are attached to the district offices of the Department. In carrying out their duties they are subject, in matters of discipline and organisation, to the general supervision and control of the District Superintendent or District Officer in charge of the particular office; but on technical questions they deal directly with Head Office in Wellington. The sphere of operations of an inspector may extend beyond the departmental district to which he is attached.

181. The following tabulation shows the number and distribution of the inspectors, and the areas in which they operate:

Number	*Headquarters*	
4	Auckland	..... Auckland, Whangarei.
1	Hamilton	..... Hamilton.
1	Rotorua	..... Rotorua, Tauranga.
1	Hastings	..... Hastings, Napier, Gisborne.
1	Wanganui	..... Wanganui, New Plymouth.
1	Palmerston North	..... Palmerston North, Masterton, Levin.
3	Wellington	..... Wellington, Hutt, Blenheim, Nelson.
3	Christchurch	..... Christchurch, Ashburton, Timaru, Greymouth, Westport.
2	Dunedin	..... Dunedin, Oamaru, Invercargill.
17		

182. In addition to the above full-time inspectors, the Department has two other officers, one stationed in Nelson and the other in Greymouth, who hold appointments as inspectors of scaffolding and are available for urgent inspection work.

183. Section 6 of the Scaffolding and Excavation Amendment Act 1948 declares that the principal Act shall bind the Crown. By section 51 of the Statutes Amendment Act 1949, the following subsection (2A) was inserted in section 3 of the principal Act which deals with the appointment of Inspectors:

> Nothing in the proviso to subsection one of this section shall apply to any officer employed in the service of the Crown or of any local authority who is registered as an engineer under the Engineers Registration Act 1924 and is appointed to be an Inspector under this Act for the purpose of any undertaking being carried out by the Department or local authority of which he is an officer.

184. We were informed that, under the above subsection, seven officers of the Railways Department and seven officers of the State Hydro-electric Department hold appointments as inspectors of scaffolding for the purposes of undertakings being carried out by the respective Departments. We were advised that no other appointments have been made under the subsection. For example, there is no registered engineer in the employ of the Ministery of Works holding such an appointment, despite the wide constructional activities of that organisation. On the other hand we had evidence that there was close co-operation between the full-time inspectors of the Department of Labour and the engineers of the Ministry of Works in respect of scaffolding carried out on its projects.

185. It was submitted at the inquiry that the number of full-time inspectors of the Department of Labour was inadequate, having regard to the fact that over 20,000 inspections were reported to have been made during the year ended 31 March 1957.

186. In considering this submission it is of interest to compare the number of officers engaged in the inspection of certain other hazardous occupations, and the average annual fatalities in the industries concerned. Fatalities associated with all the operations coming within the scope of the Scaffolding and Excavation Act have averaged 4·4 per annum during the ten years 1947 to 1956 inclusive.

187. Coal mining has been responsible for an average of 3·8 fatalities per annum during the same period with an inspectorate of seven officers, including the Chief Inspector of Coal Mines. In the case of quarries, metal mines, and tunnels, the average annual fatality rate has been 4·1, with an inspectorate of six, including the Chief Inspector of Quarries.

188. The number of inspections made under the Coal Mines Act in 1956 was 1,027, while the number of inspections of quarries, metal mines, and tunnels was 1,888 for the same year. It must be realised, of course, that the nature and comprehensiveness of inspections under the Scaffolding and Excavation Act are very different from those in the other two industries, and a mere comparison of numbers of inspections alone is not a fair indication of the relative numbers of inspectors that should be employed. Moreover, scaffoldings are concentrated in city areas, whereas quarries and mines are usually isolated and located generally at appreciable distances from departmental district offices.

189. Nevertheless, we think the inspecting organisation should at once be strengthened by the appointment of a full-time chief inspector of scaffolding to be attached to the Head Office of the Department of Labour, whose only function should be the administration of the Scaffolding and Excavation Act. This officer should be a man of higher educational attainments and technical experience than the present district inspectors of scaffolding.

190. We make this proposal first, because an inspectorate of seventeen full-time officers warrants specialised direction and control, and, secondly, because we think that, in the Head Office of the Department of Labour, there is need to concentrate to a greater degree in one individual officer the responsibility for the administration of the Act and regulations, and for tendering advice to ensure that the law does not lag too far behind technical and commercial developments. He would, of course, be subject to the general direction of the Permanent Head.

191. We propose to mention only one very striking instance of the need for strengthening the organisation. The document relating to metal scaffolding issued by the Department in October 1956, and referred to in this report as the 1956 directive, contains the following sentence:

> The load due to the weight of men and materials uniformly distributed over the area of a scaffolding platform shall not exceed 28 lb. per square foot of area.

Applied to the D.I.C. scaffold, the inspector of scaffolding stated that this provision allowed only a total distributed load on one bay of 885 lb. Certain technical witnesses later expressed the conviction that the proper interpretation of the sentence allowed a total distributed load on one bay of the D.I.C. scaffold of 11,502 lb.

192. Where human lives are involved, the need for greater precision in such matters is obvious.

193. A further point that has some special relevance at present is that there is greater activity today in the erection of large commercial buildings and flats than there has been for many years with consequentially greater use of high scaffolding.

194. To bring the inspection of scaffolding and excavation into proper focus with other multifarious responsibilities of the Department of Labour, it might be mentioned that the inspectors of scaffolding constitute seventeen out of a total staff of the Department of 1,031. It is also to be noted that the space devoted to the administration of the Act in the annual reports of the Department appears to be roughly in the same proportion.

195. It is perhaps understandable that the administration of the Act has been relegated to a position of relatively minor importance amongst the many activities of the Department, some of which, such as the solution of industrial problems, make intense day-to-day demands upon the time and energy of the senior administrative and executive officers of the Department.

196. The Act itself is not satisfactory, the regulations are worse, and these facts have conspired to engender looseness and improvisation in administration and inspection.

197. We are satisfied that field inspection requires to be strengthened and improved, but we are not satisfied that, at the present stage, an increase in the number of field inspectors is necessary. More efficient administration of the Act and greater safety for workers and the public can be achieved by other means.

198. Inspectors of scaffolding have in most cases been drawn from operatives with considerable experience in the building industry. They are basically practical men, who have endeavoured to carry out their duties within the limits of their capacities, but have been handicapped by their own lack of technical knowledge and the absence of technical assistance.

199. In the course of the inquiry we have developed the opinion that higher educational and other qualifications should be demanded of future appointees to the position of inspector. We do not go so far as to suggest that they should be professionally qualified, but they should, for example, have a sound grasp of elementary science and the basic principles of theory of structures.

200. There are occasions, however, when inspectors are faced with complex problems warranting professional advice, and we suggest an administrative liaison with the Ministry of Works so that inspectors will

have the right to seek technical advice from the professional officers of that Department. This arrangement would operate at district level as well as at head office level. The Engineer-in-Chief of the Ministry of Works, in giving evidence before the Commission, stated that there would be no difficulty in reaching or operating such an arrangement so far as his Department was concerned.

201. There is a further reason for proposing higher qualifications for inspectors. Elsewhere in this report we recommend a proper and effective system of certification of competent scaffolders, and we believe that the adoption of that recommendation will do much to ensure safer working conditions on scaffolds. The issue of such certificates would be a responsibility of the inspectors who therefore should, through education and experience, be in a class well above that of an expert scaffolder.

202. During the inquiry considerable criticism was levelled at the Department of Labour on the grounds that it had been most lethargic in not initiating or promoting amendments to the Act and regulations to bring them up to date. We do not propose to comment on this criticism, because amendments to the legislation and regulations are the responsibility of the Legislature and the Executive Council.

SYSTEM OF PAYMENT OF SCAFFOLDERS ENGAGED ON ERECTION AND DISMANTLING OF SCAFFOLDING

203. A matter related to the D.I.C. accident and the inquiry, which we consider should be brought to the attention of the Government, is the system of payment of scaffolders engaged on the erection and dismantling of scaffolds.

204. During the periods in which the two scaffolders on the D.I.C. Building were actually occupied in erecting and dismantling the scaffolding they were paid on the basis of a fixed unit rate per fitting. The unit rate for dismantling was less than that for erection.

205. Workers engaged on scaffolding in Wellington are covered by the Gisborne, Wellington, Marlborough, Nelson, Westland, Canterbury, and Southland Building, Quarries, Contracting, Civil Engineering, Constructional and Allied Industries Labourers and Other Workers' Award. Clause 17 of the award reads:

> Workers covered by this award shall be prohibited from working piecework, except in the case of mutual agreement between the workers' union and the employers' union.

206. It is not for the Commission in these proceedings to determine whether a breach of the award has been committed; but it seems to us that the procedure adopted by the scaffolders of stacking the very large quantity of dismantled materials on decks at high levels was closely related to the system of payment. From evidence placed before us, we consider that the scaffolders were aware that the stacking procedure was to their financial advantage in that it would have facilitated the re-erection of the scaffolding in Panama Street by eliminating the tedious process of lowering much of the dismantled materials to the ground, transporting it around the corner of the building, and lifting it into position again for re-erection.

207. If such systems of payment for the work of erection and demolition of scaffolds are to be used, we are of the opinion that the supervision of the operations of the scaffolders must be most vigilant.

208. In the case of the D.I.C. scaffolding we find that the supervision and checking of the work of the scaffolders as pieceworkers was seriously inadequate.

THE SCAFFOLDING AND EXCAVATION ACT 1922

209. In the order of reference we are directed in particular to report our opinion whether any additional legislation is necessary and, if so, the scope of the same, and whether the regulations included in the existing law provide for reasonable and proper safeguards against similar accidents, or whether any amendments or additions to them are required.

210. The Scaffolding and Excavation Act 1922 covers a number of matters other than scaffolding. We interpret the word "similar" in the above extract from the order of reference as limiting the scope of our inquiry to those provisions in the Act and regulations which relate directly or indirectly to the erection and use of scaffolding and associated gear, and which require to be reviewed in the light of the D.I.C. accident with the object of preventing scaffolding accidents in the future.

211. The D.I.C. accident arose out of the dismantling of the scaffold and the operations of the scaffolders doing the dismantling. We have already stated that these activities in themselves do not appear to be subject to the Act.

212. The preamble to the Act setting out its object refers to the "Prevention of Accidents in Connection with the Erection and Use of Scaffolding . . .", but nowhere in the statute does there appear any reference to the dismantling or demolition of a scaffolding except in section 8 (3) (a) which merely empowers an inspector to give a direction that a dangerous scaffold be dismantled.

213. In section 2, the definition of "Building" excludes scaffolding. The definition of "Building work" refers to demolition of any building and therefore also excludes the demolition of any scaffolding. "Scaffolding" means any structure or framework used or intended to be used for the support of persons engaged in any building work. Once the building work is finished it appears that the scaffolding used thereon, and which is in the process of being dismantled, is not "scaffolding" within the meaning of the Act, and it seems clear also that the scaffolders engaged on the dismantling are not covered by the Act as, although they are supported by the framework, they are not engaged in building work.

214. In sections 3 (1), 5 (1) (a), 6, 8 (1) (a), and 17 (a) there are varying references to the erection, use, and maintenance of scaffolding, but no reference to dismantling or demolition of scaffolding.

215. In the British Building (Safety, Health, and Welfare) Regulations 1948 (No. 1145), clause 6, prescribes that no scaffold shall be erected or be substantially added to or altered or be dismantled except under the immediate supervision of a competent person. . . .

216. Section 2 of the Western Australia Inspection of Scaffolding Act (No. 39 of 1924) defines "scaffolder" as meaning the person in charge of the erection or demolition of scaffolding. . . .

217. Section 11 (1) of the same Act prescribes *inter alia* that there shall be at least one duly licensed scaffolder employed or engaged in the supervision of the erection or demolition of scaffolding. A free translation of the German Scaffolding Regulations includes a direction that scaffoldings shall be faultlessly constructed, erected, and dismantled in accordance with the principles of mechanics.

218. We are satisfied that the statute dealing with scaffolding in New Zealand should be amended so as to cover clearly the dismantling or demolition of scaffolding, and provide for the protection of the scaffolders and other workmen engaged on such work as well as members of the public who, as the D.I.C. accident shows, require to be considered.

219. The definition of the word "Gear" in section 2 of the Act should be widened to include and recognise the special materials, fittings, and equipment which have been introduced for the erection of steel and aluminium alloy scaffolding.

220. It seems doubtful whether a hoist mounted on a scaffold falls within the definition of "crane", because "building" does not include scaffolding.

221. Dealing with section 3, we consider that for reasons already given elsewhere in this report, provision should be made for the appointment of a chief inspector of scaffolding. We are disposed to suggest that section 3 (2) of the Act should be repealed.

222. The powers of entrance provided in section 4 seem to be inadequate to cover all the responsibilities of inspectors.

223. Section 5 of the Act requires a person about to erect a scaffold or commence any building work, where any person engaged thereon may incur the risk of a fall of 12 ft. or more, to give notice to the inspector of the time when he intends to begin such work. The evidence disclosed that a practice has developed for scaffolding subcontractors to give such notice, but we are of the opinion that the responsibility for giving notice, and for compliance with the Act and regulations, should fall on the principal building contractor. We consider that provision should be made in section 5 for giving notice to an inspector when large scaffolds above a prescribed height are about to be dismantled, particularly if there is any unusual risk to the general public.

224. We also think that where, under section 3 (2A), inspectors are appointed within other Government Departments, the requirement for notice in respect of work being carried out by these Departments should be dispensed with in the same way as is provided for in section 4 of the Amendment Act of 1948.

225. A further suggestion to streamline administration is that when a large localised undertaking is embarked upon, such as a hydro-electric scheme, a dam, or a large bridge, during the course of which a considerable amount of scaffolding is likely to be used continuously or intermittently on different sections of the work, one initial notice could be deemed to be adequate for the purposes of the Act, provided the Permanent Head of the Department of Labour, or the chief inspector of scaffolding (if one is appointed), is satisfied that it is reasonable in the circumstances to accept one such notice only, and that the adequate inspection of the scaffolding used on the undertaking will not thereby be jeopardised.

226. On the intention of section 6 there in some confusion. The section appears to contemplate the issuing of a certificate in respect of every scaffolding exceeding 25 ft. in height and every crane.

227. Regulation 28 (The Scaffolding Regulations 1935 (Reprint): Serial number 1952/70) reads:

> Every certificate issued by an inspector under section 6 of the said Act that the person named therein is competent to supervise the erection or alteration of a scaffolding exceeding 25 ft. in height, or of any crane, shall be in the form numbered 4 in the Second Schedule hereto.

The form referred to contains the words:

> . . . a scaffolding exceeding 25 ft. in height (*or* of a crane) at . . .

The blank space after the word "at" appears to us to call for a specific address, thus making the certificate valid for only one particular site. Yet the evidence shows that inspectors have issued certificates which gave blanket coverage either for the whole Dominion or for particular provinces and which contained no restrictions to any one specific case.

228. We consider that the Act should provide for the licensing of scaffolders after oral examination and submission to practical tests by an inspector of scaffolding, and that on all scaffolding exceeding, or likely to exceed, 25 ft. in height, at least one licensed scaffolder should be employed or engaged in the supervision of its erection or demolition.

229. Section 9 of the Act requires clarifying. The question arises whether, in the case of an accident in which only a member of the public is killed or seriously injured, a notice is necessary. Regulation 31 and Form S. & E. 8 of the Second Schedule to the regulations seem to provide only for the reporting of accidents to workers engaged on the job. Incidentally, we would point out that section 4 (1) of the Amendment Act of 1951 is not concerned with the safety of the public.

230. Subsection (4) of section 9 relates only to building work and excavation. We have already pointed out that building work does not include scaffolding.

231. With regard to section 14, we pose the question as to whether subsection 1 (d) thereof is fully consistent with subsection 7 (c) of section 8.

232. Section 17 (a) should be expanded to cover dismantling of scaffolding, and also allow for the prohibition of the use of any particular kind of scaffolding. Section 17 (c) should be extended to include provision for the examination of applicants for licences as scaffolders.

233. The matters pointed out in the foregoing are not exhaustive of the unsatisfactory features of the Act. There is, for example, considerable confusion over the inspection and control of cranes and hoists, but we have not embarked upon such questions as we doubt whether they fall within the scope of our order of reference. We do express the view, however, that the whole Act should be thoroughly overhauled.

234. We would like to add that we think the Act should be expanded to cover adequately the use of scaffolding and scaffolding materials for allied purposes such as constructional centring, concrete falsework supports, scaffolds or elevated runways for power-driven concrete dumpers, etc., trestles or stages for the assembly or installation of plant, and temporary grandstands and other structures of a similar character.

235. We consider that such uses, except perhaps for simple cases in the second group, should be under the control of a registered professional engineer who would be responsible for the design, construction, and use of the structures and their subsequent dismantling.

