# Chorus' Seismic Policy and Standards Review

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Chorus is New Zealand's largest telecommunications infrastructure company. It maintains and builds an open network predominantly made up of local telephone exchanges, antenna towers, cabinets and copper and fibre cables. Chorus is part way through a review and rationalisation of the many seismic-related internal standards it has inherited with its demerger from Telecom. The ANSI Telecommunications Industry Association Standard TIA 942 has been used as a basis for a Rating Standard that ranks the importance of all of its company's buildings and infrastructure. A performance-based seismic policy has been signed off, and the various in-house structural design standards are currently being rationalised/aligned in terms of the requirements for a utility in the Civil Defence and Emergency Management Act 2002, and the New Zealand Building Code and its Verification Methods. The objective is to have a set of requirements that international equipment suppliers can relate to, and which are transparent for local designers of buildings, support structures, and infrastructure. This paper informs New Zealand designers of the background to the work being undertaken, and how Chorus is integrating its seismic requirements with its network reliability targets.

## 1 INTRODUCTION

Chorus maintains and builds an open network predominantly made up of local telephone exchanges, antenna towers, cabinets and copper and fibre cables. It has inherited much of this from its recent demerger from Telecom, along with many seismic-related internal standards which Chorus is reviewing and rationalising.

As a first step, Chorus has prepared a seismic design policy, and wishes to take this opportunity to inform those who directly or indirectly provide structural design services for its network of its rationale and proposed application.

### 1.1 Overview

The prime function of Chorus's buildings, structures and building services plant is to support the reliable and continuous operation of Chorus or its customer's networks with an acceptable level of safety for those occupying the buildings and working on plant or systems.

These assets must also be able to perform within the limitations accepted by society (through governmental laws, regulation, etc), and to the expectations of Chorus's key stakeholders.

Chorus's policy for the structural integrity and seismic resilience of these assets outlines minimum performance standards in terms of acceptable risk of loss of serviceability, onset of damage and resilience when external loads including those arising from natural hazards (earthquakes, wind, etc) are applied to them.

This policy also applies to the structural performance of the framework supporting equipment and plant so that these items can operate at an acceptable level of safety when installed in buildings or attached to towers.

This policy does not specifically cover the mechanical performance of equipment and plant (including antennae) that are installed in buildings or attached to towers. It is intended that such equipment

should, in general, meet the minimum conditions outlined in Telcordia's Generic Requirements document GR-63 – NEBS documentation. Telcordia (an Ericsson company) is a chief architect of the telecommunications system in the USA, and its origins were in the Bell System. NEBS (Network Equipment-Building System) is the most common set of design guidelines for telecommunications equipment. Compliance with it is an industry requirement rather than a legal/government one.

### 1.2 **Context**

As professional engineers know, the New Zealand Building Act 2004 defines the minimum performance standards to which buildings and structures are to be designed, built and modified. The Building Code references a set of design Standards and methods which, when followed, are deemed to meet the requirements of the Act.

The Civil Defence Emergency Management Act 2002 (CDEM) requires lifeline utilities such as Chorus to have an emergency management plan to ensure recovery after and during emergencies by:

- being able to function to the fullest possible extent during and after an emergency
- having plans for "being able to function" that can be made available to the Director of Civil Defence Emergency Management.

Chorus buildings and structures have been constructed under many versions of the Building Act, and so there are many variations in structural capability and seismic resilience across the asset base, and sometimes within individual assets. Since the creation of these buildings and structures, loads have been imposed on and in them that consume the available capability. Sometimes this requires modified approaches of installation to ensure operations meet an acceptable level of safety. Most Chorus buildings have a design working life of 50 years.

The changes to the acceptable seismic performance under the Building Code and its supporting standard NZS 1170 means that periodic performance evaluations of the assets are required to ensure Chorus operates buildings, structures and equipment at an acceptable level of safety in and on them.

### 1.3 **Policy re Importance**

The policy deems that Chorus telephone exchange buildings have an Importance Level (IL) 3 under the definition in Table 3.2 of NZS 1170.0 2002. IL3 is defined as appropriate for:

*Structures that as a whole may contain people in crowds or contain contents of high value to the community or pose risks to people in crowds.*

### 1.4 **Related Reference Material**

Chorus' policy acknowledges that designers and suppliers must also comply with the over-arching requirements in New Zealand such as the Civil Defence Emergency Management Act 2002, the Building Act and its regulations, and the New Zealand Building Code including its compliance documents and Verification Methods.

The Telecordia Generic Requirements document (GR-63) mentioned above presents minimum spatial and environmental criteria for all new telecommunications equipment used in Exchanges and other environmentally-controlled telephone equipment spaces.

## 2 **DEFINITIONS**

### 2.1 **Buildings**

Chorus defines buildings as structures that house network equipment; have adequate strength to support that equipment; can withstand earthquakes and wind; are weather-proof and fire-resistant; are structurally strong enough to provide good security; have acceptable levels of safety for those working in them; contain engineering services to support the operation of equipment.

## 2.2 **Towers and Masts**

Chorus defines towers and masts as structures that accommodate antennae for radio systems; have adequate strength to support those antennae against earthquakes, wind and ice; support connecting cables; have acceptable levels of safety for those who climb and work on them.

