	PRACTICE NOTE NO: 1	Version 2	Amended May 2001	Page 1 of 6
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	The Checking of Structural Plans and Computations			

This Practice Note has been revised and reissued and includes information that was formerly Practice Note 2

Preamble

The circumstances in which a Checking Engineer undertakes his work can vary widely and it is difficult therefore to set down hard and fast rules to cover this role in all situations. The following advice has been prepared by the ACSE in order to guide and, where appropriate, warn members of potential problems when undertaking a checking role.

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Function of this Practice Notes

Whilst it is intended that these guidelines should apply to the role of Checking Engineer generally, it must be recognised that the Note cannot provide hard and fast procedures or rules for the role. To do so and suit all cases would not be practical. Members must make their own assessment of the extent of work required in any particular instance. For instance, it will be apparent that the Note is somewhat 'heavy handed' for a simple case such as one or two beams in an alteration job, whereas a complete check of a major building may require the establishment of more systematic and elaborate checking procedures not covered by this Note.


Reasons a Check May be Required

A Checking Engineer might be engaged

- 1) by a Client who wants a separate assessment of a design done for him by a Design Engineer
- 2) by a Client who wants an assessment of where savings might be made in a design
- 3) by a Landlord who wants an independent assessment of a design done for a tenant
- 4) by a Council or Principal Certifying Authority who requires the issue of a Compliance Certificate by an Accredited Certifier – Structural.
- 5) by a Lending Authority or Insurance Company who want to carry out an independent assessment for their own protection.
- 6) by the Owner of an adjacent property concerned about damage to his property from an adjacent development.

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	PRACTICE NOTE NO: 1	Version 2	Amended May 2001	Page 2 of 6
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	The Checking of Structural Plans and Computations			

Function of Checking Engineer

The work of checking, although requiring less work than the original design process, demands that a qualified, experienced engineer, who has had no previous involvement with the design, reviews the relevant documents for the project, to whatever extent is necessary for him to be satisfied that the work conforms to established professional practice, and in particular that the work conforms to the relevant Standards Australia Codes. Such checks should not be contrived to annoy or delay or to change structural concepts, materials or layout and should be limited to an assessment of compliance. A Checking Engineer should bear in mind that there may be several valid approaches to a design and should remain open to examining alternative approaches before reporting that there may be a design problem.

Responsibility

It would appear that the Checking Engineer undertakes a substantial responsibility and in some cases this responsibility has been found to be equal to that of the Design Engineer. Legal liability is usually in no way proportional to the fee received for the service. A number of the recommendations of this Practice Note flow from this fact.

Relationship with Design Engineer

The Checking Engineer should extend normal professional courtesies to the Design Engineer. He should advise the latter that a check is being undertaken and should advise his Client that he is obliged to advise the Design Engineer at the outset.

Where the Checking Engineer disagrees with the design on any point, he should contact the Design Engineer and attempt to reach an agreement before finalising his report to his client.

Checking should be kept confidential between the Checking Engineer, his client and the Design Engineer.


Brief for Checking

Because of the responsibilities involved, it is essential to carefully identify the scope of the checking required and to obtain the client's clear understanding and agreement to the scope prior to commencement of the checking procedure.

Where certain elements only are to be checked, (eg. an underpinning system or a steel frame), the situation may be reasonably clear-cut. However, this is often not the case and where doubt could exist, members are advised to draft a return brief for their client's consideration which clearly delineates the extent of work to be undertaken and the limitations of the checking.

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	PRACTICE NOTE NO: 1	Version 2	Amended May 2001	Page 3 of 6
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	The Checking of Structural Plans and Computations			

The following points should be kept in mind when preparing the brief –

- 1) The brief should extend to all features which could affect the element being checked and should recognise that it is often difficult to dissociate one part of a structure from another. For example, a frame will apply moments and forces to a footing system and the acceptance of the Design Engineer's calculations of such design effects may not be held to be satisfactory when checking that footing system. The Checking Engineer may elect to carry out his own calculation of such design effects.
- 2) Those features of the structure not being checked should be carefully listed in the brief.
- 3) Where a 'spot check' only is undertaken, then the limitations of such checking should be emphasised. It is doubtful whether even this procedure will serve to limit the
- 4) Checking Engineer's responsibilities unless the Checking Engineer arranges for the Client to legally indemnify him from any matters subsequently arising in relation to the structure.
- 5) Any data that the Checking Engineer is obliged to accept, (eg. floor loadings, foundation investigation information or computer output) should be listed in the brief.
- 6) The Checking Engineer should satisfy himself as to the extent of checking required for any particular project.
- 7) The Checking Engineer should make it clear to the Client whether the check extends only to the strength limit state or includes a serviceability limit state check as well.

Data Required

The Checking Engineer should obtain the following:


- 1) Architectural plans for perusal
- 2) Fully detailed structural drawings
- 3) Design calculations

He should also endeavour to obtain a Design Brief or a Statement of Design Policy from the Design Engineer. This statement should include:

- 1) superimposed dead load assumptions
- 2) live load assumptions
- 3) wind loading assumptions
- 4) earthquake loading assumptions
- 5) geotechnical report reference and summary
- 6) description of the structural system
- 7) assumptions in respect to vertical load paths
- 8) applicable Standards Australia Codes
- 9) strengths of materials specified and the design criteria adopted in the design
- 10) estimated deflections and the means used in deriving them

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	PRACTICE NOTE NO: 1	Version 2	Amended May 2001	Page 4 of 6
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	The Checking of Structural Plans and Computations			

11) Building Code of Australia classification

The Checking Engineer should also consider whether a site inspection is warranted.