THE SCAFFOLDING REGULATIONS 1935

236. We are directed in the order of reference to report our opinion whether the regulations included in the existing law provide for reasonable and proper safeguards against similar accidents, or whether any amendments or additions to them are required.

237. The only relevant regulations in force are the Scaffolding Regulations 1935, which were reprinted in 1952 (Serial Number 1952/70).

238. We have already discussed certain deficiencies of the Scaffolding and Excavation Act 1922 in its relation to scaffolding. Naturally some of those deficiencies are reflected in the regulations, and there is no need to reiterate our previous comment in full, but attention is drawn to a few typical shortcomings. For example, there is no mention in the regulations of the dismantling of scaffolding. Even the sole reference to dismantling in section 8 (3) of the Act is not repeated either in regulation 29, or in Form S. & E. 5, which is prescribed to be used in the giving of directions under section 8 (3).

239. In some respects the regulations are completely out of date. As an instance, regulation 2 (b) purports to set out the meanings assigned to terms by the Act. Although the regulations were reprinted in 1952, the definitions of terms do not incorporate the changes made in those definitions by the Scaffolding and Excavation Amendment Acts 1948 and 1951, so that therefore the regulations are nine years behind the statute.

240. So far as the D.I.C. accident and current scaffolding practice are concerned, the greatest deficiency of the regulations is the complete absence of any recognition of metal scaffolding of the types in common use today or of any requirements providing for reasonable and proper safeguards against accidents in the use of such material.

241. While there are indications of the existence of metal scaffolding in New Zealand even earlier than the thirties, the first occasion on which the use of one particular type of such scaffolding was approved by the Department of Labour was in May 1938. It happened to be the same type of scaffolding as was erected on the D.I.C. Building.

242. After World War II the use of metal scaffolding increased steadily, until by May 1950 the Head Office of the Department of Labour found it necessary to send out a circular or directive combining three previous circulars which had been issued to cover conditional approvals already granted to three proprietary types of metal scaffolding. A further and more comprehensive directive was issued in 1956. It is certain that metal scaffolding was in wide use in 1950 and is in exceedingly common use today.

243. It is clear that for some considerable time it has been accepted by inspectors of scaffolding as being satisfactory. It is also clear from the evidence of inspectors that they did not deem the departmental directives to be mandatory, and that they considered they had discretionary power to depart from the detailed conditions prescribed in the directives. In the case of the D.I.C. scaffolding there were a number of such departures, and these are mentioned elsewhere in this report.

244. In response to questions seeking the authority in the regulations which allowed approval of any form of metal scaffolding, we were referred to regulation 3 which reads:

> All scaffolding and gear shall be of the description indicated in these regulations under the respective headings, and shall be set up, built, maintained, and used in accordance with such regulations:
>
> Provided that it shall be lawful for any inspector to authorise the use for any particular purpose of any other description of scaffolding or gear in any case where he has personally inspected the same and has certified in writing that in his opinion such scaffolding or gear may safely be used for the purpose intended.

The only type of ordinary scaffolding described in the regulations is timber scaffolding, which is dealt with in regulations 15 to 19 inclusive. Consequently, in dealing with metal scaffolding, reliance must be placed on the proviso to regulation 3 just quoted. We consider, however, that the proviso was never intended to be used for giving blanket approval to any particular class of scaffolding.

245. Regulation 25 (which incidentally includes a reference incorrectly to regulation 2 instead of regulation 3), and Form S. & E. 1 in the Second Schedule to the regulations, support our view.

246. It is manifest that the proviso contemplates an individual personal inspection of a particular scaffolding by the inspector, followed by a certificate in writing that in his opinion such particular scaffolding may safely be used for the particular purpose intended. There was no evidence that any certificate has ever been issued by any inspector under regulation 3 for such a particular metal scaffolding serving a particular purpose.

247. We would point out that in Australia metal tubular scaffolding has been covered comprehensively in at least two States since 1951 in the regulations under the Scaffolding and Lifts Act 1912–1948 of New South Wales, and the Inspection of Scaffolding Act Regulations 1950 of Western Australia.

248. It can be stated with some justification, therefore, that:

(a) The Scaffolding Regulations 1935 are nine years behind the Scaffolding and Excavation Act:

(b) They are six years behind similar regulations in New South Wales and Western Australia:

(c) They are nineteen years behind the recognition of metal scaffolding by the Department of Labour, and at least seven years behind relatively common metal scaffolding practice in New Zealand.

249. While there are many matters of detail which we could criticise, we do not think there is real necessity to add anything further to the above comment, except to emphasise that the regulations are in urgent need of a complete overhaul with regard not only to scaffolding, but also to other activities covered by the Act and regulations.

250. During the inquiry some advocates expressed the view that the revised regulations, the necessity for which was admitted by all, should incorporate a standard specification or a standard code of practice which should be compiled by the New Zealand Standards Institute, while other representatives advocated that draft regulations should be drawn up entirely by the Department of Labour after consulting all interested parties.

251. We regard this question as one of machinery, and do not consider it matters by whom the regulations are prepared so long as they are drafted quickly, are clear, easy of access, and easy to follow. We express the view that the regulations should specify in some detail standard requirements for metal scaffolding, but they should also include basic specifications for structural design which would require to be complied with in cases where the detailed standard requirements set out in the regulations are not applicable.

SUMMARY OF RECOMMENDATIONS

252. We summarise our principal recommendations under Division II of the inquiry:

1. That the Scaffolding and Excavation Act 1922 be completely overhauled.
2. That dismantling or demolition of scaffolding be covered by the Act.
3. That the scope of the Act be widened to include the use of scaffolding and scaffolding materials for allied purposes such as concrete falsework, temporary grandstands, etc.
4. That provision be made for the appointment of a chief inspector of scaffolding.
5. That section 3 (2) of the Act be repealed.
6. That powers of inspectors to enter premises be extended to conform with the later amendments to the Act.
7. That provision be made for notifying the inspector when dismantling or demolition of a scaffold above a prescribed height is to begin.
8. That the obligation to notify the inspector in the case of Departments of State and local authorities which employ an officer appointed as an inspector under section 3 (2A) be dispensed with.
9. That in the case of large localised undertakings one initial notice be deemed adequate, subject to certain safeguards.
10. That responsibility for giving notice and for compliance in general with the Act and regulations be declared to fall on the principal building contractor.
11. That the period of notice under section 5 (2) be extended to five working days.
12. That section 6 be repealed, and in its place provision be made for certification of scaffolders as such.
13. That a register of persons holding scaffolders' certificates be kept in the office of the chief inspector of scaffolding.
14. That scaffolders' certificates be reviewed annually.
15. That power be included in section 17 to prescribe examinations for scaffolders.

16. That in case of accidents provision be made for magisterial inquiries on the same lines as are provided for in the Quarries Act 1944.

17. That when the Act is revised, every endeavour should be made to define clearly its ambit in relation to such statutes as the Boilers, Lifts, and Cranes Act 1950 and the Quarries Act 1944 with the object of eliminating confusion and overlapping which appear to exist.

18. That the Scaffolding Regulations 1935 be completely reviewed and brought up to date in line with the statute.

19. That the regulations include comprehensive provisions relating to the design, construction, erection, use, maintenance, permissible loading, and dismantling of metal scaffolding.

20. That the regulations include a full glossary of terms.

21. That provision be made for the reconstitution of the scaffolding examination board to include a registered professional engineer experienced in structures.

22. That higher educational and other qualifications should be demanded of future appointees to the position of inspector of scaffolding with a view to achieving a progressive improvement in the standard of such officers.

23. That an administrative liaison be established between the Department of Labour and the Ministry of Works under which inspectors may seek technical advice from the professional officers of the latter organisation.

24. That provision be made requiring the approval of the appropriate local authority in all cases where it is proposed that scaffolding be erected on some existing structure such as a verandah in a position where human safety is involved.

25. That where the payment of scaffolders on a piecework basis or under a bonus system involving incentives for increased output is allowable under an award of the Court of Arbitration or an industrial agreement, provision should be made to ensure that the supervision and inspection of their work is most vigilant.

26. That it be made an offence for unauthorised persons to interfere with a scaffold.

27. That the stacking of dismantled materials on scaffolding be permitted, provided the maximum loading, stresses, and any other limitations prescribed in the regulations for the particular type of scaffolding are not exceeded.

28. That provision should be made for periodical detailed inspection and maintenance of all scaffolding by a certificated scaffolder who should be required to keep a written record of the dates of his inspections which must be produced upon request of the inspector of scaffolding.

253. A number of minor practical suggestions were made by different advocates which warrant careful consideration when a code for metal scaffolding is being prepared. They are fully recorded in the proceedings, and we commend them for examination by the appropriate authorities.

CONCLUSION

254. We feel obliged to mention that for the purposes of the inquiry a model of the scaffolding was made by the Railways Department in conjunction with the Ministry of Works. This model, together with plans prepared after the accident, were of considerable assistance to the Commission and to all parties concerned.

255. We also wish to state that the excellent photographs taken by the National Publicity Studios shortly before the accident and the similarly excellent pictures supplied by the press of the scene of the catastrophe at different stages after the collapse proved most useful during the course of the inquiry.

256. In concluding this unanimous report the Commission desires to record the great courtesy and co-operation it received from all counsel and advocates representing the various interests who took part in the proceedings.

257. We acknowledge with appreciation the diligence and efficiency of the reporting staff who, by working long hours, kept the record of proceedings up to date and thereby facilitated the work of the Commission.

258. Finally, we would pay a grateful tribute to the secretary Mr W. H. Dunn, A.M.C.TECH., A.M.I.MECH.E., A.F.R.AE.S., and his assistant, Mr M. R. Morrison, for the very efficient and conscientious manner in which they performed their exacting duties.

We have the honour to be,

Your Excellency's most obedient servants,

A. TYNDALL, Chairman.

C. W. HAMANN, Member.

D. S. G. MARCHBANKS, Member.

Dated at Wellington this 25th day of September 1957.

APPENDICES

APPENDIX A: ALPHABETICAL INDEX OF WITNESSES

Witness	Called By	Reference to Evidence Volume	Pages
Anderson, Vera	Department of Labour	1	1G1–1H4
Andrews, Alfred Latham	D.I.C. Ltd.	7	32R2–34V2
Anton, William Jukes	Federation of Labour	7	35X3–36B3
			42C1–42E1
Austin, Albert John	Department of Labour	1	1R2–1T3
Baker, Charles	Carpenters', etc., Unions	9	42Q2–43R1
Barker, Alan	Department of Labour	8	39U1–39X3
Barr, Allan Dallas	Department of Labour	1	N1–P3
Barrett, Lawrence Michael Stanley	Department of Labour	1	U4–X3
Baxter, Kenneth McLeod	Federation of Labour	9	41Z2–42B3
Brayshay, Darrell Thomas Cooper	Department of Labour	1	1U1–4H3
		9	43R1–44J2
Cameron, George	Certified Concrete Ltd.	5	22H1–22K4
Carlyle, Shirley	Steel and Moss Ltd.	7	31Z3–32B1
Clendon, Thomas Vivian	Inspector of Scaffolding	3	11P3–12Q1
Cormack, Harrison William	Certified Concrete Ltd.	5	22L1–22Z2
			24Q2–26T2
		6	26U2–27L4
		9	44K1–44T2
Davey, Clifford	Carpenters', etc., Unions	9	42E2–42Q3
Donaldson, Mary Ellen	Department of Labour	1	1P1–1R2
Dyer, Veronica Jane	Department of Labour	1	R2–T1
Farmer, Vivian Herbert	Department of Labour	1	1H4–1K2
Finkelstein, Joseph	Department of Labour	1	1M2–1N3
Goodall, Leith Conroy	Department of Labour	1	K3–M5
Gwilliam, Owen Llewellyn	Steel and Moss Ltd.	7	36B3–36H1
Hansard, Peter	Department of Labour	1	1C1–1F4
Hawkins, Raymond	Steel and Moss Ltd.	6	31M1–31N2
Heath, Lionel Arthur	Department of Labour	2	9J2–9P1
Hendriksen, Eric Ernest	Department of Labour	1	E3–E4, G1
		2	6P2–9H3
		7	35J2–36Q1
Hensley, Charles Henry	Inspector of Scaffolding	2	10B1–10M3
		3	10N1–11P3
Holford, Eric James	D.I.C. Ltd.	7	34V2–34Y3
Houston, Robert Rostrevor	Department of Labour	1	E4–K3
Hubbard, Edmund Francis	Department of Labour	2	5V1–6P2
Hyde, William Julius	Commission	8	39X1–40G1
Jackson, George Myers Frost	Department of Labour	8	36K1–37S3
			38J1–38X3
			39L2–39U1
Johnstone, Arthur Ernest	Department of Labour	3	13A1–13L1
Kristensen, John Robert William	Certified Concrete Ltd.	3	13S1–15M3
		4	15N3–16Q1
McArtney, Ivan James	Inspector of Scaffolding	3	12Q1–12Z1
McDonald, Leslie John	Department of Labour	8	40G2–40H1
McLeod, Joan	Steel and Moss Ltd.	7	31Y1–31Z3
McLeod, Kenneth Ian	Steel and Moss Ltd.	6	30H2–30X2
Matthews, Josephine Noni	Department of Labour	1	T2–U4
Milne, Grant Raglan	Commission	9	45C2–45D2
Morrison, Walter Gordon	Certified Concrete Ltd.	4	16Q1–20G1
		5	23A1–24Q2
Moss, Bevan Charles	Steel and Moss Ltd.	6	30X2–31M1
Moss, Bruce McKenzie	Department of Labour	1	E1–E2
Moss, Leonard Charles	Steel and Moss Ltd.	7	32B1–32Q3
Newlands, Susan	Department of Labour	1	P3–R2

Witness	Called By	Reference to Evidence Volume	Pages
Nolan, Desmond Charles ..	Federation of Labour ..	7	35R1–35X3
		8	41A1–41H3
		9	41J1–41X2
Nutter, James	Certified Concrete Ltd. ..	4	20H1–21P1
		5	21Q1–22G3
Pearson, Leslie Alexander ..	Department of Labour ..	1	4J1–4N3
		2	4P1–5U2
Robieson, Sinclair Noel ..	Department of Labour ..	1	1K2–1M2
Stevenson, Edward Alexander ..	Department of Labour ..	2	9T1–9W3
Turksma, Ernest Henry ..	Certified Concrete Ltd. ..	6	27L4–28X2
Turner, Charles William Okey ..	Commission	9	44T2–45C2
Walker, Brian Malcolm ..	Steel and Moss Ltd. ..	7	31W2–31Y1
Wells, Alfred George	N.Z. Master Builders' Federation	9	45E1–45J3
Whisher, Geoffrey Kenneth ..	Department of Labour ..	1	Y1–1C1
Whitaker, Hendrick	Department of Labour ..	2	9P1–9T1

APPENDIX B: DETAILS OF EXHIBITS PRODUCED AT THE SITTINGS

Exhibit No.	Description	Reference to Evidence, Page No.
1	D.I.C. building plans produced by Mr Watts, representative of Mitchell and Mitchell	A1
2	Photographs of the D.I.C. before the accident. Original and enlargement – taken 12.50 p.m., 8 May 1957, and 2.25 p.m., 8 May 1957. Produced by Mr Moss, National Publicity Studios: 2 Photographs A 2 Photographs B	D1
3	Drawing of front elevation of D.I.C. with scaffolding. Produced by Mr E. E. Hendriksen	E3
4	Photograph of D.I.C. with scaffolding drawn in. Produced by Mr E. E. Hendriksen	E3
5	Model of scaffolding prepared by Ministry of Works. Produced by Mr E. E. Hendriksen	E3
6	Press photograph of tangled mass	1D2
7	Photograph of broken verandah looking northward under verandah	1D2
8	Photograph taken from other side of Lambton Quay looking south including mobile crane	1D2
9	Photograph close up showing the three sections of the verandah collapsed	1D2
10	Photograph taken of broken verandah looking south from under the dome and including police sergeant	1D2
11	From dome looking southwards with two men in left-hand corner	1D2
12	Photograph from inside upper floors on opposite side of Lambton Quay showing site after the scaffolding was removed ..	1D2
13	Earliest photograph of collapsed scaffold taken from upper stories of a building across the street. Produced by Mr A. D. Barr ..	1T1
14	Copies of Department of Labour's correspondence with Fletcher Construction Co. Ltd. *re* approval of Burton type scaffolding and types of scaffolding approved. Also the 1950 directive and 1956 directive. Produced by Mr D. T. C. Brayshay ..	1U1
15	Photograph similar to No. 4 without scaffolding drawn in. Produced by Mr D. T. C. Brayshay	1V1
16	Photograph of pavement after accident debris cleared away showing bent hanger H3. Produced by Mr D. T. C. Brayshay	1V1
17	*Labour and Employment Gazette*, Vol. VII, No. 1, page 52. Produced by Mr D. T. C. Brayshay	1V1
18	Rules of guidance for inspectors of scaffolding. Reprinted Scaffolding and Excavation Act 1922. Scaffolding Regulations 1935 (Reprint). Produced by Mr D. T. C. Brayshay	1V1
19	Circular – certificates of competency to supervise erection of scaffolding or crane. Produced by Mr D. T. C. Brayshay ..	1X2
20	Photograph showing the scaffolding on the northern side taken on 9 June by union photographer. Produced by Mr P. M. Butler	2T1
21	Notice of intention to erect a scaffolding on the D.I.C. lodged by Certified Concrete Ltd. Produced by Mr D. T. C. Brayshay ..	3B1
22	Schedule of scaffolding accidents prepared from Department of Labour annual reports. Produced by Mr D. T. C. Brayshay ..	3C2
23	Technical Pamphlet No. 4 – "Scaffolding – Tubular Steel and Suspended". The Royal Society for the Prevention of Accidents. Produced by Mr D. T. C. Brayshay	4H3
24	Photographs: Bolt H4–A1 north. H3–A2 south. Test rig for longitudinal impact test. Test rig for slip test on coupler. Test rig for measuring deflection on coupled tube sections. Produced by Mr E. F. Hubbard	5V2

