

**THE INSTITUTION OF PROFESSIONAL ENGINEERS NEW  
ZEALAND INCORPORATED (IPENZ)**

**REPORT OF THE STRUCTURAL ENGINEERING TASKFORCE  
ENQUIRING INTO THE STATE OF PRACTICE IN STRUCTURAL  
ENGINEERING IN NEW ZEALAND**

Taskforce Members:

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## 1. EXECUTIVE SUMMARY

A Structural Practice Review Task Force was formed to investigate concerns raised by Mr John Scarry MIPENZ in an open letter sent to IPENZ in September 2002.

The Task Force has investigated the practice of structural engineering in New Zealand, considering submissions and holding discussions with some interested parties. In their opinion, unacceptable variability in practice standards does occur, and some work of an inadequate standard has been done by the profession, particularly when engaged for only a limited role within projects. Nevertheless many structural engineers do a highly professional job in all respects.

Some concerns were expressed over technologies and products as well as practice and the Task Force considers that pre-cast hollow-core floor slabs when used in more flexible buildings and pre-cast slender wall panels with high height to thickness ratios are examples of technologies that require an immediate review of current research to ascertain whether restrictions should be applied in their future use.

In the course of the Task Force's work the Building Industry Authority and IPENZ were assisting the Ministry of Economic Development with a review of the Building Act. The Task Force made recommendations that were included in the IPENZ submissions. The Building Bill (September 2003) reflects many of the findings of the Task Force.

The seven principal recommended actions which relate primarily to overcoming systemic failures in the regulatory environment for the Building Industry are:

1. *Development of Standards and Codes of Practice.*

There is an urgent need to develop more comprehensive standards (for practices that can be described in a prescriptive way) e.g. through Standards NZ processes; and codes of practice (for practices requiring substantial professional judgement) through the professional body. A funding model independent of commercial interests within the industry is required. The development of standards for the building industry should be controlled and commissioned by the Building Industry Authority or its replacement.

2. *Identification of competent structural engineers.*

Competence assessment of structural engineers must be stringent. Engineers working outside their competence should be identified and censured where appropriate.

3. *Professional involvement through all stages of project delivery.*

It is essential that professional involvement is maintained throughout the implementation (construction) phases of the work. Ideally the original designers should observe the construction phase. At the completion of construction the design professionals should issue producer statements to validate any design variations that have occurred during construction, and to confirm that they are satisfied that what has been constructed meets the design intent.

4. *Expanded technical leadership role for Government's central regulator (currently the BIA) in providing a code of practice for Territorial Local Authorities to follow.*

The central agency must take a foresight and leadership role so that problems are anticipated and assertive actions taken to ensure the regulatory regime is kept relevant and

up-to-date as innovations are made. This will help improve the standards set by the Territorial Local Authorities and certifiers.

5 *Improved Consent and Audit Processes.*

The variability in the enforcement of standards between Territorial Local Authorities, and the unacceptably low standards in some cases, must be eliminated. This could be by ensuring that consent approvals and code compliance certification take place only after high-quality evaluation processes, including peer review by expert structural engineers where the building has non-standard structural features. Territorial Local Authorities must establish a culture of complaining about the competence of engineers who present sub-standard work repeatedly, so that such practitioners can be investigated by the registering authority under the Chartered Professional Engineers of NZ Act 2002.

6 *Responsibility of Building Owners.*

Building owners must be required to employ or engage suitably qualified people for both design and construction, and must be made liable for the consequence of not doing so.

7 *Evaluation of New Materials, Procedures and Processes.*

A process needs to be established to exclude new materials with uncertain properties and performance in the New Zealand context from release on to the market and into use without thorough prior evaluation.

## 2. INTRODUCTION AND BACKGROUND

IPENZ is a membership-based professional body for the engineering profession, with some 9,000 Members of various Membership classes. IPENZ is the Registration Authority for the Chartered Professional Engineers of New Zealand Act of 2002, and is responsible for setting ethical standards for the profession. It has influence over technical standard setting, in part through its associated Technical Groups and Members' involvement in Standards NZ Technical Committees.

Mr John Scarry MIPENZ is a structural engineer who lives in Auckland and contracts his services out to consulting engineering companies. He has become increasingly concerned at what he sees as declining standards in the practice of structural engineering and at the standard of work he has witnessed on construction sites around Auckland.

Mr Scarry met with IPENZ Deputy Chief Executive, John Gardiner, in February and early March 2002. Mr Gardiner encouraged Mr Scarry to put his concerns on paper in the form of an open letter to IPENZ, which would then be seriously considered by IPENZ. He advised Mr Scarry to take steps to disguise real cases if he wished the matter to be considered in an open manner. The open letter was delivered to IPENZ in late September 2002.

Because the open letter raised issues of engineering practice, the governing Board of IPENZ referred it to the Engineering Practice Board (EPB) for their consideration. The Engineering Practice Board is responsible for advice to the elected governing Board of IPENZ on issues of Engineering Practice.

The Engineering Practice Board resolved (in part) that:

- *a task force be established for full review of the open letter, involving members with a wide range of perspectives and interests in structural engineering, and*
- *the process of review be conducted in such a way that the profession is shown to be acting honestly, openly, and effectively in terms of its ability to face and resolve any difficulties that might arise.*

The Task Force was established at the December 2002 meeting of the EPB.