Compliance with Standards Australia Codes

Members should be aware that any departure from the Code, although it may be structurally acceptable, does change the onus of proof in the legal sense if a fault is subsequently found in the structure, so that a structure which does not conform may be treated as prima facie defective until the contrary is proved. At the very least, departure from Code provisions would be the source of considerable legal argument.

Indemnity Insurance

If a member undertakes checking work, he should ensure that this does not affect his professional indemnity cover and he should make such disclosure in his proposal or give such notice to his insurers as may be required. If he has any queries or doubts in this regard he should consult his insurance adviser.

Note that an Accredited Certifier – Structural is required to have this role identified on the Professional Indemnity Policy.

Checking Procedures

Having regard to the responsibilities involved, members are advised to employ only senior experienced engineers for checking services. The work should be oversighted by a Principal.


Emphasis should be placed on checking basic assumptions on which the design is based and in the case of computer aided design, on the accuracy of the input data and of the source program used.

The Checking Engineer generally should make independent calculations rather than simply checking supplied calculations for accuracy. The Checking Engineer should not make any assumptions unless he is forced to do so, in which case he should state the nature of the assumptions in his report. Generally, where the documents contain inadequate or conflicting information, he should seek clarification from the Design Engineer, preferably before writing his report.

Where problems can be expected using the details in the design documents (eg. Thickened edge slab founded on clay soil or brickwork built off thin slabs) then the Checking Engineer should point this out in his report.

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	PRACTICE NOTE NO: 1	Version 2	Amended May 2001	Page 5 of 6
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	The Checking of Structural Plans and Computations			

The Checking Engineer should also keep in mind the risk of potential damage to third party property. This can, for example, be a relevant issue when checking basement retaining wall structures. A check may find the walls adequate to resist imposed loads; however, any movement or settlement of soil during construction or subsequently may cause damage to adjacent buildings or utility services. The use of an appropriate construction technique can be important in such a situation and the Checking Engineer should draw attention to this in his report.

It is unwise to assume in looking at any design that workmanship and materials will be to a standard of perfection or contractual compliance which cannot normally be expected in practice. Only the standards nominated in Standards Australia Codes should be assumed.

Reporting

The Checking Engineer should produce a written report for his client. This should list at least the following items as applicable:

- 1) Limitations on the extent of checking as set down in the brief
- 2) A list of the documents which have been checked
- 3) A list of any supporting data
- 4) A list of matters resolved between the Checking Engineer and the Design Engineer
- 5) Items considered unsatisfactory or requiring clarification which have not yet been resolved between the Checking Engineer and the Design Engineer. Where possible,
- 6) the inclusion of any items under the item above should be avoided by resolving such matters between the Checking Engineer and Design Engineer prior to writing the report.
- 7) Any comments which may be of concern to the client in respect to his later supervision of the project.


Terms Of Engagement

A time basis is considered to be the most appropriate method of charging Clients for a checking assignment. The hourly rate quoted should reflect the use of a senior experienced engineer and the level of responsibility and liability which the Checking Engineer assumes. Ideally a brief should be established by the Client and a fee proposal prepared in response to that brief. The scope of the checking required should then be clear to both parties.

It is not unusual to be asked to nominate an upper limit to the fee which will be charged and in some instances a fixed fee may be sought by the Client. In such cases, the scope of the checking to be undertaken must be related to the fee quoted. The Client can

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	PRACTICE NOTE NO: 1	Version 2	Amended May 2001	Page 6 of 6
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compare this fee with the original design fee and this should alert the Client to the limitations which apply to the checking service to be provided.

It is desirable to attempt to limit any liability to the Client for whom the checking is undertaken as part of the Professional Services Agreement. This may not always be successful.

Typical Problems Encountered with Checking Role

- 1) Insufficient time allowed so that project will not be delayed.
- 2) Disagreement about Code interpretations between Checking Engineer and Design Engineer
- 3) Disagreement about design assumptions and approach
- 4) Different interpretations of computer output.
- 5) Different computer modelling assumptions

Typical Faults Encountered by Structural Checkers

- 1) Foundation conditions assumed instead of investigated.
- 2) Ground levels not shown. Cavity brick walls to ground floors become retaining walls.
- 3) Mixing of dissimilar materials without due regard to effects at interface.
- 4) Lack of attention to secondary effects – shrinkage and temperature, brick growth, differential temperature, creep shortening under prestress – and restraint to such movements.
- 5) Lack of attention to detail – poor arrangement of reinforcement at re-entrant corners and at cantilever balconies.
- 6) Loose and incomplete specifications and fatuous notes on drawings ('soils shall be satisfactory for required bearing pressure....').
- 7) Consideration not given to transfer of forces into and out of bracing systems (to steel framed industrial roofs for instance) resulting in unacceptable localised stresses. Also membrane action assumed where roof interrupted (by gutters).
- 8) Deflections not taken into account.
- 9) Calculations not supplied or partly supplied and either not referenced or out-of-date.
- 10) Gross mistakes.
- 11) Regard departure from normal practice with suspicion.
- 12) No account taken of wind uplift.
- 13) Stability of balustrades ignored.
- 14) Stability of brick panels and walls.
- 15) Neglect of fire rating requirements.

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