Exhibit No.	Description	Reference to Evidence, Page No.
25	Tensile test piece. A1 bolt H5. Produced by Mr E. F. Hubbard ..	5X1
26	Fractured portion of bolt H5. Produced by Mr E. F. Hubbard ..	5X1
27	A1 north-fractured portions of bolt, 2 parts. Produced by Mr E. F. Hubbard	5X2
28	A2 south-fractured portions of bolt, 2 parts. Produced by Mr E. F. Hubbard	5X2
29	A1 showing how threads stripped in mandrel. Produced by Mr E. F. Hubbard	5Y1
30	Bolt A2–H3 impact test piece unstrained section. Produced by Mr E. F. Hubbard	5Z2
31	Impact test piece-portion from strained section of bolt A2. Produced by Mr E. F. Hubbard	5Z2
32	Portion from mild steel test piece. Produced by Mr E. F. Hubbard	5Z2
33	Bolt H5 – 3 pieces of longitudinal impact test specimen. Produced by Mr E. F. Hubbard	6A1
34	Tie wires as received. Produced by Mr E. F. Hubbard	6B1
35	Tested tie wires – 3 pieces. Produced by Mr E. F. Hubbard ..	6B1
36	Further test specimen double twisted wire, failed at 1,165 lb. – 2 pieces. Produced by Mr E. F. Hubbard	6B1–2
37	Specimen double coupler for slip test. Produced by Mr E. F. Hubbard	6C1
38	Specimen double coupler for slip test. Produced by Mr E. F. Hubbard	6D1
39	Compressive test specimen of open-seam tube with joint in centre as shown in Exhibit 24. Produced by Mr E. F. Hubbard ..	6E1
40	2 broken coupler bolts – $\frac{5}{8}$ in. diameter from scaffolding. Produced by Mr E. F. Hubbard	6F1
41	Scaffolding tightening spanner. Produced by Mr E. F. Hubbard	6F2
42	Mild-steel tensile test specimen. Produced by Mr E. F. Hubbard	6G1
43	Photograph of scaffolding on northern side taken from across the street. Produced by Mr E. E. Hendriksen	7Y2
44	11 inspector's job sheets for inspection of D.I.C. scaffolding. Produced by Mr C. H. Hensley	10B1
45	Notice of accident on D.I.C. scaffolding. Produced by Department of Labour	11D2
46	The Employers' Liability Insurance Regulations 1957 – Form No. 4. Produced by Department of Labour	11E3
47	Certificate of Competency to supervise Erection or Alteration of Scaffolding exceeding 25 ft. in Height or of a Crane. Issued to Mr Kristensen. Produced by Mr C. H. Hensley	11G2
48	Photograph taken from Lambton Quay of Brandon Street scaffolding. Produced by Certified Concrete Ltd.	12T3
49	Photograph showing fixing of wire ties. Produced by Certified Concrete Ltd...	13U3
50	Plan of D.I.C. showing position of ties on scaffolding. Produced by Certified Concrete Ltd.	13W2
51	Photograph taken looking straight down onto the verandah of D.I.C. Produced by Certified Concrete Ltd.	13W3
52	Elevation of hanger stringers for the D.I.C. (Drawing Plan 4). Produced by Mr W. G. Morrison	16Q1
53	Details of construction of verandah as determined by measurement after the collapse. (Drawing No. 1180/1). Produced by Mr W. G. Morrison	16R1
54	Details to accompany evidence on method of failure (Drawing No. 1180/2). Produced by Mr W. G. Morrison	16R1
55	Photographs showing details of verandah construction, Panel I. Produced by Mr W. G. Morrison	16R1
56	Photographs showing details of verandah construction, Panel II. Produced by Mr W. G. Morrison	16R1
57	Photographs showing details of verandah construction, Panel II. Produced by Mr W. G. Morrison	16R1
58	Photographs showing details of verandah construction, Panel III. Produced by Mr W. G. Morrison	16R1

Exhibit No.	Description	Reference to Evidence, Page No.
59	Photographs showing details of verandah construction, Panel III. Produced by Mr W. G. Morrison	16R1
60	Photographs showing details of verandah construction, Panel III. Produced by Mr W. G. Morrison	16R1
61	Close up of end of verandah joists, Panel II. Produced by Mr W. G. Morrison	16R1
62	Close up of end of verandah joists, Panel II. Produced by Mr W. G. Morrison	16R1
63	Close up of end of verandah joists, Panel II. Produced by Mr W. G. Morrison	16R1
64	Close up of end of verandah joists, Panel II. Produced by Mr W. G. Morrison	16R1
65	Close up of end of verandah joists, Panel II. Produced by Mr W. G. Morrison	16R1
66	Sketch showing details of tests carried out by Certified Concrete Ltd. in Auckland on tubular scaffold to determine resistance to lateral forces. Produced by Mr W. G. Morrison	16S1
67	Publication *Civil Engineering*, February 1957, at page 205. Produced by Mr W. G. Morrison	16T1
68	Piece of timber on which a load of 3 tons has been applied through the end of a scaffold tube. Produced by Mr W. G. Morrison ..	17E1
69	Photograph: Test No. 5 on two timber beams. Produced by Mr W. G. Morrison	17E2
70	Photograph: Shows the beams after they have failed in bending in test No. 5. Produced by Mr W. G. Morrison	17E2
71	Photograph: Test No. 5. Shows the seating at the end of the beams and shows the ½ in. bolts (ties) before the load was applied. Produced by Mr W. G. Morrison	17E2
72	Photograph: Test No. 5. Shows the end of the same beam after failure. Produced by Mr W. G. Morrison	17E2
73	Photograph: Test No. 5. Shows a close up of the central part of the beam after it failed in bending. Produced by Mr W. G. Morrison	17E2
74	Photograph: Another view of same subject as Exhibit 73. Produced by Mr W. G. Morrison	17E2
75	Test loading on scaffolding frame erected in Auckland. Produced by Mr W. G. Morrison	17L1
76	Test loading on scaffolding frame (axial load on complete frame). Produced by Mr W. G. Morrison	17L2
77	Photograph: Enlargement of part of photograph Exhibit 2A. Produced by Department of Labour	18H2
78	"No bolt" joint pin type of coupling. Produced by N.Z. Federation of Labour	19X2
79	Swivel coupler and putlog coupler "No bolt" type. Produced by N.Z. Federation of Labour	19X2
80	Right-angle coupler "No bolt" type. Produced by N.Z. Federation of Labour	19X2
81	Translation of German Standard Specification D.I.N. 4420 for Scaffolding. Produced by N.Z. Federation of Labour ..	19Y2
82	Statute 1948, No. 1145 – Factories. The Building (Safety, Health, and Welfare) British Regulations 1948. Produced by N.Z. Federation of Labour	19Y2
83	Mr Nutter's Certificate of Competency to supervise Erection or Alteration of Scaffolding exceeding 25 ft. in Height or of a Crane. Form S. & E. 4. Produced by Mr J. Nutter ..	21E2
84	Amended plans of Exhibit 50 of D.I.C. showing position of ties. Produced by Mr H. W. Cormack	22Q2
85	Full scale detail of timber joists and R.S.J. showing notching of beam in D.I.C. Produced by Mr H. W. Cormack	22U1
86	Substitute drawing for Exhibit 53 (Drawing 1180/1). Details of construction of verandah. Produced by Mr W. G. Morrison ..	23L1
87	Amended drawing 1180/2 to replace Exhibit 54. Produced by Mr W. G. Morrison	23M1

Exhibit No.	Description	Reference to Evidence, Page No.
88	Calculations of deflection of joist 4 in Panel III. Produced by Mr W. G. Morrison	23P1
89	Photograph of beam support for test No. 5 prior to test. Produced by Mr W. G. Morrison	23Q2
90	Photograph of beam support for test No. 5 after test. Produced by Mr W. G. Morrison	23Q2
91	Photograph taken by Mr Molineux prior to Exhibit No. 7 showing verandah "Tent". Produced by Carpenters', etc., Union	24H3
92	Photograph of test rig shown on plan in Exhibit 75. Produced by Mr H. W. Cormack	24Q2
93	Photograph of the test rig shown in plan Exhibit 75. Test in compression of a single tube. Produced by Mr H. W. Cormack	24Q2
94	Leaflets showing various types of Burton's patent couplings. Produced by Mr H. W. Cormack	24Q3
95	Wellington City Consolidated Bylaws, Amendment No. 24 (Building), 1940. Produced by Wellington City Council	25W1
96	New South Wales Regulations 1912–48 (including the N.S.W. Act). Produced by N.Z. Federation of Labour	26D3
97	Letter of approval by the Department of Labour to Certified Concrete Ltd. for the use of tubular steel scaffolding. Produced by Mr H. W. Cormack	26S2
98	Estimate of scaffolding weights at D.I.C. on Lambton Quay (a) showing the weight coming down a pair of standards spaced 10 ft. apart and with ledgers spaced 6 ft. 4 in. apart, 13 bays; (b) the weight of material stacked on each lift. Produced by Mr H. W. Cormack	26X1
99	District Office, Department of Labour, Wellington – correspondence with Certified Concrete Ltd.	27L3
100	Department of Labour's circular concerning use of split seam scaffolding tubes	27X3
101	Tests 1 to 4. Details of tests on timber joists. Produced by Certified Concrete Ltd.	28P2
102	Tests 5 to 8. Details of tests on timber joists. Produced by Certified Concrete Ltd.	28P2
103	Certified Concrete's yard time of scaffolders (yard time and hourly rates). Produced by Certified Concrete Ltd.	28P3
104	Form of contract used by Certified Concrete Ltd. Produced by Certified Concrete Ltd.	28X2
105	Job card of Certified Concrete Ltd. for the D.I.C. showing issues of tubes and fittings. Produced by Certified Concrete Ltd.	28Y1
106	Putlog coupler used by Mr Adams for demonstration purposes. Produced by Painters' Union	29J2
107	Tests of timber beams (weathered oregon). Produced by Mr A. L. Andrews	32U1
108	Drawing showing deformation of H3 and H4 made from observations by Mr C. W. Hamann. Produced by Mr A. L. Andrews	33B2
109	Draft British Standards Specification dealing with steel design in structures – Draft D4811. Produced by Mr A. L. Andrews	34P1
110	Strong back (typical) from D.I.C. Produced by Mr E. J. Holford	34V3
111	Bundle of ties from D.I.C. offices after the accident. Produced by Mr E. J. Holford	34W1
112	Small bundle of ties and loop. Produced by Mr E. J. Holford	34W2
113	Tube used for tests of penetration of tubes into timber. Produced by Mr E. F. Hubbard	34Y3
114	Douglas fir specimen – penetration under various loads. Produced by Mr E. F. Hubbard	34Z1
115	*Pinus insignis* specimen – heart side up for test as in Exhibit 114. Produced by Mr E. F. Hubbard	34Z1
116	*Pinus insignis* specimen – heart side down for test as in Exhibit 114. Produced by Mr E. F. Hubbard	34Z1
117	Heart rimu used in test as in Exhibit 114. Produced by Mr E. F. Hubbard	34Z1

Exhibit No.	Description	Reference to Evidence, Page No.
118	Section of *pinus insignis* which was loaded after being placed on four layers of malthoid and a layer of 1 in. thick timber. Produced by Mr E. F. Hubbard	34Z2
119	Shear test piece – tangential cut from section of 12 in. x 3 in. x $1\frac{7}{8}$ in. timber from D.I.C. verandah. Produced by Mr E. F. Hubbard	35A2
120	Shear test piece – radial cut from 12 in. x 3 in. x $1\frac{7}{8}$ in. timber from D.I.C. verandah. Produced by Mr E. F. Hubbard	35A2
121	Shear test piece – taken from joist No. 7, Panel I, between H4 and H5 (No. 1R). Produced by Mr E. F. Hubbard	35B1
122	Shear test piece – taken from No. 7, Panel I, between H4 and H5 (No. 3T). Produced by Mr E. F. Hubbard	35B1
123	A beam taken from joist No. 7, Panel No. I, between H4 and H5. Produced by Mr E. F. Hubbard	35C1
124	Specimen taken from joist No. 7, Panel No. I, between hangers H4 and H5. Produced by Mr E. F. Hubbard	35C1
125	Piece of No. 8 tie wire taken from Room 607 in the D.I.C. Produced by Mr D. G. Nolan	35R1
126	Photograph of the workers clearing away the debris immediately after the accident. Produced by Mr D. G. Nolan	35R2
127	Mr Nolan's sketch book showing some of the details of the tomming of the verandah. Produced by Mr D. G. Nolan	35G1
128	A group of 17 photographs taken on 9 and 10 May 1957 (lettered A-Q). Produced by Mr W. J. Anton	35Y2
129	Machinery Act 1950. Produced by Department of Labour	36J2
130	Letter to employers' and workers' organisations in building trades asking for suggestions *re* amendment to scaffolding regulations. Produced by Mr G. M. F. Jackson	36P3
131	Department of Labour – letter to Secretary, Federation of Labour, 26 September 1956 – proposed basis for discussion – regulations – Scaffolding and Excavation Act 1922. Produced by Mr G. M. F. Jackson	38S2
132	Summary of prosecutions under the Scaffolding and Excavation Act 1922 from 1938 to 1956. Produced by Mr G. M. F. Jackson	38S2
133	Safeway Scaffolding Ltd. – conditions of hire. Produced by N.Z. Federation of Labour	
134	16 photographs – Nos. 1–16. Submission No. 18, page 87. Produced by Mr W. J. Hyde	40A1
135	New Zealand Standards Institute Code of General Bylaws, Part II, Scaffolding and Deposit of Building Materials. Produced by Mr L. J. MacDonald	40N1
136	American Standard – Safety Code for Building Construction American Standards Association A.10.2.1944. Produced by Mr L. J. MacDonald	40N1
137	Group of 13 photographs – various scaffolds in Wellington. Produced by Mr D. G. Nolan	41C2
138	Correspondence between Labourers' Federation and Department of Labour. Decision of Disputes Committee 1939. Copy of Labourers' Federation Conference Report 1955. Minutes and records of Combined Unions Scaffolding Committee 1957. Finding of 1957 Committee. Produced by Mr D. G. Nolan	41C2
139	Depositions of witnesses at inquest in respect of death of Robert E. Williams. Produced by Mr D. G. Nolan	41G1
140	Deposition of witnesses at inquest in respect of death of Thomas Elliott Doch. Produced by Mr D. G. Nolan	41G1
141	Correspondence between the Department of Labour and Wellington, Nelson, Westland, and Marlborough Local Bodies, Other Labourers, and Related Trades Industrial Union of Workers concerning Wilkins and Davies construction job (Wool Board Building). Letters dated 18 December 1956, 15 January 1957, and 17 January 1957. Produced by Mr D. G. Nolan	41H1
142	Depositions of witnesses at inquest in respect of death of Ronald Thomas Francis Bugden. Produced by Mr D. G. Nolan	41H2

Exhibit No.	Description	Reference to Evidence, Page No.
143	Depositions of witnesses at inquest in respect of death of Clarence Vincent Cooper. Produced by Mr D. G. Nolan	41J1
144	Western Australia Inspection of Scaffolding Act 1924–1950 and amendments, regulations under this Act 1951. Produced by Mr D. G. Nolan	41K3
145	Correspondence concerning Scaffolding Examination Board. Produced by Mr K. M. Baxter	42A1
146	10 photographs: Four relating to hoists. Two relating to chutes. Four relating to scaffolding in Adelaide Road. Produced by Mr W. J. Anton	42C2
147	Depositions of witnesses at inquest in respect of death of Christian Hohan Arapita. Produced by Mr W. J. Anton	42D1
148	Photograph of wire tie on the Victoria University science block. Produced by Mr W. J. Anton	42D2
149	Photographs: Tomoana Freezing Works four-storey addition to slaughter chambers. Produced by Mr C. Davey	42F2
150	Department of Labour's Circulars Nos. 37 and 38. Produced by Department of Labour	42S2
151	Copy of *Public Service Official Circular* dated 2 March 1955. Produced by Mr D. T. C. Brayshay	43R1
152	Summary of suggested amendments to Scaffolding and Excavation Act 1922. Produced by Mr D. T. C. Brayshay	43R1
153	Examination papers for examination of inspectors of scaffolding. Produced by Mr D. T. C. Brayshay	43R1
154	"Norstel" Aluminium couplers: 1 right-angle coupler. 1 swivel coupler. Produced by Mr D. T. C. Brayshay	43R2
155	Right-angle coupler "Acrow". Produced by Mr D. T. C. Brayshay	43R2
156	Swivel coupler "S.G.B." Produced by Mr D. T. C. Brayshay ..	43R2
157	Right-angle coupler – Type B. "S.G.B." Produced by Mr D. T. C. Brayshay	43R2
158	Right-angle coupler (not approved) "Crabtree". Produced by Mr D. T. C. Brayshay	43R2
159	Contribution book to the Wellington Amalgamated Society Painters, Decorators, Display, and Poster Artists Industrial Union of Workers. Produced by Mr D. T. C. Brayshay ..	43X1

APPENDIX C: GLOSSARY OF TERMS USED IN COMMISSION'S REPORT

The definitions set out hereunder are not intended as authoritative or standard definitions, but have been compiled solely to convey the meanings which the Commission has attached to the several terms used in the report.