### 3 TERMS OF REFERENCE, MEMBERSHIP AND TIMETABLE

#### 3.1 Terms of Reference

The agreed terms of reference for the practice review were:

1. Identify any areas of Structural Engineering Practice where there is variability in the standards of practice.
2. Identify any Structural Engineering practices that are placing life or property at potentially unacceptable risk.
3. Develop recommendations to overcome shortcomings and identify if possible ways to implement them.
4. If appropriate propose a programme that IPENZ could implement to address the recommendations in 3 above.

As an interim measure, and to meet urgent Ministry of Economic Development deadlines, it was agreed that the group would also

5. look at operational shortcomings around the implementation of the Building Act, and formulate proposals for improving the regulatory environment.

The proposed study referred primarily to buildings, and not what are generally designated civil engineering structures, such as bridges.

#### 3.2 Membership

The Task Force members were chosen by the EPB to ensure that a wide variety of perspectives was included, as follows:

<u>Perspective</u>	<u>Member</u>
Independent Chair	Mr Ian Mills FIPENZ
Smaller Consultancy	Dr Roy Taylor MIPENZ
Large Consultancy	Mr Richard Built MIPENZ
ACENZ	Mr Adam Thornton MIPENZ
Territorial local authority	Mr Hugh McNaughton MIPENZ
Construction	Mr Wayne Raymond MIPENZ
SESOC	Dr Barry Davidson FIPENZ
Secretary	Mr Murray Isdale MIPENZ

#### 3.3 Modus Operandi

The taskforce was to operate as follows:

1. Conduct a preliminary review of the issues raised in the Scarry Open Letter, using an analysis of the letter by the Management Committee of the Structural Engineering Society (SESOC), a Collaborating Technical Society of IPENZ (Appendix 1), as a reference document.

2. Invite submissions from IPENZ Members and others to gather evidence on the state of structural engineering in New Zealand. Relevant groups were
  - a) IPENZ members
  - b) SESOC members
  - c) Research or Industry Associations: CCANZ, HERA, BRANZ, ACENZ
  - d) Regulatory agencies: BIA
  - e) Universities and other tertiary institutions
1. Gather evidence from any other source the Task Force considered relevant.
2. Prepare a draft report addressed to the Chair, Engineering Practice Board.
3. Give the IPENZ Membership the opportunity to make submissions.
4. Finalise the report, taking into account the second round of submissions.

### 3.4 Timetable

A provisional timetable was established as follows:

1. A call for submissions from IPENZ Members via *engineering direct*, the weekly electronic newsletter, before Christmas 2002, with a closing date of 28 February 2003.
2. A parallel call for submissions from other interested parties, via written or e-mailed communication with relevant organisations.
3. First draft of report to be completed by 11 April 2003.
4. Draft report to be released in the Member-only area of the IPENZ website; Members to be notified and comment sought via *engineering direct*.
5. Peer review by selected reviewers by 9 May. Membership comment to close at the end of May 2003.
6. Final report to the EPB in mid-June 2003.
7. EPB to formulate a response in terms of
  - a) its own work programme;
  - b) proposals to the IPENZ Board.
8. Proposed public report to be prepared by July 2003 and sent to the IPENZ Board's August meeting.

In practice, the steps were followed but more time was needed to ensure all submissions and issues could be thoroughly explored.

## 4 FINDINGS OF THE TASK FORCE

The findings of the Task Force are presented in the following sections in the form of responses to the terms of reference. The statements in italics at the start of each section are restatements of the Terms of Reference.

### 4.1 Variability in Standards of Practice

*Identify any areas of Structural Engineering Practice in which there is variability in the standards of practice*

The Task Force formed the view that unacceptable variations in standards of practice, examples of which were reported by Mr. Scarry, do occur.

Examples of deficiencies are:

- inadequate or inappropriate structural design and analysis
- inadequate supervision of junior or inexperienced staff
- poor levels of documentation
- inadequate checking and peer review
- insufficient construction monitoring
- poor communication
- variable levels of service

The Task Force is strongly of the view that in the current loose regulatory environment there is a correlation between poor standards of practice and commercial pressures.

The Task Force concluded that Mr Scarry had raised valid concerns throughout his open letter. However they are also of the view, supported by Member submissions, that the extent and severity of problems were lesser than may have been implied by the way his open letter was worded.

Whilst there are some problems, there are also many dedicated and excellent structural engineers seeking to do a good job. These engineers are often frustrated by a regulatory environment that allows the clients engaging their services to bypass what the engineers regard as good practice. The construction industry, including designers, constructors, suppliers and regulators, needs to strive for higher standards, but structural engineering is not completely in crisis as may have been inferred from Mr Scarry's open letter.

### 4.2 Unacceptable Practices

*Identify those Structural Engineering practices that are placing life or property at potentially unacceptable risk.*

The Task Force considers there are some current practices that if they continue would place property or life at more than desirable risk during a major earthquake. Unacceptable practices are considered to be:

1. use of products and processes that are insufficiently proven in the circumstances in which they are being used
2. performance and acceptance of work that is not compliant with current codes or standards
3. significant departures from recognised good practice

Examples include

- Pre-cast slender panels: these are currently being erected at height-to-slenderness ratios that exceed allowable values given in Standards.
- Pre-cast hollow-core flooring: much research on its performance is in progress. There has been professional debate about the performance of this form of flooring under certain seismic loads for several years. Recent tests have shown it performs worse than previously predicted under some possible load conditions.
- Introduction of 500E steel: this product was launched and alternatives withdrawn from the market. before the professional concerns of respected academics were answered.
- Construction not carried out in accordance with design. This is the result of poor standards of construction, and of failure to retain design engineers to adequately monitor construction.

