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Royal Commission of Inquiry
into Building Failure Caused by the Canterbury Earthquake
Level 1
Unit 15 Barry Hogan Place
Addington
Christchurch

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Transmitted by email to: Canterbury@royalcommission.govt.nz

Attention: Commissioners

Dear Sirs,

Submission Concerning Quality Assurance within a Large Engineering Consultancy

Introductory Comments

This submission is made by Beca Carter Hollings & Ferner Ltd, on behalf of the Beca Group of companies. It focusses on describing how Beca approaches quality assurance in the delivery of projects.

Beca Approach to Quality Assurance for the Delivery of Professional Engineering Services.

- Beca aims to provide a consistent approach to quality assurance for all jobs we undertake. The systems described below are documented in the Beca Quality Management System (QMS), a single, consistent system used throughout the company, which sets out minimum requirements.
- Beca is ISO 9001 certified. As part of Beca's on-going obligations to maintain its ISO 9001 certification we maintain an internal audit programme. Every six months the technical group's in each office are audited against the requirements of the Beca QMS by Beca staff from other parts of the company, who have been trained as internal auditors. This involves approximately two days of auditing a random selection of individual jobs currently underway within each group. Corrective Action Requests (CARs) are issued for non-compliance, rectification and future learning. Beca is also subjected to regular independent audits by Bureau Veritas NZ, who audit at both a system level as well as a random selection of individual jobs.
- Each project is allocated both a Job Director and a Job Manager at project inception. These individuals are responsible for the successful delivery of the project and work as a team throughout the project. Regular meetings are held between Job Director and Job Manager to review the "health" of the project from technical, financial, project team and client service viewpoints. This is facilitated by a standardised form to prompt discussion on each topic and record agreed actions arising from the meeting.
- Beca has a structured group of risk committees comprising senior technical and business leaders within the firm. These risk committees are tiered reflecting different risk levels and include Business Line risk committees, Company risk committees for each of the operating

companies and a Group risk committee. The Beca QMS system requires that projects are assessed for technical (and other risks) as part of the project procurement process. Risks and proposed mitigations to manage the identified risks are developed by the Job Director and Job Manager. The risks and proposed mitigations are reviewed at the appropriate risk committee in a challenge session where a group of senior technical leaders with expertise in the type of project, client, and market, review the project. Agreed actions are recorded for implementation and are monitored by the risk committee. The risk committee determines the requirement for on-going reviews throughout the project duration. Topics commonly discussed at risk committee meetings include: identifying the appropriate technical expertise for each project with a best for project focus, technical issues and requirements arising from the project brief, project verification requirements and appropriate allocation of Job Managers and Job Directors to projects. In the case of the recent Canterbury earthquakes a dedicated risk committee was formed to focus on the risk prevailing in Christchurch throughout 2011 (e.g. health and safety concerns), and convene with greater frequency in response to the dynamic market conditions and high workloads.

- The Beca QMS requires each job to be planned at the setup stage, including the verification processes required for the project. Job planning includes: the technical aspects of the work, organisational structure and responsibilities, resources, and programme.
- Design projects, particularly larger projects, usually follow the generally accepted industry approach of concept design, preliminary design, developed design and construction documentation followed by construction observation during the implementation phase. Extensive use is made of the NZCIC Design Documentation Guidelines to define the inputs and deliverables across the different design disciplines at each stage of the design. This provides an ordered approach to design, with the aim of designs coordinated across all disciplines.
- Within the structural group concept committees are frequently convened at an early stage. These committees usually comprise the project Job Director, Job Manager, structural staff working on the project, and other senior structural technical leaders who are not otherwise involved in the project. Their objective is to review and agree the project concept design in a focussed challenge session.
- Design verification is performed on all design work in order to confirm design outputs meet the design requirements such that:
 - the client brief has been satisfied,
 - safety in design principles have been followed,
 - the design complies with the relevant design standards and accepted design practice,
 - the design is efficient and buildable,
 - a suitable approach has been taken and alternative solutions have been considered where appropriate, and
 - the technical accuracy of designs and other work has been subject to appropriate checking.
- For non-routine designs the verification is often led by senior practitioners that are independent of the design team. The project verifier role is defined in the Beca QMS as being an independent role from that of the Job Manager. The Job Director is required to sign off the verification plan including identification of project verifiers as part of the project planning process. In some circumstances the verifier may be a specialist sub consultant.
- Verification comprises both the activities of review and checking as defined below:

- "**Reviewing**" means evaluating concepts, approach, methodology and overall content and direction, and recommending any changes; it may include checking, but is typically broader and more conceptual.
- "**Checking**" means ascertaining correctness the work. This may be by a duplicate or equivalent methodology, or by assessing conformance to criteria by observation, comparison with other jobs, or physical measurement.

Verification may include techniques such as design reviews, alternative calculations, qualification tests and comparison with analogous designs.

Peer reviews, brainstorming sessions and value engineering processes may also be adopted on projects with client agreement or initiation. These may or may not be considered as part of the verification process depending on the specific project.

Where verifiers have indicated errors or required/suggested changes, these are required to be resolved and the outcome recorded. The Beca QMS requires records of all verification activities to be kept in the project files for reference and possible audit.

- Graduate engineers are exposed and included in the quality assurance process though their daily work. Beca operates an open plan office with Technical Directors and other senior technical leaders sitting with all the other staff. We aim to seat the graduates beside seniors, and wherever possible, our Technical Directors. This promotes communication and close cooperation between all staff and provides an informal learning environment. Graduates work on each project under the direction of a Job Manager and Job Director. The Job Manager is responsible for planning and supervising the work of each graduate on their projects. Graduates are privy to the project planning and verification planning for their projects and then exposed to the quality assurance programme during project implementation. Our processes require that all work is verified before issue, and graduates are often involved in addressing comments arising from the verification process.
- The application of appropriate, up to date analysis and design techniques is important. Beca maintains a central repository of company best practice for each technical discipline. The Structural Knowledge Portal (SKP) contains several thousand of guidance documents and productivity tools comprising much of the organisation's intellectual property. Content is typically generated by either capturing learning's from projects, or targeted investment in specific technical initiatives.
- Continuing Professional Development (CPD) plays an important part in maintaining current knowledge. Engineers at Beca typically attend both external seminars and conferences, as well as regular internal training sessions.
- Technical development at Beca is coordinated via technical development groups, reporting to the Professional Leadership Group. Gap analyses are undertaken to identify knowledge and techniques needed to respond to prevailing client requirements. Following the Canterbury earthquakes, the bulk of targeted technical development initiatives have focused on seismic assessment, retrofit techniques and effective communication of risk.

Closure

We thank the Royal Commission for the opportunity to provide information about the quality assurance system we operate at Beca and would welcome the opportunity to amplify our observations and comments.

Yours sincerely

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