During the sittings of the Commission some of the terms were used in different senses from those given here, and such differences have been noted below. All definitions have been framed in relationship to a scaffold of the independent type in so far as all vertical loads would be presumed to be sustained within the scaffold framework itself without any reliance upon the building for the supporting of such vertical loads.

Base plate:

A metal plate with a short pin fixed centrally at right angles to it over which the end of a tube is placed, the device being used to distribute the axial load in the tube over a larger area than the sectional area of the tube.

Adjustable base plate:

A base plate embodying a screw jack.

Bay:

That space extending from the base to the top of a scaffold enclosed within four neighbouring standards, i.e., two adjacent outer standards and the two corresponding inner standards. (Various and conflicting interpretations were put on this term by witnesses.)

Brace:

(a) *Longitudinal diagonal:*

A tube placed diagonally in the plane of a row of standards to afford stability to the scaffold in its longitudinal direction.

(b) *Cross*:

A tube placed diagonally between two standards lying in a plane at right angles to the length of a scaffold to afford stability in the transverse direction of the scaffold.

Coupler:

A fitting used to hold two tubes together by means of grip, applied through shaped jaws to the external surfaces of the tubes.

(a) *Double:*

A coupler, other than a putlog coupler, in which the sets of jaws for gripping two tubes at right angles are rigidly fixed in relation to each other in the one mounting, and are tightened independently by separate screws, bolts, or other tightening devices.

(b) *Swivel:*

A coupler which has two sets of independently tightened jaws connected by a pivot joint so that it can be used to connect two tubes at any angle to each other.

(c) *Putlog:*

A coupler for connecting a putlog at right angles to a ledger and having only one tightening device which simultaneously exerts the grip on each of the two tubes.

(d) *Sleeve:*

A coupler for connecting the butting ends of two tubes (normally used in conjunction with a joint pin).

Other Associated Fittings:

(e) *Base plate:*

See separate definition.

(f) *Joint pin:*

A fitting inserted in the ends of two butting tubes which are to be connected end to end (normally used in conjunction with a sleeve coupler).

(g) *Reveal pin:*

A fitting used for tightening or jacking a reveal tie between two opposing surfaces. (See "*Ties* (a)".)

Deck:

Any horizontal framework comprising the ledgers and putlogs of a scaffold. (During the hearing the term "lift", q.v., was generally used as having this meaning.)

Fender board:

A plank on edge running horizontally between and attached to the standards of a scaffold and having the lower edge in contact with the top surface of a working platform so as to provide a solid kerb to the platform to prevent materials or tools from falling off.

Hand rail:

A tube running horizontally between and secured to the standards of a scaffold and mounted at a specified height above the upper surface of a working platform to provide a safety fence to the working area.

Ledger:

A tube running horizontally in the longitudinal direction of a scaffold and secured to the standards so as to carry loads on the span between any two neighbouring standards.

Lift:

The vertical height between any two neighbouring decks in the same bay. (During the hearing this term was generally used to mean a deck, as defined above.)

Putlog:

A tube spanning horizontally in the transverse direction of a scaffold and secured to the ledgers.

Sole plate:

A timber plank or member placed under a standard of a scaffold to distribute the load over a larger area of bearing surface than the sectional area of the tube or the area of a base plate.

Standard:

A tube used as a vertical support, i.e., as a post or column in a scaffold.

Strongback:

A timber or other structural member (other than a reveal tie) fitted to a rigid part of a building to afford anchorage to a scaffold tie.

Ties:

(a) *Reveal tie:*

A tube jacked between two opposing surfaces of a building or other body to which a scaffold is to be attached to afford a secure anchorage to a tie from the scaffold.

(b) *Tie:*

A tube or twitched wire connecting the frame of a scaffold to a reveal tie or other rigid anchorage (e.g., strongback) to secure the whole scaffold transversely or to afford lateral restraint to a particular member (e.g., standard).

Tube, metal:

(a) *Close jointed:*

A steel strip rolled into the form of a circle in cross section, the butting edges not being joined.

(b) *Seamless:*

A tube consisting, in cross section, of a circle of continuous metal that has been manufactured either in one piece or from a tube of the close jointed type in which the butting edges have been welded together.

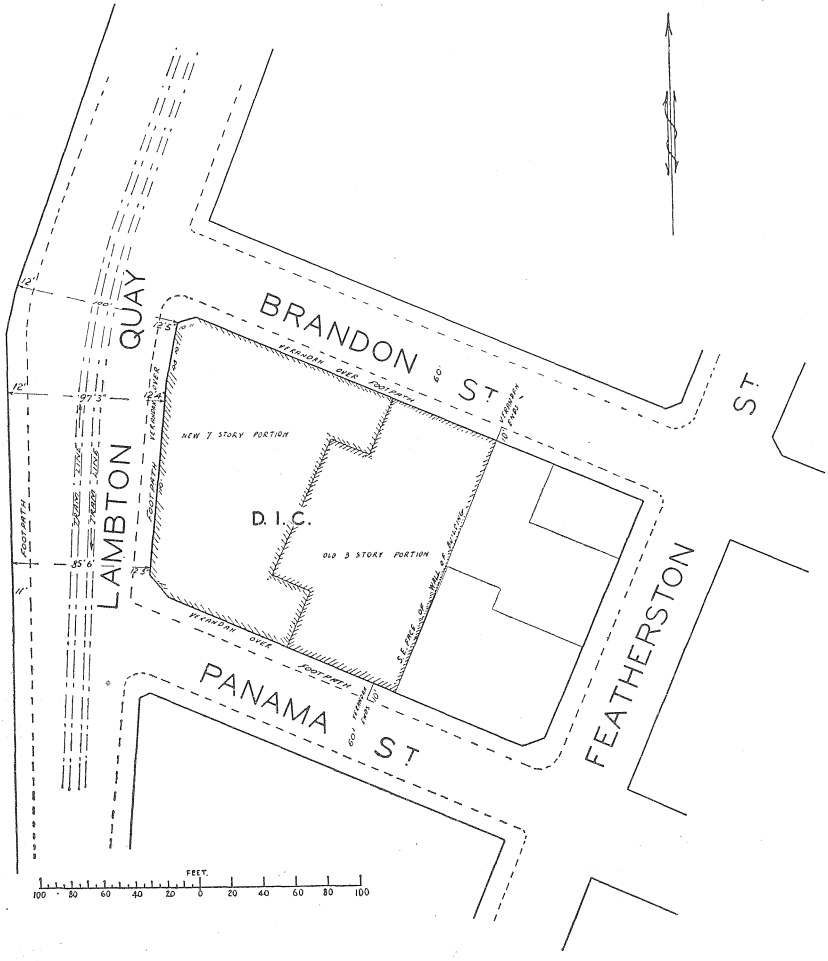
Tubular metal scaffolding:

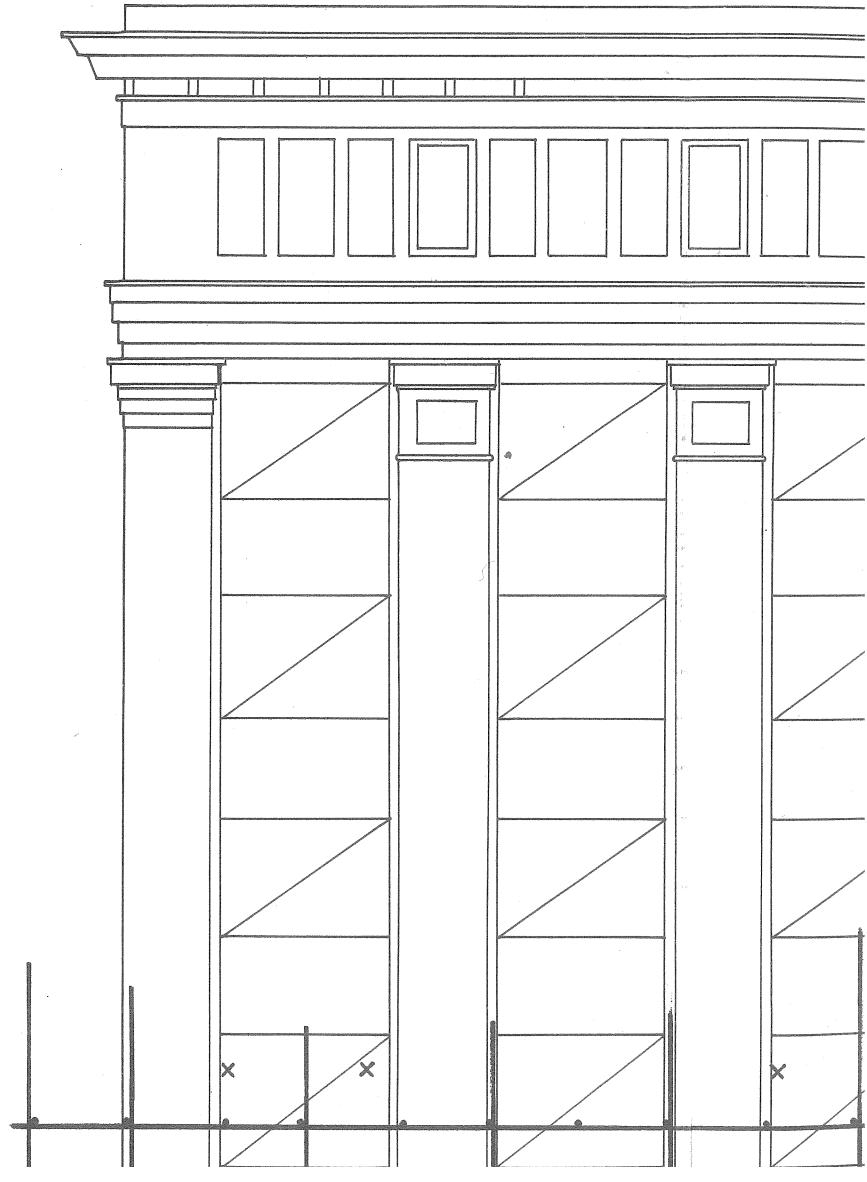
A temporary framed structure used to enable work to be done on a new or existing building, or for other similar purposes, and composed of steel or aluminium alloy tubes appropriately coupled together at the site to form the framework of standards, ledgers, putlogs, braces, ties, etc., or a similar structure assembled with pre-fabricated frame units.

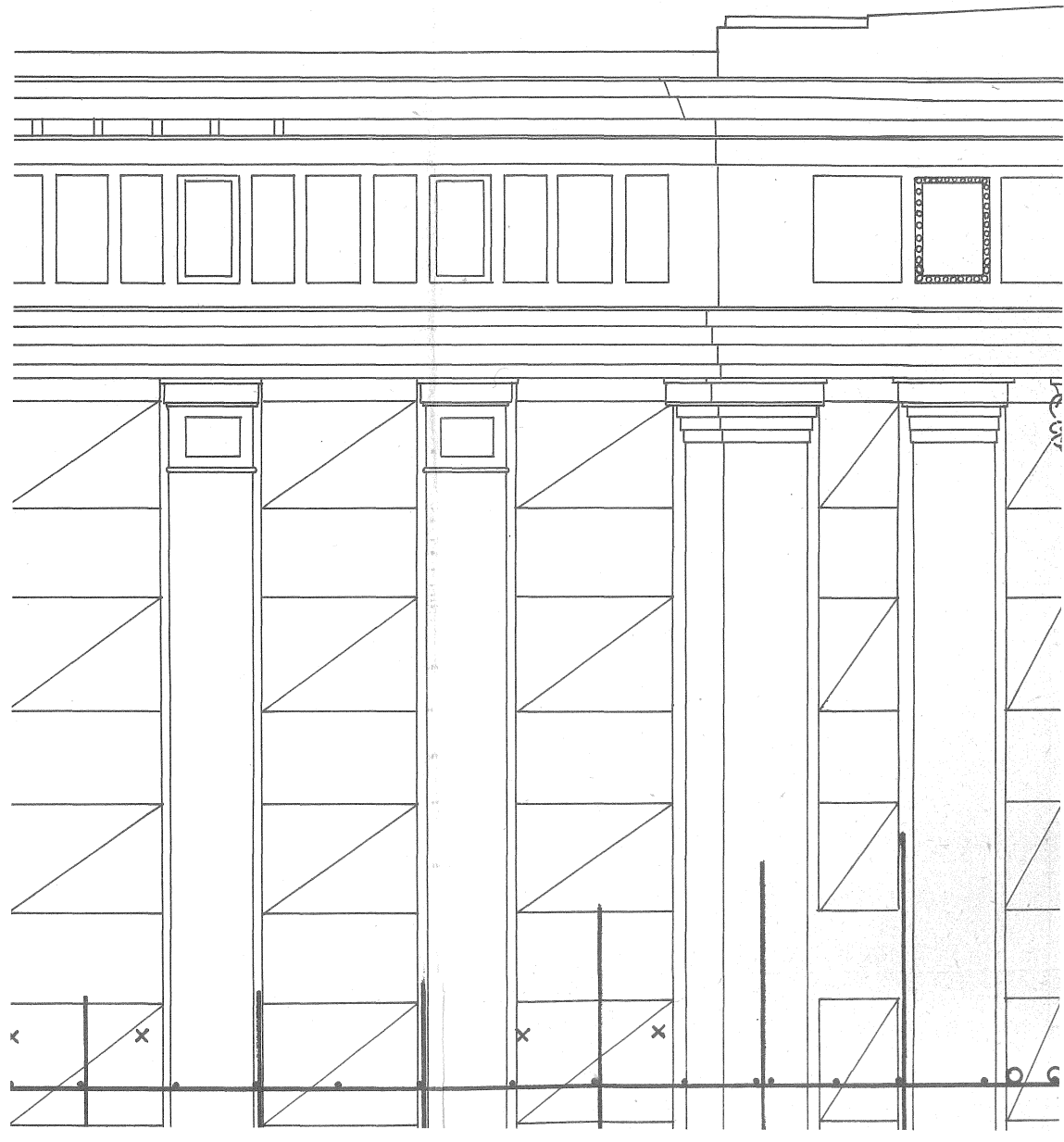
Working platform:

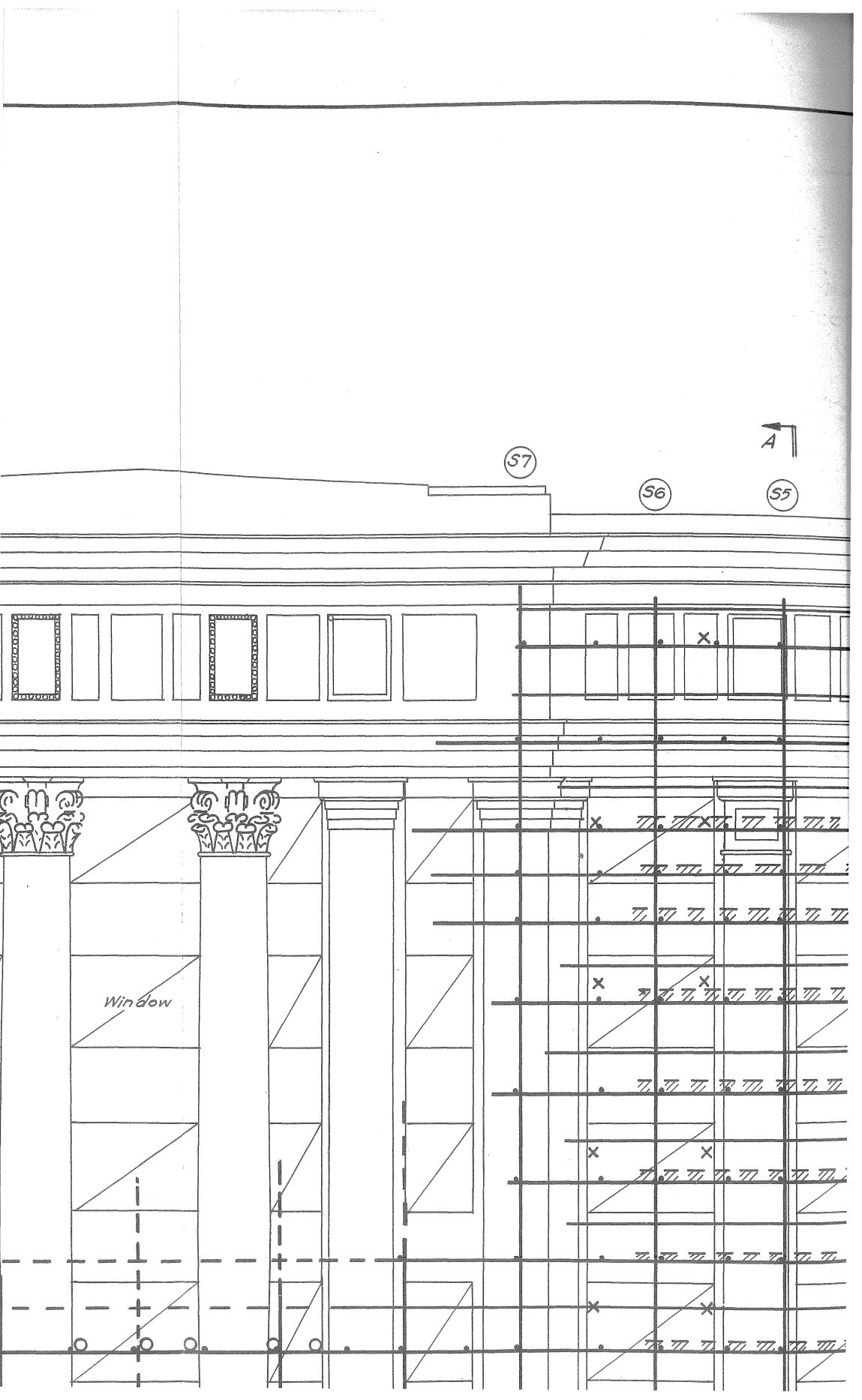
Planking placed on, and secured to, any deck of a scaffold to provide a safe floor for workmen.

APPENDIX D: SITE PLAN OF D.I.C.








A
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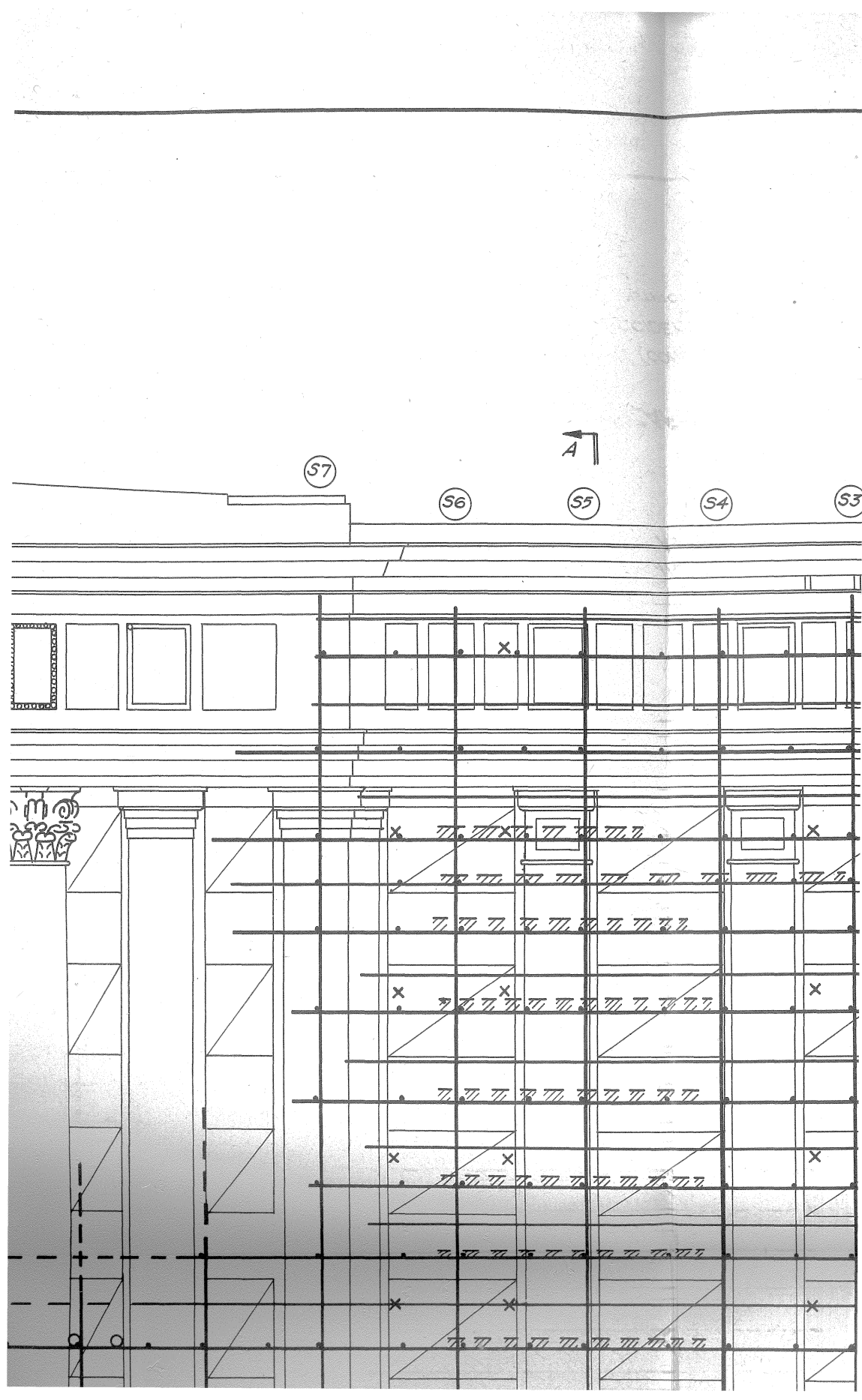
S6
S5
Window


A
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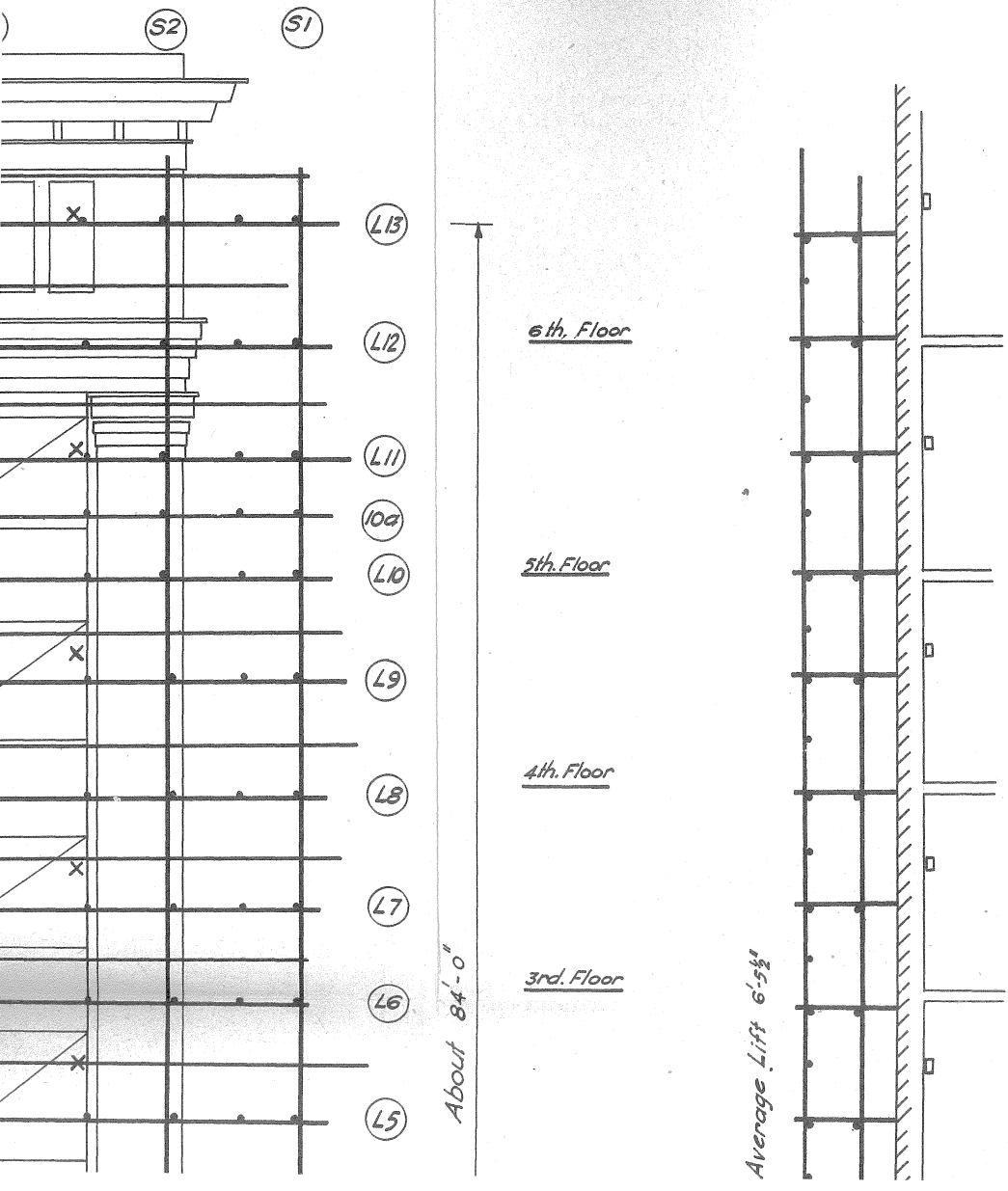
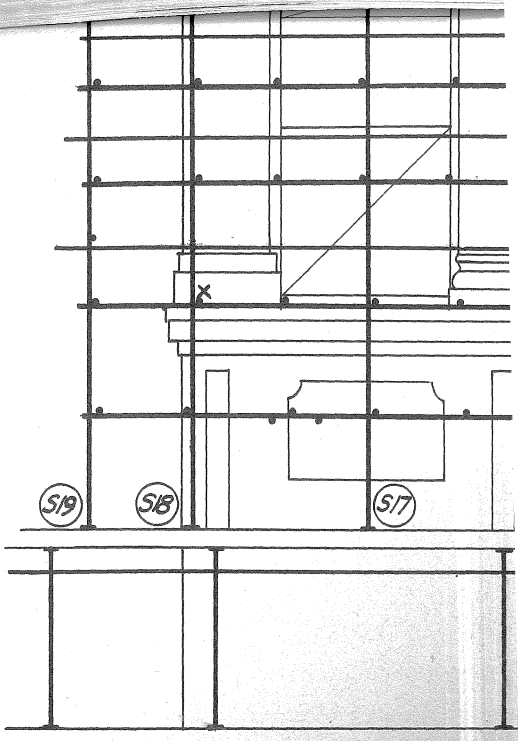
S3

DRAWING No. 2
APPENDIX E





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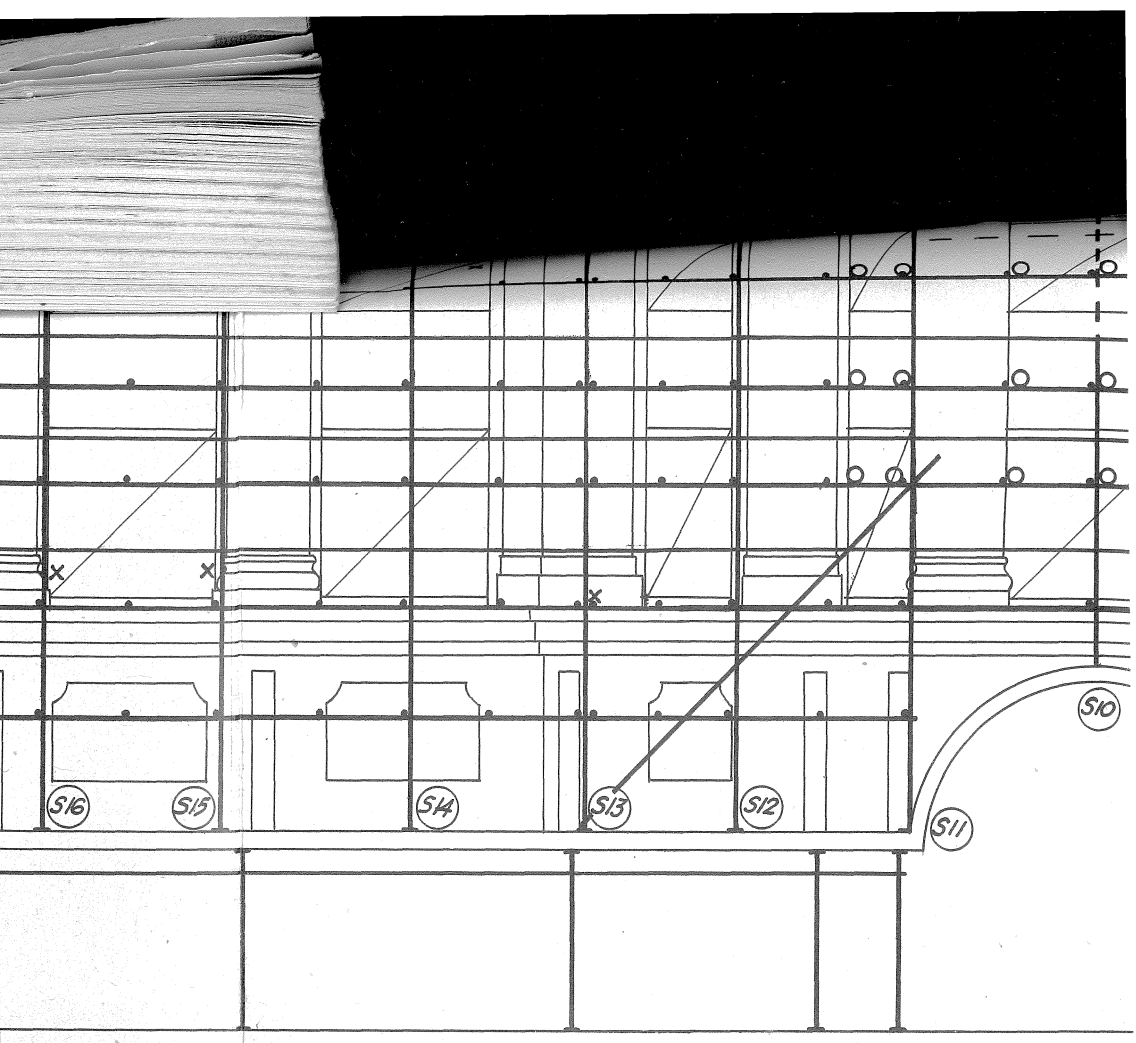
Position of t
Where tied b
Stacked M