IPENZ has no jurisdiction that allows it to identify specific buildings that may pose a significant and immediate risk. Problems in buildings may have arisen after professional engineering involvement was completed, (after consenting and before construction), or the engineers concerned may not have been IPENZ Members. IPENZ has sought to ensure that Members act responsibly in respect of buildings known to them. Newsletters were sent to Members reminding them of their ethical responsibilities. Should they be aware of buildings that pose a *significant and immediate* risk it is their ethical duty to inform the building owner if the risk is judged to be sufficient. We expect that Members will have acted on this advice, but they are not obliged to inform us if they have done so. We note that under the existing Building Act there is no legal obligation to inform the Territorial Local Authority (TLA), and this is a concern. The Task Force has not become aware through the submission process, its discussions with engineers or other means, of any specific buildings that they regard as posing a significant and immediate risk.

It is noted that the proposed changes to the Building Act will create new obligations on Territorial Local Authorities regarding risk management of existing buildings.

### **4.3. Recommendations**

*Develop recommendations to overcome shortcomings and identify if possible ways to implement these.*

The Task Force has developed seven major recommendations:

#### *1. Development of Standards and Codes of Practice.*

There is an urgent need to develop more comprehensive standards (for practices that can be described in a prescriptive way) e.g. through Standards NZ processes; and codes of practice (for practices requiring substantial professional judgement) e.g. through the professional body. A funding model independent of commercial interests within the industry is required. The development of standards for the building industry should be controlled and commissioned by the Building Industry Authority or its replacement.

2. *Identification of competent structural engineers.*  
Competence assessment of structural engineers must be stringent. Engineers working outside their competence should be identified and censured where appropriate.
3. *Professional involvement through all stages of project delivery.*  
It is essential that professional involvement is maintained throughout the implementation (construction) phases of the work. Ideally the original designers should observe the construction phase. At the completion of construction the design professionals should issue producer statements to validate any design variations that have occurred during construction, and to confirm that they are satisfied that what has been constructed meets the design intent.
4. *Expanded technical leadership role for Government's central regulator (currently the BIA) in providing a code of practice for Territorial Local Authorities to follow.*  
The central agency must take a foresight and leadership role so that problems are anticipated and assertive actions taken to ensure the regulatory regime is kept relevant and up-to-date as innovations are made. This will help improve the standards set by the Territorial Local Authorities and certifiers.
5. *Improved Consent and Audit Processes.*  
The variability in the enforcement of standards between Territorial Local Authorities, and the unacceptably low standards in some cases, must be eliminated by ensuring that consent approvals and code compliance certification take place only after high-quality evaluation processes, including peer review by expert structural engineers where the building has non-standard structural features. Territorial Local Authorities must establish a culture of complaining about the competence of engineers who present sub-standard work repeatedly, so that such practitioners can be investigated by the registering authority under the Chartered Professional Engineers of NZ Act 2002.
6. *Responsibility of Building Owners.*  
Building owners must be required to employ or engage suitably qualified people for both design and construction, and must be made liable for the consequences of not doing so.
7. *Evaluation of New Materials.*  
A process needs to be established to exclude new materials with uncertain properties and performance in the New Zealand context from release on to the market and into use without thorough prior evaluation.

These recommendations are amplified in section 5.

#### **4.4. Actions by IPENZ**

*If appropriate propose a programme that IPENZ could implement to address the recommendations in section 3 above.*

IPENZ and its Membership must take a lead role in the maintenance of high ethical and competence standards.

IPENZ should take action on two levels:

1. as the registering authority under the CPEng Act, where it is responsible for ensuring that structural engineers meet the CPEng standard (already up and running) it must ensure rigorous assessments of competence, and
2. as an agency (in conjunction with its collaborating technical society, SESOC, the NZ Structural Engineering Society), ideally resourced by the building levy, it should develop codes of practice for structural engineering work requiring substantial professional judgement.

IPENZ and the profession at large must also work to promote a culture of professionalism, quality, and acceptable (higher) standards, rather than one of fee cost-reduction.

#### **4.5. Feedback on Building Act**

*Provide feedback to the BIA and MED on the current review of the Building Act.*

IPENZ made a detailed submission on the discussion paper issued by MED, including the recommendations of the task force among other suggestions. The submission is a much wider document, and is not a report of the taskforce. The submission is available on the IPENZ web site, at [http://www.ipenz.org.nz/ipenz/practicesupport/Structural\\_review.cfm](http://www.ipenz.org.nz/ipenz/practicesupport/Structural_review.cfm)

Any matters that concern IPENZ and are not considered to be fully addressed in the draft Bill will be submitted on at the Select Committee stage.

## 5 DETAILED ANALYSIS SUPPORTING THE RECOMMENDATIONS

### 5.1 Development of Standards and Codes of Practice

*Development of Standards and Codes of Practice. There is an urgent need to develop more comprehensive standards (for practices that can be described in a prescriptive way, e.g. through the Standards NZ processes) and codes of practice (for practices requiring substantial professional judgement e.g. through activities of the professional body).*

#### 5.1.1 Rationale

In this section the terms "Standard" and "Code of Practice" are used. The latter is not to be confused with the Building Code, which is a subsidiary document to the Building Act and has legal standing. Standards are generally developed in a process administered by Standards New Zealand as the trading arm of the Standards Council. The Standards Council is a crown entity operating under the Standards Act 1988. Other recognised Standards have been developed by similar bodies from other jurisdictions. Many Standards used in the construction industry and Codes of Practice are developed by professional groups and learned societies on the basis of consensus views on good practice. Codes of Practice are usually less formalised than Standards. Codes of Practice are more appropriate than Standards in areas where considerable professional engineering judgement is required.