## 2.3 **Network Equipment**

Network equipment is that used in the provision of telecommunications services. This may include both powered and non-powered devices, and cable termination and management systems. It has acceptable level of safety to be worked on with a minimum of safety precautions.

Most telecommunications equipment frames are neither designed to withstand moderate earthquakes nor to support the weight of cable trays that provide connectivity to other parts of the telecommunications networks. External support structures are therefore required.

## 2.4 **Earthquake-prone Buildings**

Chorus' policy acknowledges the earthquake-prone buildings policies by regulation and territorial authorities.

## 2.5 **Planned Failure Hierarchy**

Chorus has an underlying design philosophy that damage should develop according to a planned hierarchy which is most favourable for the restoration of telecommunications services. It is, in effect, a continuum where damage is more tolerated by individual systems than by a building that accommodates many systems.

Effectively, the hierarchy works on the basis that the easiest item to repair, and those that have the least impact, are designed to fail before elements that can have a greater impact on the continuity of network services at any one site.

## 2.6 **Serviceability Limit State**

Chorus has chosen a higher-than-normal Serviceability Limit State for earthquake shaking. It has an annual probability of exceedance of 1/500 for the specific site being considered.

## 2.7 **Ultimate Limit State**

Chorus' policy acknowledges that reaching this state effectively means that a structure is no longer operational and would need to be rebuilt. It is likely to be severely damaged, but not to have collapsed.

## 2.8 **Robustness Level**

The policy takes a position on robustness of the design solution. It requires a level of robustness that ensures that adequate plant capacity is available to provide the required level of service (power, air conditioning, etc) to operate equipment, additional plant units are installed to ensure that capacity is still available should a number of pre-specified units fail or be taken out of service.

This is referred to as the level of robustness where the capacity to support the load is referred to as "n" and extra number of units required to provide the robustness is reference as a whole numerical number but usually "1" – hence the term n+1.

When referring to a structure, the increased level of robustness relates to adding additional structural members that from engineering calculations (and supported by the relevant standards), increases the ability of the structure to withstand increased externally applied forces (e.g. earthquakes, wind, ice loading, etc.).

## 3 POLICY

### 3.1 Structural Performance Parameters

All Chorus's buildings and structures are required to be designed in accordance with at least the New Zealand Building Code.

The following parameters are Chorus's minimum requirements for the design of specific assets. They are to be read in conjunction with NZS 1170.0:2002 for all other parameters.

**Table 1. Structural Performance Parameters.**

| Asset | Design Life (years) | Importance Level | Serviceability Limit State SLS2 (annual probability of exceedance) |
|---|---|---|---|
| Telephone Exchanges | 50 | 3 | 1/500 |
| Equipment Shelters | 30 | 2 | 1/500 |
| Self-Supporting Lattice Towers | 50 | 3 | 1/500 |
| Supported (guyed) Lattice Towers | 30 | 2 | 1/500 |
| Supported (guyed) Masts | 25 | 2 | 1/500 |
| Supports for Equipment & Plant | 25 | 3 | 1/500 |

## 4 PROPOSED REVISION OF TELECOM STRUCTURAL (INCL SEISMIC) STANDARDS

Chorus and Telecom currently have a set of Seismic Standards (commonly referred to as the Structural Standards), made up of a collection of generic standards references and practices of how these standards should be applied. It is some time since most of these documents have been reviewed.

Both Chorus and Telecom have a need for these standards to ensure that its buildings and other structures are fit for purpose, safe to operate and will provide an economic platform that will support the operation of its telecommunications network.

Chorus intends to develop a set of documentation that can be used for references and can be used to build and maintain its structural inventory. Chorus particularly wants to use New Zealand Standards and, where suitable standards are not available, adopt the most appropriate international standards that either have or are likely to have greatest support from the New Zealand structural community or industry. The standards must also integrate into the New Zealand regulatory environment. Also, where appropriate, the best practices of other overseas telecommunications operators will be incorporated so long as the above conditions can be met.

It is intended that the format developed for the Telecom Fire Standards 2854 will be used as a basis for all Chorus and Telecom Standards.

Chorus intends to develop new practice notes where gaps are identified and where revision of existing documentation is required.

### 4.1 **Inventory to be included in Chorus Standards**

The following areas will be in the scope:

- Geotechnical
- Buildings – seismic and structural
- Towers and masts – seismic, wind and structural
- Equipment seismic support structures
- Plant and building fittings - seismic and structural

As the standards are developed, it is expected that there will be a need to give more definition to the scope of what might or might not be included.

### 4.2 **Existing Documentation**

The following have been recognised as Chorus's existing standards covering the Structural / Seismic sphere of influence:

- 2856 Seismic Protection Standards – Design and Installation
- ND0077 Seismic Protection – Policy and Procedures
- ASD 2151 Lightning Protection Design Rules

Many of Chorus's existing standards and practices have references to structural requirements. It is expected that over time when these will be progressively discovered and amendments made.

Other documents are available on the Chorus website with access through the Service Partner login.

## 5 **SUMMARY**

The demerger of Chorus from its parent organisation Telecom has provided an opportunity for a consistent and up-to-date set of structural and seismic design standards to be developed across the demerged organisations. This process has been commenced by the development and adoption of a seismic policy that sets out performance requirements, and is consistent with the obligations of a utility under New Zealand's laws, and with the performance-based seismic design approach specified in New Zealand's Verification Methods.