hern Portion — — — — — — — — Central Por
bout 57'-0" About 57'-0

FRONT ELEVAT

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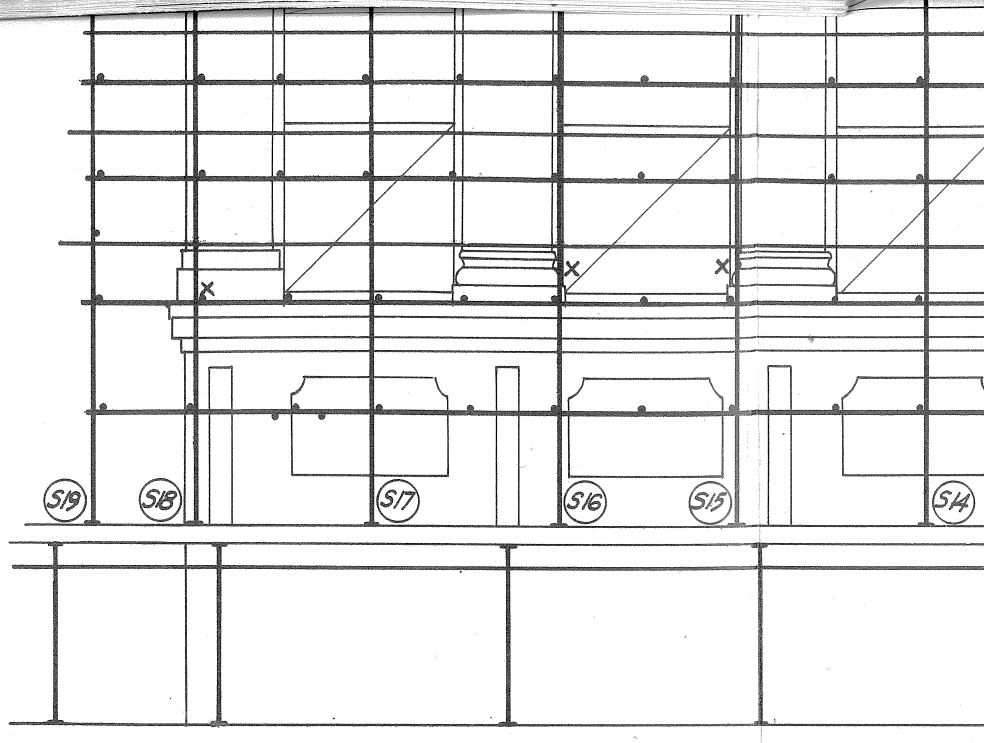
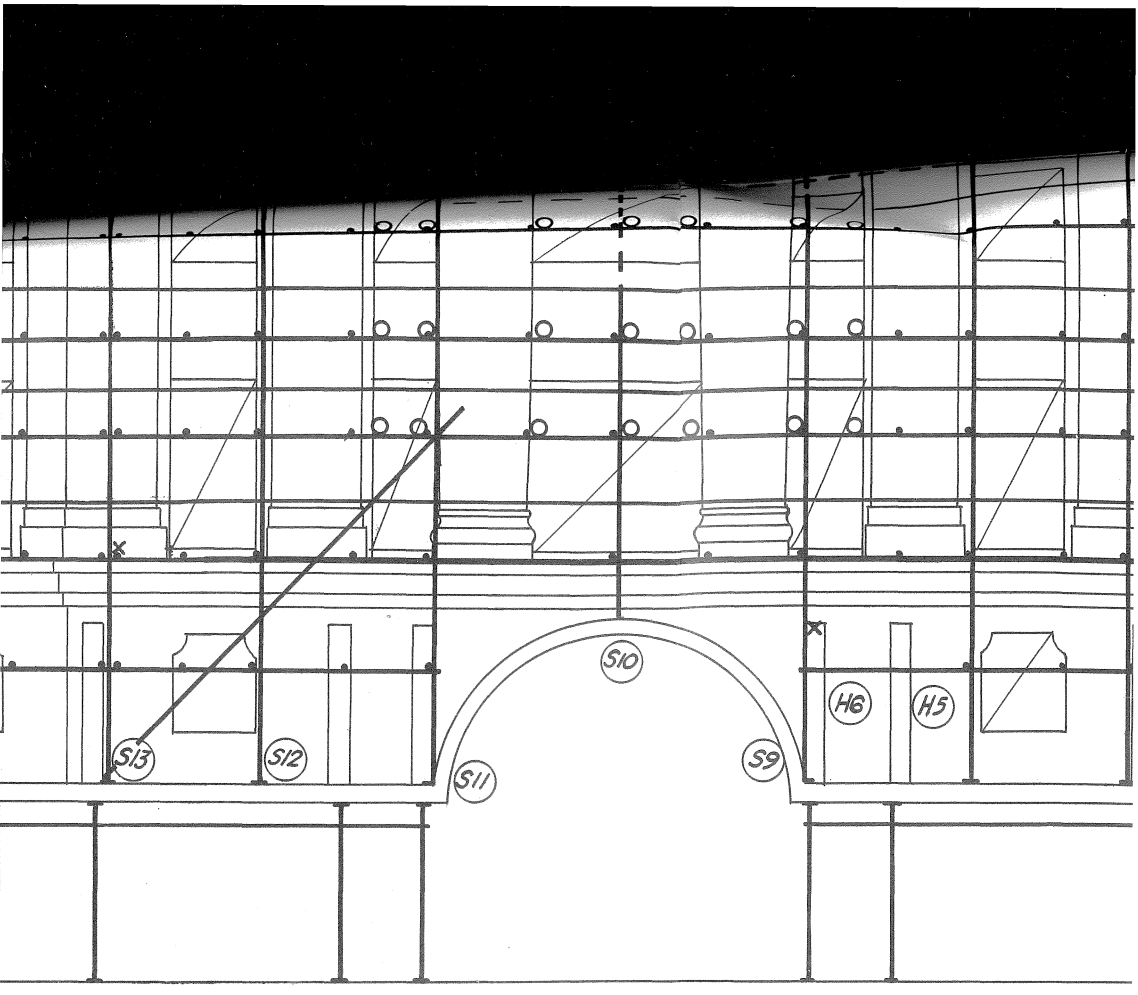
hack by tube " " ○
laterial " "



Northern Portion
About 57'-0"

Position of ties in building shown thus ×
Where tied back by tube " " ○
Stacked Material " "

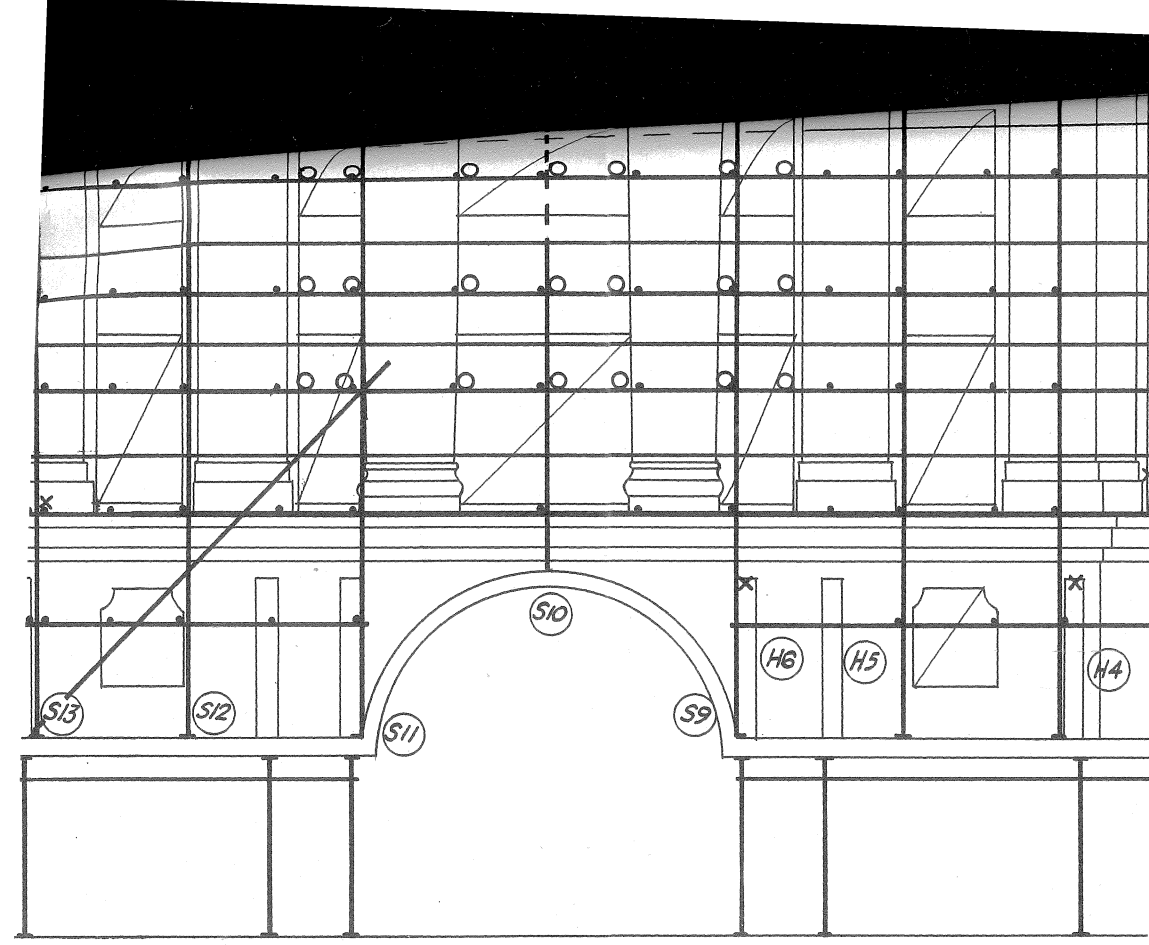


Central Portion
About 57'-0"

FRONT ELEVATION

D.I.

SCAI
PREC
PREP



Central Portion
About 57'-0"

FRONT ELEVATION

D.I.C. (

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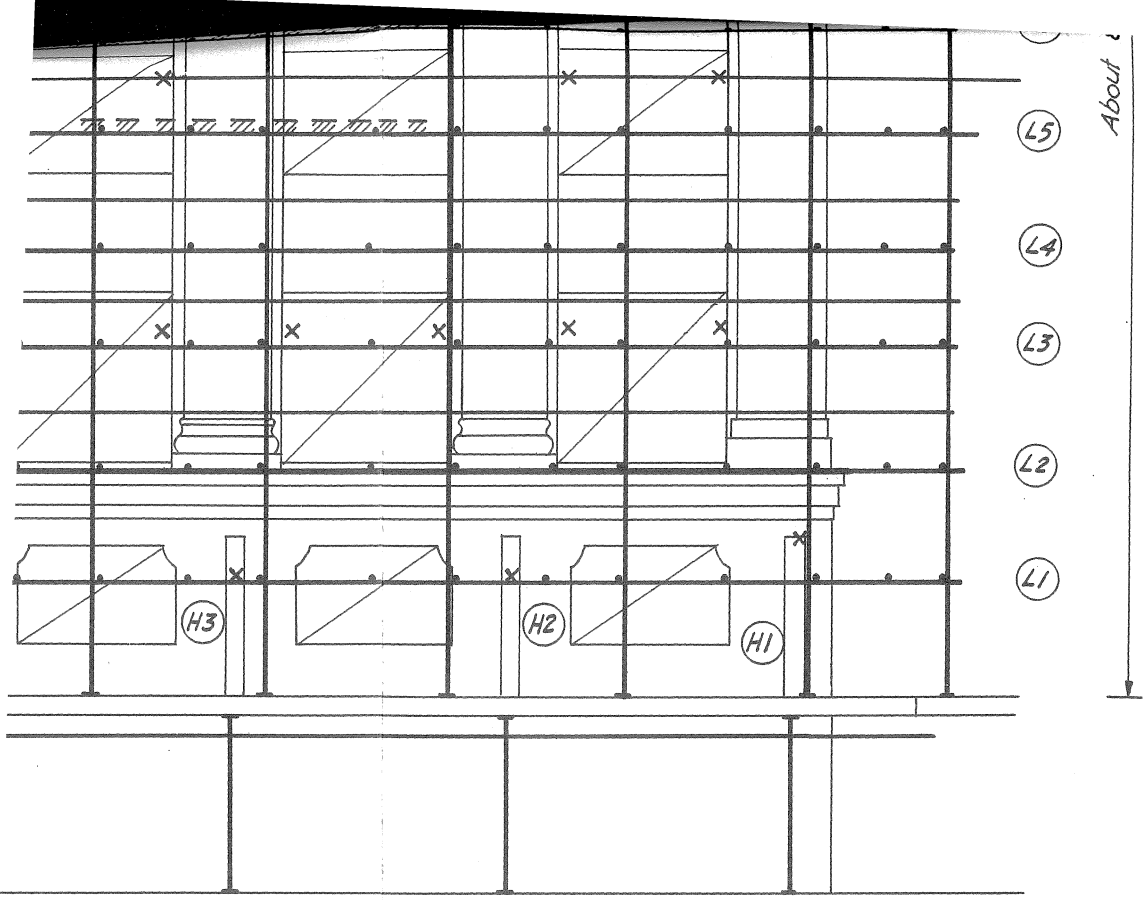


Southern Portion
About 58'-0"

A

NELLINGTON) SCAFFOLD FAILURE

8TH MAY 1957

AS AT TIME OF FAILURE (COMPILED FROM PHOTOGRAPHS & FOLLOWING THE ACCIDENT)

THE MINISTRY OF WORKS, DISTRICT OFFICE, WELLINGTON.

R.J.P. 11·6·57

11/6/57

Notes:

All props & scaffold of

All couplings of Burtor

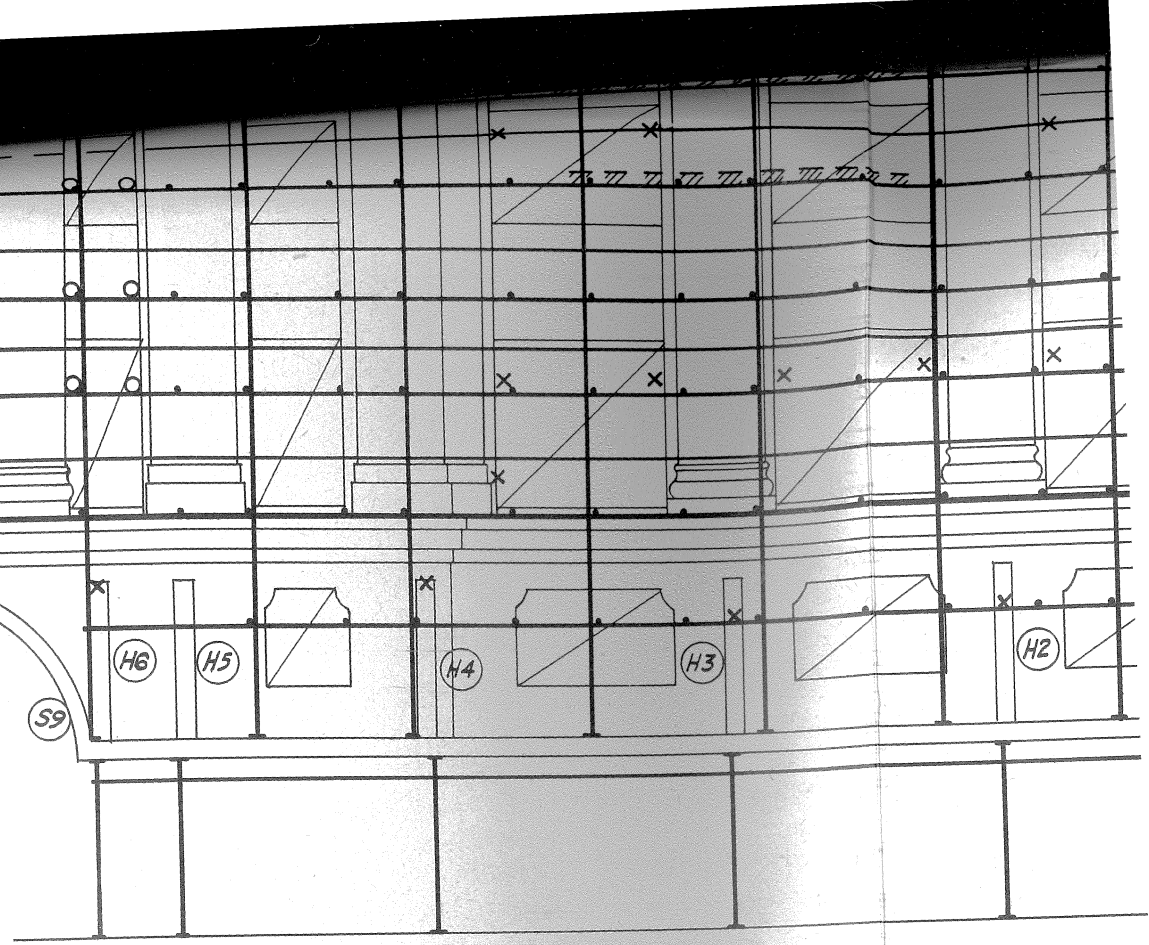
Top & bottom of veran
a screw jack foot

SL

Strongbacks in buildin
thus : □

Position of tie in building me

SCALE :- 1/8" = 1'-0"