While there are up-to-date Standards and Codes of Practice, in some important areas of practice there are none, or those that exist are out of date. This has come about as a consequence of the inadequate funding of Standards New Zealand (possibly exacerbated by internal shortfalls of efficiency and direction), the disestablishment of the Ministry of Works (which previously developed many Codes of Practice with public money) and the increased complexity of building structures, processes and materials.

Standards must now be self-funded by an industry. In many instances manufacturers subsidise the development of a Standard. This could lead to the development of Standards that were not in the interests of the safety/ financial security of the public of New Zealand.

Codes of Practice are also prepared either on shoestring budgets, or more often by volunteers working for the good of their professional body, learned society or technical society. Ultimately, progress relies on the willingness of professionals to work in their own time, which is increasingly difficult to find in an industry that is highly competitive.

In order for New Zealand design professionals to be internationally competitive, New Zealand Standards and Codes of Practice need to be sufficiently aligned with other major international Standards and Codes of Practice to ensure that software developers will be prepared to invest in developing automated design tools and post-processors. The small size of the New Zealand market often doesn't justify the cost of developing stand-alone New Zealand-specific Codes or Standards.

#### 5.1.2 Detailed Recommendations

1. The programme for the development of Standards and Codes of Practice that are related to the design, construction and maintenance of buildings must be controlled by the BIA or its replacement agency under the revised Building Act. (references to the BIA hereafter imply it or its replacement agency)

2. A comprehensive set of standards and codes of practice must be developed urgently to cover gaps or obsolescence of existing codes.
3. Development of Standards (through Standards NZ processes) and Codes of Practice (through IPENZ, SESOC and other Collaborating Technical Societies of IPENZ, in consultation with industry bodies such as the Concrete Society, University engineering schools and research agencies such as the Building Research Association NZ and HERA) is a valid use of building levy funds for the public good.
4. A section of the BIA, with appropriate technical expertise and funding, should be established, with responsibility for maintaining and approving Codes of Practice for structural design and building construction. (The division of roles and responsibilities and the interface of this BIA section with Standards New Zealand would need to be determined.).
5. Whilst the BIA should have a legal responsibility to promote and allocate funds for the development and dissemination of industry Standards and Codes of Practice, the BIA should use expertise within the various existing industry groups and tertiary institutions as described above to achieve this objective. An example of a Code of Practice developed in this way is the *"Guidelines for the Use of Structural Precast Concrete in Buildings"* developed by the New Zealand Concrete Society, New Zealand Society for Earthquake Engineering and the Centre for Advanced Engineering.
6. Funding for the maintenance and development of Standards and Codes of Practice that do not confer commercial competitive advantage should be included as part of the levy paid by owners of new and existing buildings when seeking consent.
7. To avoid duplication of effort and promote consistency, wherever appropriate international standards should be selected for adoption as New Zealand Standards. Where required a New Zealand-specific addendum should be written rather than a whole new Standard or Code. It is acknowledged that in some situations, international Standards will not be acceptable as they do not reflect New Zealand practice, or their use may have a negative influence on New Zealand industry.
8. The interface between Standards/Codes of Practice must be carefully managed to facilitate a coordinated approach to design and construction.
9. The BIA must fund research to inform forward-looking regulation of critical areas of new technology, in addition to funding the development of Standards and Codes of Practice. Such research would feed into the Standard or Code development process, and is vital if innovation is not to be unnecessarily hindered.

## **5.2 Identification of Competent Structural Engineers**

*Competence assessment of structural engineers must be stringent. Engineers working outside their competence should be identified and censured where appropriate.*

### 5.2.1 Rationale

The Task Force is of the view that the last 20 years has seen a decline in the standard of work conducted by some people performing structural engineering services in New Zealand. There are other contributing reasons for this, beyond the regulatory environment.

The hourly fees paid to structural engineers are low compared to those commanded by other professionals with comparable competence (e.g. lawyers, accountants, medical professionals). This has led many good engineers to leave the industry. While the reasons for this are diverse, one cause is the policies of successive Governments and the free-market philosophy.

Within the civil engineering discipline it is now possible to specialise to a greater extent than previously, and graduates may leave the University having made course selections that enabled them to almost avoid any study of structures beyond a rudimentary level. Thus, a degree in civil engineering is no longer in itself a reliable indicator that its holder has structural engineering knowledge.

Universities are under pressure to attract and retain good quality staff in structural engineering and sufficient numbers of well-prepared students. The inspiring lecturer is becoming a rarer phenomenon in this field, and fewer graduates have explored structural engineering beyond the minimum needed to pass.

### 5.2.2 Detailed Recommendations

1. An agreed method of competence assessment and registration should be applied to Structural Engineers. This should be an IPENZ responsibility as the appointed Registration Authority under the Chartered Professional Engineers of New Zealand Act 2002. It is recognized that SESOC and the New Zealand Society of Earthquake Engineers (NZSEE) represent a considerable pool of expertise which is available to assist IPENZ. SESOC and NZSEE could, for example, recommend engineers regarded as highly competent, to whom IPENZ could offer training as practice area assessors for those CPEng registration candidates who wish to be assessed in the structural engineering practice area. SESOC and NZSEE could also provide notes to help interpret the CPEng standard in the context of the structural engineering practice area.
2. As already signalled in the revised Building Bill, Territorial Local Authorities should accept structural designs only from engineers who are appropriately registered under the CPEng Act, and are thereby licensed building practitioners.
3. Breaches of competent practice shall be dealt with formally through the CPEng processes.
4. Persistent offenders identified by Territorial Local Authorities should be reported to IPENZ and the BIA. The BIA in these circumstances would complain to IPENZ, which as the registration authority would invoke disciplinary procedures under the CPEng Act.