A

D.I.C. (WELLINGTON) SCAFFOLD FAILU

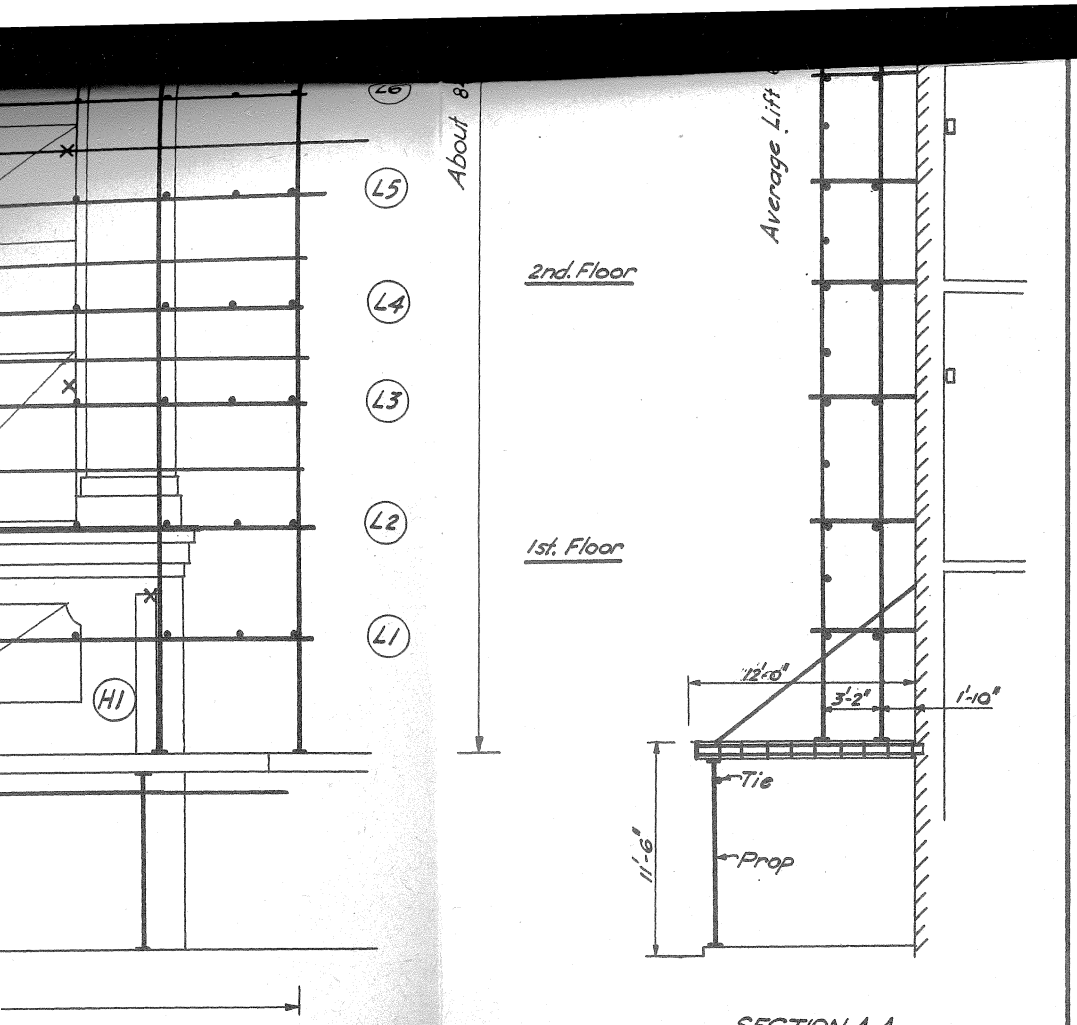
8TH MAY 1957

SCAFFOLD AS AT TIME OF FAILURE (COMPILED FROM PHOT
PRECEDING & FOLLOWING THE ACCIDENT)

PREPARED IN THE MINISTRY OF WORKS, DISTRICT OFFICE, WELLINGTO

R.J.P. 11·6·57

11·6·57



SECTION A-A

Notes:
All props & scaffold of 1 29/32" tube mostly close jointed
All couplings of Burton's Patent

Top & bottom of verandah props fitted with a screw jack foot

SECTION A-A

Strongbacks in building as determined from window openings shown thus: ▯

Position of tie in building measured up from floor shown thus: —

SCALE :- 1/8" = 1'-0"

APPENDIX F: EXHIBIT No. 13

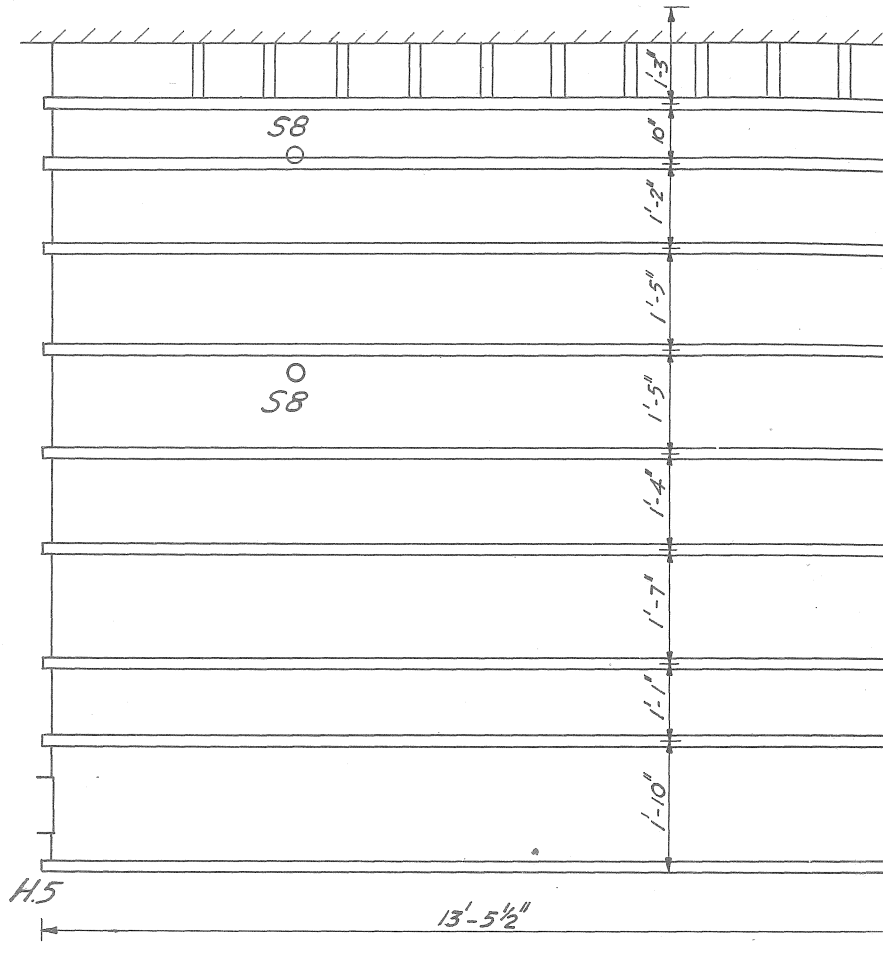
Evening Post photo.

Earliest photograph taken of collapsed scaffold.

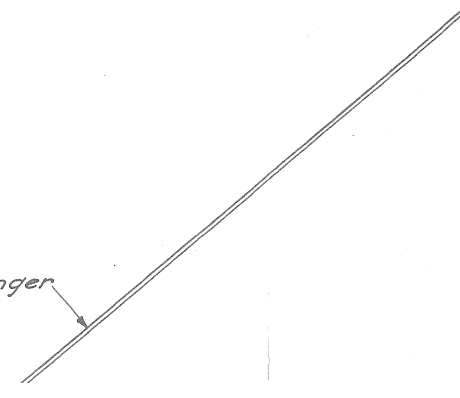
APPENDIX G: EXHIBIT No. 14

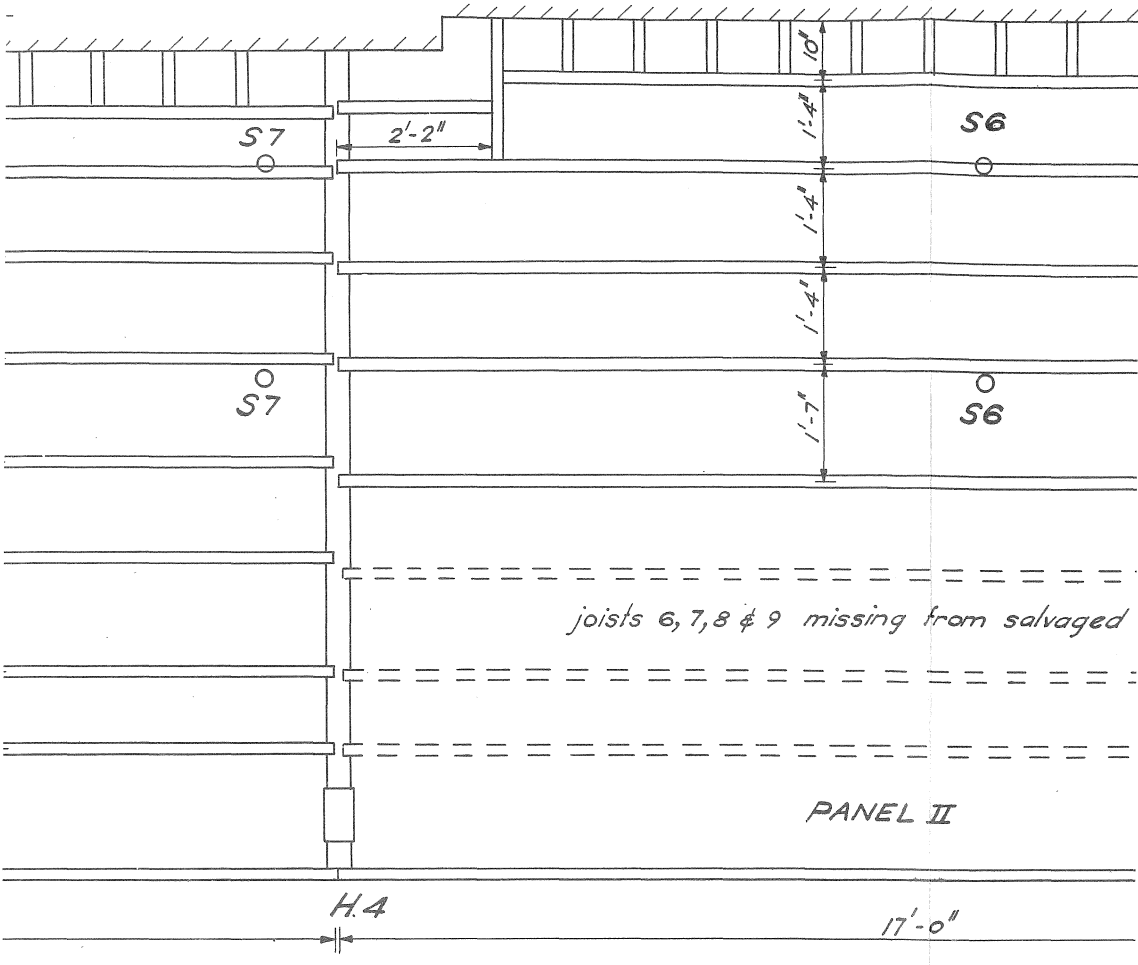
Prepared in the Ministry of Works District Office, Wellington.

Scaffold as at time of failure.



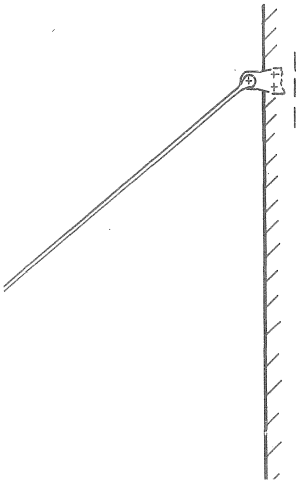
PANEL I

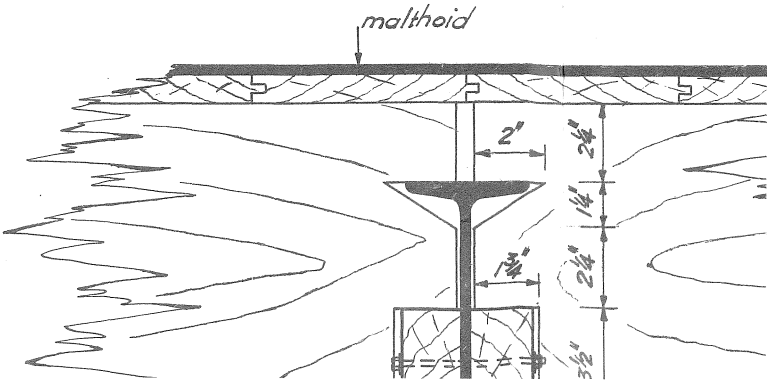


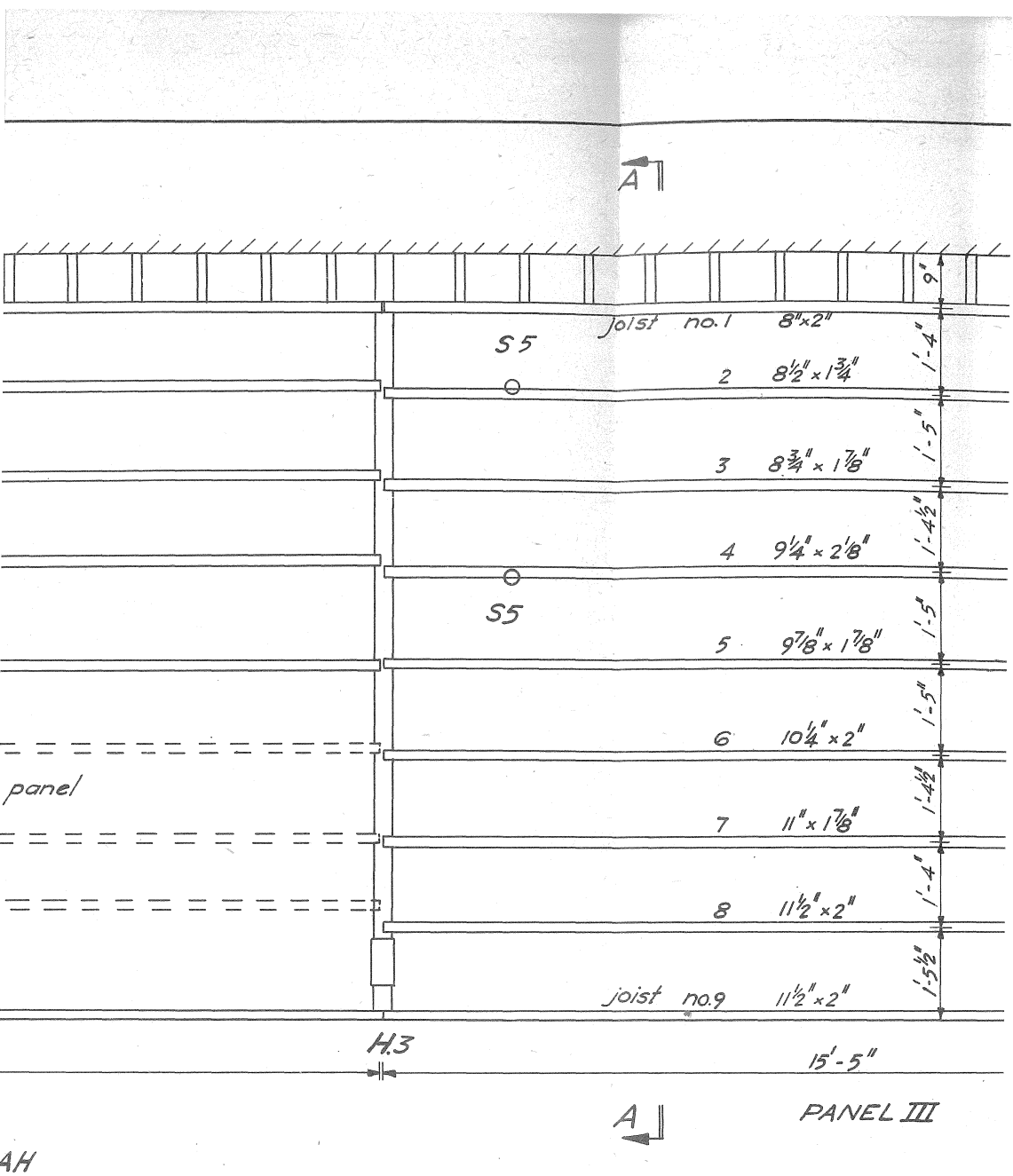


PART PLAN OF VERAND

SCALE: ½" = 1'-0"

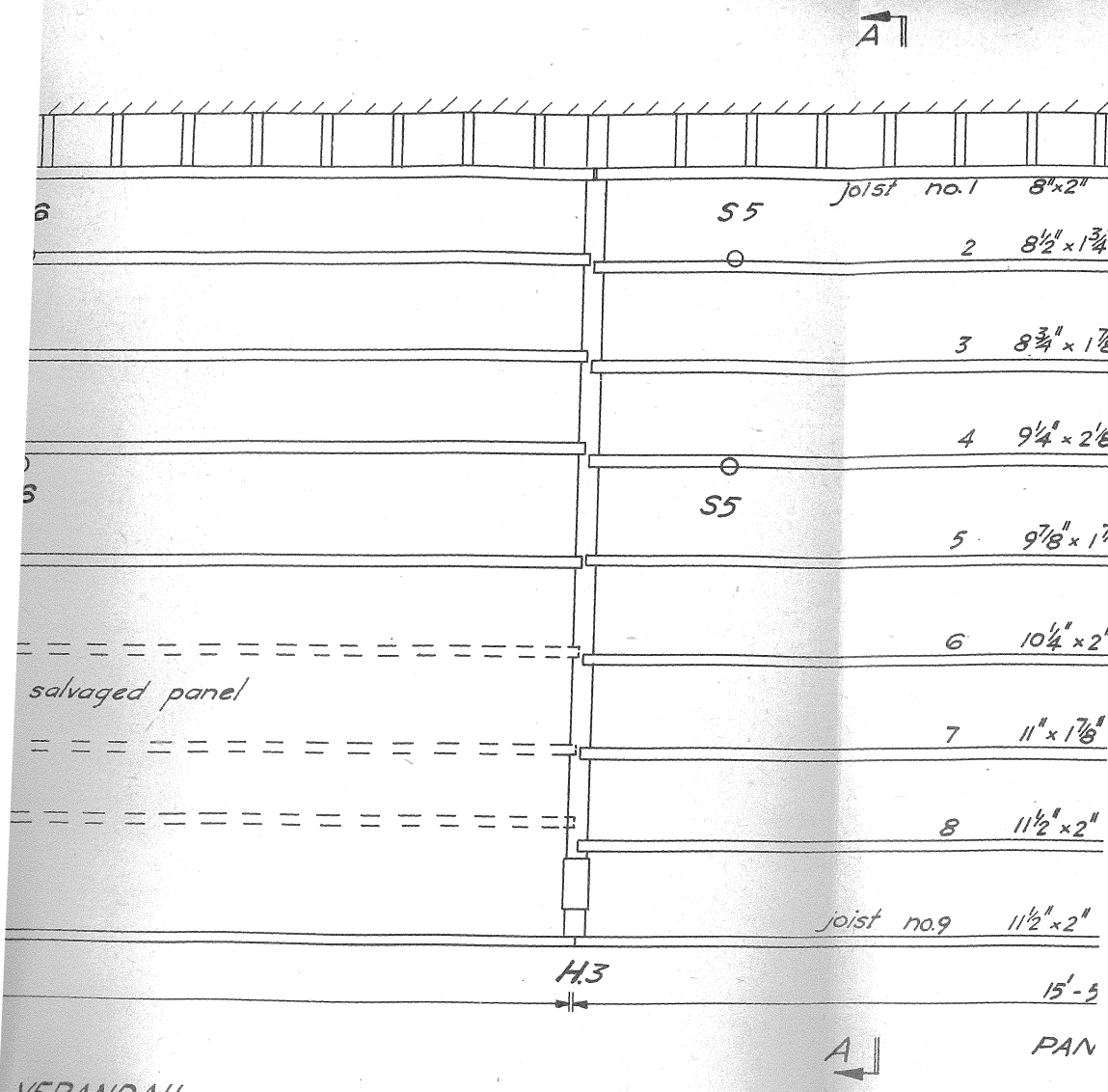





A
9"
joist no.1 8"×2"
S5
2 8½"×1¾"
1'-4"
3 8¾"×1⅞"
1'-5"
4 9¼"×2⅛"
1'-4½"
S5
5 9⅞"×1⅞"
1'-5"
6 10¼"×2"
1'-5"
panel
7 11"×1⅞"
1'-4½"
8 11½"×2"
1'-4"
joist no.9 11½"×2"
1'-5½"
H.3
15'-5"
A

PANEL III

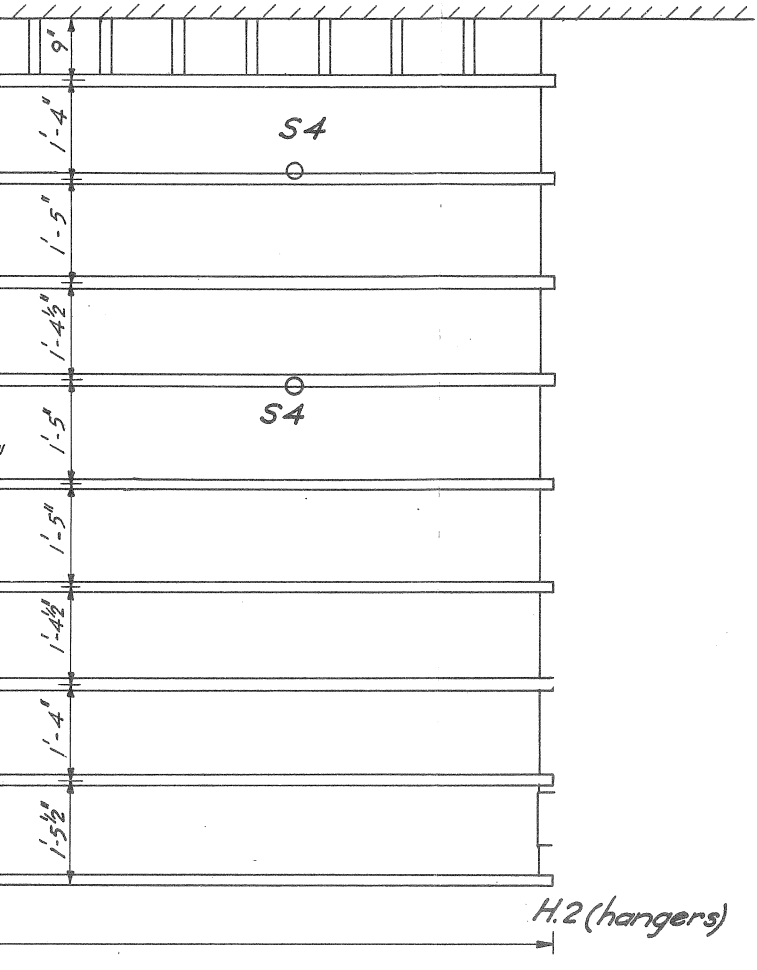
AH


A
joist no.1 8"×2"
S5
2 8½"×1¾
3 8¾"×1⅞
4 9¼"×2⅛
S5
5 9⅞"×1⅞
6 10¼"×2
salvaged panel
7 11"×1⅞"
8 11½"×2"
joist no.9 11½"×2"
H.3
15'-5
A
PAN

VERANDAH

'-0"

DRAWING No. 3
APPENDIX H



L III

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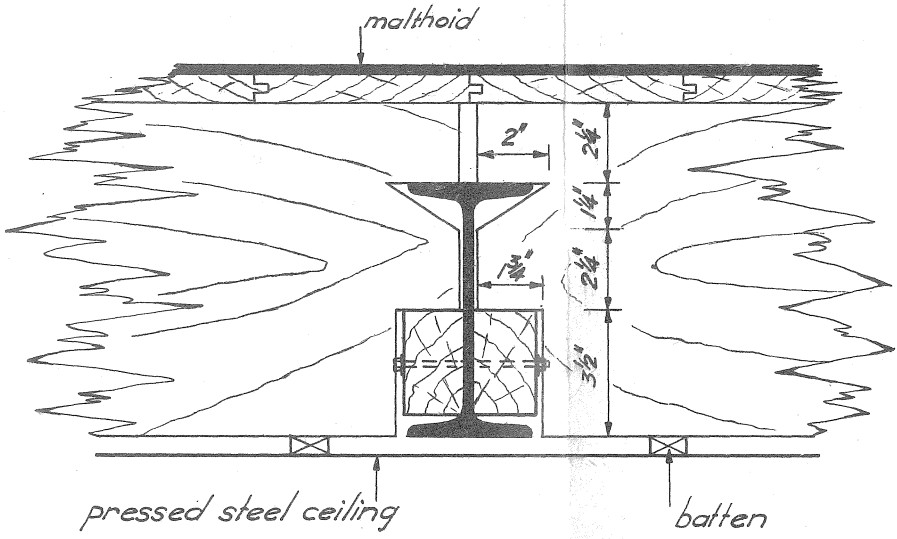
PART PLAN OF VERANDAH

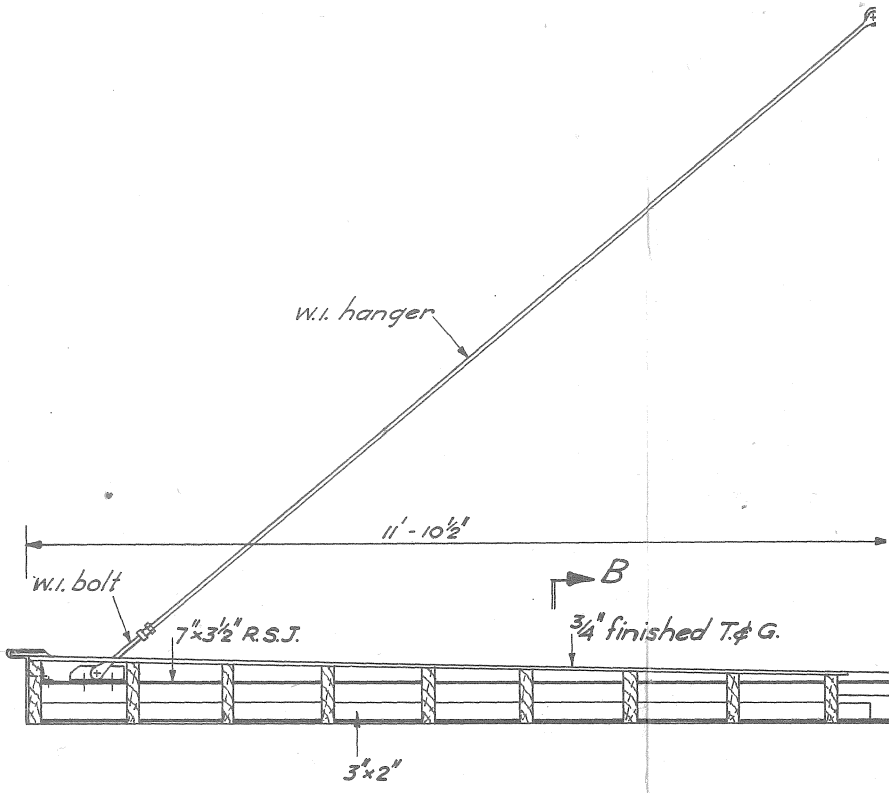
SCALE: ½" = 1'-0"



SECTION B-B

SCALE: 3" = 1'-0"

PANEL I



SECTION A-A

SCALE: ½"=1'-0"

IEL III

D.I.C. (WELLINGTON) SCAFFOLD FAILURE

8TH. MAY 1957

DETAILS OF VERANDAH AS DETERMINED BY MEASUREMENTS AFTER COLLAPSE

PREPARED IN THE MINISTRY OF WORKS - DISTRICT OFFICE - WELLINGTON

SCALES: ½" & 3" = 1'-0"

DRAWN R.J. Patterson

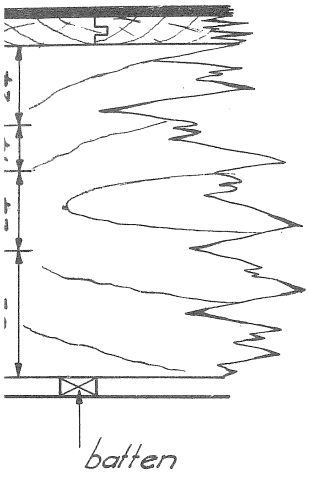
SUPERVISED M Hendriksen

A

PA

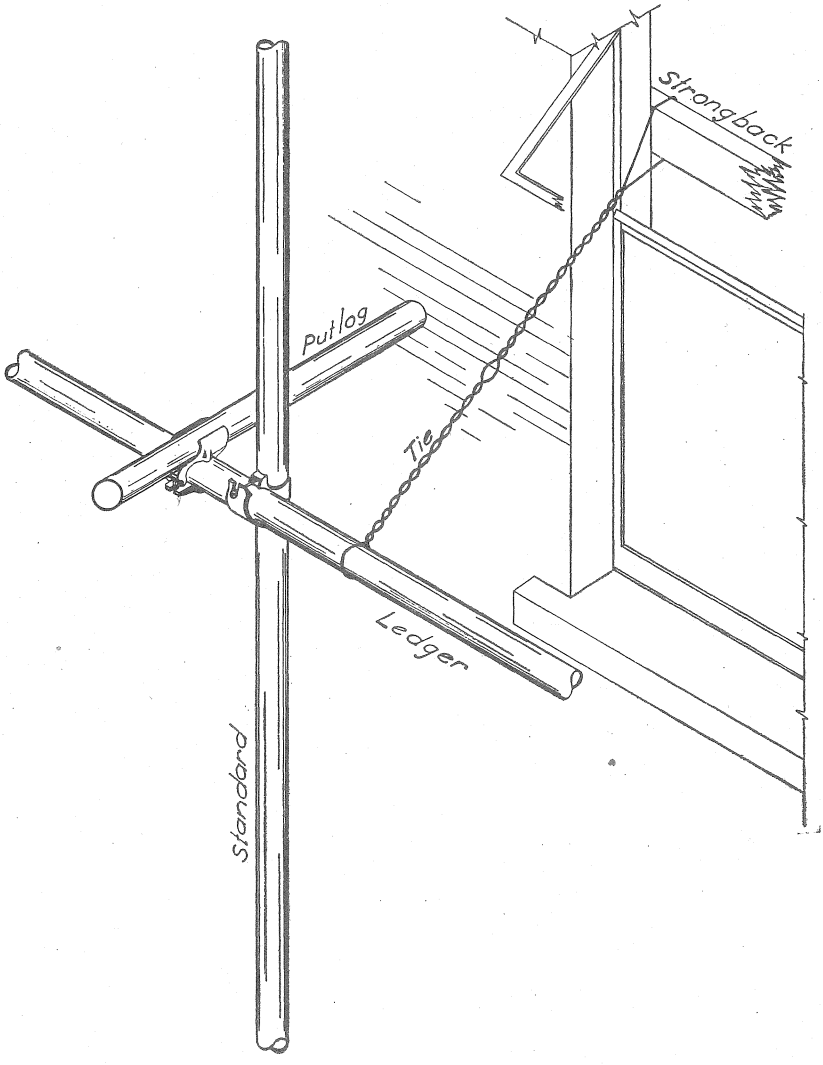
F VERANDAH

= 1'-0"



B

APPENDIX J: DRAWING SHOWING METHOD OF TYING SCAFFOLD TO BUILDING



Method of fixing ties (D.I.C. inquiry).

APPENDIX K: COMPARISON OF MAIN REQUIREMENTS OF THE DIRECTIVES FOR BURTON'S TUBULAR SCAFFOLDING

	1950 Directive	1956 Directive
1. Maximum height of scaffold	110 ft.	110 ft.
2. Maximum spacing of standards	Stonemasons, 7 ft. Concrete workers, 8 ft. Bricklayers, 8 ft. Plasterers and others, 10 ft.	Stonemasons, 7 ft. Concrete workers, 8 ft. Bricklayers, 8 ft. Plasterers, 8 ft. Painters and light work, 9 ft.
3. Maximum lift between decks	6 ft.	6 ft. 6 in. but lowest ledger may be 10 ft. from ground.
4. Maximum outside width	6 ft.	Not mentioned.
5. Maximum spacing of putlogs	4 ft.	4 ft.
6. Maximum span of putlogs	5 ft.	5 ft.
7. Bracing	Securely and rigidly braced in all directions and secured to the building by a sufficient number of reveal pins or wire ties	Securely and rigidly braced in all directions.
8. Maximum spacing of ties	15 ft. vertically 20 ft. horizontally	Ties at every alternate ledger with one tie to each 200 sq. ft.
9. Maximum uniform distributed load on a scaffolding platform	35 lb. per sq. ft.	28 lb. per sq. ft.
10. Maximum concentrated load on any bay	400 lb.	335 lb. concentrated load and distributed load not to act together.
11. Base plates	Not mentioned	Required on all standards.
12. Planks	Not mentioned	Not less than 8 in. wide by 1½ in. thick.
13. Guard rail	Not mentioned	Tubular rail 3 ft. from deck level.
14. Fender boards	Not mentioned	Required on working platform 10 ft. or more above ground. Boards not less than 6 in. by 1 in.

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