### 5.3 Professional involvement through all stages of project delivery.

*It is essential that professional involvement is maintained through the implementation (construction) phases of the work. Preferably the original designers (or with their agreement suitably qualified people) should observe the construction phase. At the completion of construction the design professionals should issue producer statements to validate any design*

*variations that have occurred during construction and to confirm that they are satisfied that what has been constructed meets the design intent.*

### **5.3.1 Rationale**

A major problem has been that the involvement of competent professional engineers has often been terminated once a building consent is obtained. The construction and any design variations have then been supervised and observed by less competent people. Even when acting responsibly these people cannot detect and fix all the things that a more competent person would. So small bugs in the original design can persist, variations can be inadequately reviewed, and shortfalls in construction quality are not recognised as major problems from a structural perspective. The only answer is to ensure that there is ongoing involvement of competent structural engineers.

It is reasonable and practical to expect that the design engineer verify that the construction works are undertaken in accordance with the construction documentation as part of an overall quality assurance process. This process should provide for qualified or competent day-to-day supervision.

### **5.3.2 Detailed Recommendations**

The announcement by Government of licensing and certification regimes in the revised Building Act should largely meet the concerns of the taskforce. To be able to certify that a structure “as built” is satisfactory, the licensed building practitioner (engineer) must have been involved on a continuing basis throughout the life of the project. Territorial Authorities should use a system such as the IPENZ/ACENZ Construction Monitoring Services for defining an appropriate role for the design professional during the construction phase of the project. Territorial Authorities should be required to define the minimum appropriate level of involvement, and specify it as a pre-requisite of building consent approval.

## **5.4 Expanded Technical Leadership Role for the Central Regulator**

*Expanded technical leadership role for Government’s central regulator (presently the BIA) in providing a “code of practice” for Territorial Local Authorities to follow. The central agency must take on a foresight and leadership role so that problems are anticipated and assertive actions taken. This will help improve the standards set by the Territorial Local Authorities and certifiers.*

### **5.4.1. Rationale**

Prior to 1991 building regulation was largely the domain of local authorities. The 1991 Act created a performance-based national building code that left the existing agencies in place but added many more elements (private certifiers, acceptable solutions etc.). This Act introduced a new conceptual base and required the existing agencies to adapt to a new environment. The conceptual base is largely sound and should not be changed when problems in implementation are addressed. The essential needs are a regulatory authority with technical capability, which will take responsibility for:

- developing the Building Code according to the Act
- identifying the regulatory research and codification needs of the industry and making grants (from the Building levy) for research to inform regulatory and/or standard development, but not necessarily to BRANZ or Standards New Zealand.

- approving acceptable solutions (incorporating approval of products and their systems of application) which can be taken by a consenting or certifying authority as conforming to the reasonable grounds test
- approving any regimes to be applied by consenting or certifying authorities in deciding who is competent to perform work
- leadership in establishing the education needs of the construction industry and its regulators
- quality assurance (and licensing) of consenting and certification agencies
- quality assurance (and licensing) of agencies responsible for creating and maintaining lists of competent people
- making determinations and acting in a judicial role

#### 5.4.2 Detailed Recommendations

It is vital that the revised BIA should have the appropriate authority and structure under the new Act to undertake the necessary expanded technical leadership role. It must provide a “code of practice” for Territorial Local Authorities through the accreditation process proposed for certifiers. The central agency must take on a foresight and leadership role so that problems are anticipated and assertive actions taken. This will help improve the performance of Territorial Local Authorities and certifiers.

### 5.5 Improved Consent and Audit Processes

*The variability in enforcement of standards between Territorial Local Authorities, and the unacceptably low standards in some cases, must be eliminated by ensuring that consent approvals and code compliance certification are granted only after high-quality evaluation processes, including peer review by expert structural engineers where the building has non-standard structural features. Territorial Local Authorities must establish a culture of complaining about the competence of engineers who repeatedly present sub-standard work so that these practitioners can be investigated by the registering authority, under the Chartered Professional Engineers of NZ Act 2002*

#### 5.5.1 Rationale

The existing Act and current practice in its implementation allows documentation of varying quality and completeness to be submitted for Building Consent application. Structural aspects may or may not be covered by a Producer Statement. Documentation typically will not specify which aspects of the work are designed to:

- Acceptable Solutions
- Verification Methods
- Alternative (performance-based) Solutions

There is a wide variation in practice among Territorial Local Authorities: from accepting Producer Statements for design (PS1's) from known practitioners with no supporting calculations and consequently no audit checking, to requiring full accompanying calculations with a PS1 and carrying out random audits and checks on all unusual structures.

This inconsistency in practices is not satisfactory, and more importantly does not inspire confidence that Territorial Local Authorities are satisfying themselves on reasonable grounds that required minimum standards are being met. Neither will a reasonable record of the calculations be held in the longer term.

There is common acceptance that Territorial Local Authorities at present generally do not have in-house technical expertise to check much more than Acceptable Solutions and the more basic Verification Methods. There is also a perception that Territorial Local Authorities review the documentation that is submitted but do not always check for completeness.

Territorial Local Authorities and certifiers have a high level of responsibility for complex projects; commercial pressures, and available staff, funds and time are all limiting factors.

Furthermore, many people will try to “get things through” or “try something on” with the Territorial Local Authority and certifiers, further increasing the responsibilities of the Territorial Local Authority and certifiers without any penalty to the consent applicant, who simply resubmits when the defects are found.

It would also appear that the present BIA audit process is not working adequately because of the variable quality of consent processes and large variations in the standards that different Territorial Local Authorities set.

The accreditation scheme for certifiers proposed in the new Bill is designed to address this, but the absence of ongoing auditing between accreditation reviews is a concern.

The auditing of a selection of projects as proposed by the task force would help Territorial Local Authorities, certifiers and consent applicants to focus on their responsibilities in this area – especially if the results of reviews were regularly published.

### **5.5.2 Detailed Recommendations**

- 1) The BIA accreditation procedures should provide inter alia for:
  - i) Review of the appropriateness of accepting the competence of the designers.
  - ii) Review of the adequacy of documentation submitted for the project. All Building Consents shall clearly state which aspect of the work are Acceptable Solutions, which are designed to Verification Methods and which are Alternative, performance-based solutions. Clear statements attributing responsibility to the various agencies involved in the design and construction processes are needed.
  - iii) A qualified architect reviewing architectural parts of a job for correctness.
  - iv) One or more qualified engineers should review structural and other engineering aspects of a job for soundness. The skill level of the reviewing engineer should be at least similar to, and preferably higher than, that of the original designer. In the event that the Territorial Local Authority does not have appropriately trained and qualified auditors in house, the Territorial Local Authority should engage independent consultants or personnel to carry out the audit functions. The independent auditor/reviewer should be required to submit a PS2 (Producer Statement – Design Review) as part of their review documentation. Guidelines should be developed on the extent and comprehensiveness of the design review. Guidelines for assigning the relative liability between the designer and reviewer, preferably on a proportional basis, should also be prepared. The competence of the auditor should at least match that of the designer.
  - iv) Visiting the building and ensuring all current documentation is up to date, i.e. that complete drawings for the job are held by the Territorial Local Authority, not just a first stage to get a consent under way.
  - v) Identifying any illegal or un-consented work.

- vi) Confirming the completeness of an appropriate trail of records for all structural engineering and other observation work.
- vii) Identifying any defects in the documentation, design, site observation etc.
- viii) Consolidation of these findings into a report to Government and to the Territorial Authority.
- ix) Publication of the findings in a BIA publication.

The BIA should have power to restrict or remove the ability to certify if certain standards are not met.

2. All reviews by the TLA or certifiers of content should be required to check the submitted design against Acceptable Solutions, Verification Method or agreed minimum required performance levels. Reviews should also check the adequacy and completeness of the construction documentation. [Note that the Construction Industry Council Documentation Working Party Guidelines are an attempt to address this issue but cover only a limited range of project types. Further work is required to provide comprehensive guidance.]
3. An assessment should be made of the differences between consent documents and final (as built) documents, to determine whether there should be a further compliance review. In this electronic age, one assumes that supplying a set of "as built" drawings would not be too much to ask for.
4. The proposed audit process would require the BIA to audit a percentage of completed building projects each year (say 50 of various sizes) and report to:
  - i) Government
  - ii) The Territorial Authority

This proposed review of a selection of projects is likely to be complementary to the present BIA practice of reviewing Territorial Local Authority procedures. It would be a review of substance rather than procedure. If problems are found and not corrected accreditation should be withdrawn
5. The present BIA practice of reviewing the procedures within Territorial Local Authorities should be supplemented with provision for some definite action if deficiencies are found and not addressed within a specified time.

## **5.6 Responsibility Of Building Owners**

*Building owners or developers must be required to employ or engage suitably qualified people for both design and construction*

### **5.6.1 Rationale**

The commercial/industrial building industry has become fragmented as a result of multi-levelled subcontracting of specific trades, whereby a tradesperson does not undertake and complete a full project, but rather completes discrete elements of work. This is a fact of life and unlikely to change.

The quality of work performed is also influenced significantly by the shortage of skilled/qualified tradespeople, and poor or absent specific skills in the lower-tier subcontracting environment.

To ensure the delivery of a quality product, qualified or competent supervision is necessary. Ideally more carpenters (post apprenticeship) are needed. To be effective in ensuring quality, these people need to be recognised as both qualified and competent to supervise. Some specific supervisory training will be required to prepare them for the responsibility of signing off packages or elements of the work as complying with the construction documentation and fit for the intended purpose.

### 5.6.2 Detailed Recommendation

1. It would be reasonable to require the contractor to name and present the credentials of the supervisors prior to the commencement of the work. These people or their approved replacements should be required to be present at the site during the critical phases of the works.
2. A series of simple but comprehensive forms would be needed to ensure that an audit trail was available.

These recommendations have been addressed in the announced Building Bill

## 5.7 Evaluation of New Materials and Practices

*There needs to be a process to ensure that new materials and practices with uncertain properties and performance in the New Zealand context are not allowed on to the market and into use without proper evaluation.*

### 5.7.1 Rationale

The uncontrolled introduction of new products or methods without sufficient evidence that the product or method works should not be allowed. This is not to stifle innovation, but to provide reasonable safeguards. There must be a system of notifications to the BIA (by the product owner, an innovator or a regulator); and the BIA should be given the power to act, by delaying use until more information to inform the assessment is available, allowing conditional use or banning use.

Verification methods require the exercise of judgement and their use must therefore be restricted to those equipped to apply them, normally professionals of demonstrated competence.

Product appraisals and accreditations must be rationalised into a single system of approval. Certification of products and processes is necessary to support acceptable solutions in particular, and alternative solutions to a lesser extent. There may be more than one proprietary product that meets the requirements of an acceptable solution, and this should be recognized. Certification must be of product systems– including the method of use as well as the product.

If a supplier is required to guarantee a product over an extended period they will often, for commercial reasons, wish to limit those who are allowed to apply it. This has potential to create a commercially-driven set of pseudo-registers of competent people, separate from those created by statute. This is a concern.

The Building Bill will address most of these issues.

### 5.7.2 Detailed Recommendations

1. In practice, the means might be as follows: prior to the sale of a new product for use in the construction of buildings a description of the product, stating its purpose and the testing it has undertaken, must be lodged with the BIA. This information would be made public for comment. All questions concerning the behaviour of the product and the appropriate response by the developer would be documented by the BIA. The BIA may require further testing of the product (at the expense of the product's advocate) before allowing its sale in New Zealand. It should be noted that the use of the product in other countries (even seismically active countries) does not automatically mean that the product should satisfy New Zealand requirements, as design procedures in New Zealand may differ from those elsewhere. An appeal provision should be built in.
2. The BIA, as a matter of urgency, should set up a panel of experts to assess the body of research now available, and advise on the use of precast hollow-core floor units, grade 500 reinforcing steel, and pre-cast slender wall panels with height to thickness ratios of greater than 30, with a view to developing advisory notes (Codes of Practice) on design with and application of these technologies.
3. The use of building materials that do not comply with New Zealand standards must be made illegal

## 6 CONCLUSIONS

The Task Force is of the view that unacceptable variations in standards of practice do exist. The main causes are systemic, and are addressed in the Building Bill, but the engineering profession can make improvements of its own volition.

The Task Force makes 7 major recommendations:

1. *Development of Standards and Codes of Practice.*  
There is an urgent need to develop more comprehensive standards (for practices that can be described in a prescriptive way) e.g. through Standards NZ processes; and codes of practice (for practices requiring substantial professional judgement) e.g. through the professional body. A funding model independent of commercial interests within the industry is required. The development of standards for the building industry should be controlled and commissioned by the Building Industry Authority or its replacement.
2. *Identification of competent structural engineers.*  
Competence assessment of structural engineers must be stringent. Engineers working outside their competence should be identified and censured where appropriate.
3. *Professional involvement through all stages of project delivery.*  
It is essential that professional involvement is maintained throughout the implementation (construction) phases of the work. Ideally the original designers should observe the construction phase. At the completion of construction the design professionals should issue producer statements to validate any design variations that have occurred during construction, and to confirm that they are satisfied that what has been constructed meets the design intent.
4. *Expanded technical leadership role for Government's central regulator (currently the BIA) in providing a code of practice for Territorial Local Authorities to follow.*  
The central agency must take a foresight and leadership role so that problems are anticipated and assertive actions taken to ensure the regulatory regime is kept relevant and up-to-date as innovations are made. This will help improve the standards set by the Territorial Local Authorities and certifiers.
5. *Improved Consent and Audit Processes.*  
The variability in the enforcement of standards between Territorial Local Authorities, and the unacceptably low standards in some cases, must be eliminated by ensuring that consent approvals and code compliance certification take place only after high-quality evaluation processes, including peer review by expert structural engineers where the building has non-standard structural features. Territorial Local Authorities must establish a culture of complaining about the competence of engineers who present sub-standard work repeatedly, so that such practitioners can be investigated by the registering authority under the Chartered Professional Engineers of NZ Act 2002.

6. *Responsibility of Building Owners.*

Building owners must be required to employ or engage suitably qualified people for both design and construction, and must be made liable for the consequence of not doing so.

7. *Evaluation of New Materials.*

A process needs to be established to exclude new materials with uncertain properties and performance in the New Zealand context from release on to the market and into use without thorough prior evaluation.

IPENZ can act by applying rigorous competence assessments within the structural engineering field and by developing a culture of identifying , complaining about and disciplining poor performers.

## APPENDIX 1: SESOC ISSUES PAPER

*This paper was prepared by Dr Barry Davidson for discussion at the December 2002 meeting of the Engineering Practice Board to assist discussion by distilling the main issues from the 120-page Scarry open letter*

### Report to IPENZ Engineering Practice Board On John Scarry Letter

B. J. Davidson (President SESOC)  
12<sup>th</sup> December 2002

#### Brief Summary of Concerns Described in John Scarry Letter

- A. Professional Engineering
  - 1. Widespread low standard of technical competence
    - (a) A large number of common practices at odds with documented "best practice"
    - (b) Many deficiencies in RC, precast concrete and steel design
    - (c) Poor computer modelling of structures
    - (d) Inconsistency in design approach for all but the simplest of members
  - 2. Lack of CPD and motivation to improve
  - 3. Very poor documentation
  - 4. Incompetence in immigrant engineers
  - 5. Unprofessional behaviour by structural engineers
  - 6. Structural engineering considered by many as a "commodity"
  - 7. The only basis of competition between structural engineers is fees
- B. Territorial Local Authorities
  - 8. Unprofessional behaviour by territorial authorities
  - 9. Abrogation of responsibility of territorial authorities and building checkers
- C. Construction Industry
  - 10. Building skills being lost
  - 11. A "couldn't care less" attitude by contractors
  - 12. Today's engineers and construction workers less skilled than those of previous years

#### John Scarry claims

- "examples should not be viewed as worst examples of an otherwise well functioning structural engineering profession"
- "views are consistent with many of [his] colleagues"

#### John Scarry Suggestions for Rectifying the Situation

- Swift and effective steps to ensure maintenance of high standards of the structural engineering profession
- Registration of all engineers and draughtsman working in the structural engineering industry

- Permanent technical body for the support and oversight of all technical aspects of structural engineering design, supervision and construction.
- Reintroduction of minimum fee scales
- Protection of the status of NZ Structural Engineers by law
- Improved training at Universities
- Compulsory full site inspections by the designer.
- Structural failures disclosed to the public
- Obligatory "Practising Certificates" for management and workers in the Construction industry
- Registration and bonding of construction and fabrication companies

#### **Comments on Scarry Letter by SESOC Reviewers**

- The letter over-dramatises the situation. However all agree that they have seen some if not all of the issues described in the letter.
- Most tend to disagree with minimum fees, although several submissions strongly supported this concept to allow for Professional development and support.
- Many of John Scarry's recommendations are impractical.
- All agree that some form of action needs to be taken. This action must have the support of all parties in the building industry.

#### **Brief Overview**

The issues described in the letter occur sufficiently frequently for all structural engineers to agree that they have observed many or most of them. The causes of these issues are human error, lack of training, or lack of supervision/checking (poor systems). The consequences of poor construction in a high seismic region will be devastating to the economy and morale of the country.

#### **Interim Recommendations by SESOC**

There have been a number of suggestions/recommendations developed by the SESOC committee to address some of these concerns. They are listed below. More time and effort is required to develop a complete strategy to address such a wide-ranging list of concerns. The development of such a strategy requires a working group to be formed that includes participants from other parts of the construction industry. Representatives from IPENZ, ACENZ, Territorial Local Authorities, BIA, and BRANZ should be included.

SESOC can immediately put into place strategies to address concerns (A(1)) on page1. These are primarily issues of education and code development.

Solutions to the other concerns require the co-operation and participation of other parties such as BIA and BRANZ. Although SESOC has developed some initial recommendations, they need to be reviewed and agreed upon by others.

### **Possible Solutions**

1. SESOC and IPENZ should continue to promote a role for BIA in auditing outcomes of the New Zealand Building Code in the as-built environment and the performance of these outcomes in practice to achieve a near optimum whole of life cost for buildings. BIA audit role be extended beyond auditing procedures.
2. IPENZ/ SESOC should promote the establishment of a body to act as an independent advisor to the industry.
3. Increased research into the performance of buildings is desirable, with particular emphasis on the consequences of failure of building components approved as compliant with the New Zealand Building Code
4. IPENZ/ SESOC express concern over undue reliance by territorial authorities on acceptance of Producer Statements, and in particular, their acceptance on the basis of listings irrespective of the nature of work, adequacy of documentation and importance of the building for public safety.
5. IPENZ/ SESOC should promote a focus on the production of Standards to protect the public good in areas where the consequences of failure have significant public downstream impact. (Note that there is an opinion within SESOC that the production of Standards cannot be seen as a total solution to poor design practice).
  - Appropriate Government funding is essential to ensure that Standards produce documents that protect against unacceptable outcomes.

## APPENDIX 2: TASK FORCE PROCESS

In broad terms, the taskforce has followed the proposed modus operandi, but found that the timetable proposed was too short. Because of the timelines set by others for the Building Act review, specific issues that were germane to that Act received early scrutiny while consideration of other aspects of practice were delayed. The taskforce process also relied on voluntary input from busy professionals and as a result the original deadline was not met.

### MILESTONES

Calls for submissions from Members were made in the IPENZ publications *engineering dimension* (February '03 and March '03) and *engineering direct* (28 February and 4 April '03). The Chief Executive, Dr Cleland also published some ethical advice on the question of at-risk buildings and invited feedback in *engineering direct* on 11 April 2003. Feedback was specifically sought on the IPENZ submission to changes in the Building Act in the *engineering direct* issues for 31 Jan '03 and 14 February '03. Submissions closed on 21 February, and five comments were received. Further information was provided to members in the *engineering direct* of 21 February '03.

The first two meetings of the taskforce, held on 16 January 2003 in Auckland and in Wellington on 28<sup>h</sup> January, concentrated on building a picture of the industry and establishing how the individual members saw modern structural engineering practice. The discussions were wide-ranging and a list of issues was identified and refined.

The third and fourth meetings (24 February 2003 and 21 March 2003) were focused on issues related to the Building Act review, and the preliminary findings were used to inform the IPENZ submission to the Ministry of Economic Development's discussion paper on regulation of the building industry. This submission was made on 11 April 2003.

At the fifth meeting, held on 8 May 2003 in Wellington, Mr Scarry and Professor John Mander, Professor of Civil Engineering, University of Canterbury, were invited to be present, the latter to outline his research work on hollow-core flooring and pre-cast slender panels. Dr David Hopkins and Dr Arthur O'Leary representing the BIA attended as observers.

Subsequently this draft report was drawn up and agreed amongst the members of the taskforce. The draft report was made available for Member comment on the IPENZ web site and a number of submissions were received. These submissions and the availability of the Building Bill informed the final editing process. Two further meetings of the task force were held to agree the report.