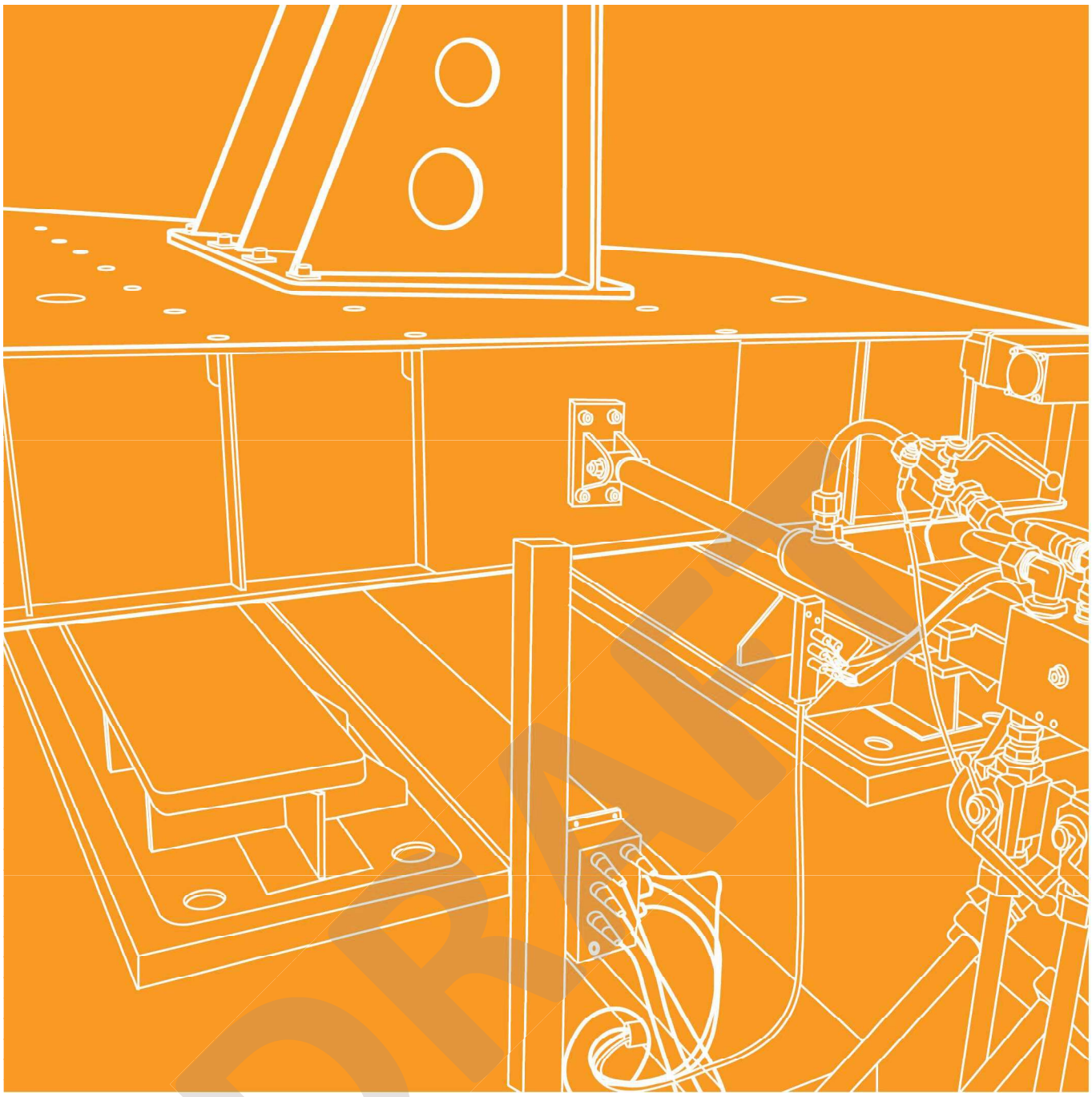

Leco Sales
Shake-table Seismic Testing

Quantum Cabinet System

Holmes Solutions

Revision: 0.2
19 December 2023
Project: 145778.00

1 EXECUTIVE SUMMARY

Leco Sales is a New Zealand based company specialising in the design, manufacture and distribution of switchboards and switchgear. They are the New Zealand representative company for a number of switchgear component companies in the switchboard building industry. Leco Sales requested that Holmes Solutions undertake shake-table testing to demonstrate compliance of their Quantum cabinet system with New Zealand performance criteria for seismic actions.

The required response spectra for horizontal and vertical shake-table testing was generated by scaling the NZS 1170.5:2004, section 8 floor response spectra to meet the peak horizontal and vertical acceleration coefficients of 3.6g and 2.5g respectively, in accordance with NZS 1170.5:2004 and NZS 4219:2009.

Testing was conducted in three separate principal directions in accordance with the test method as outlined in ICC-ES AC156, using the two uniaxial seismic shake-tables at Holmes Solutions Structural Test Facility in Hornby, Christchurch. Both units under test appeared to successfully pass structural integrity verification at the completion of the test program.

2 INTRODUCTION

Leco Sales is a company the specialises in the design, manufacture and distribution of switchboards and switchgear for the New Zealand market.

Leco Sales have engaged Holmes Solutions to formulate a testing program to demonstrate to engineers and specifiers that their product range can meet or exceed the required New Zealand performance criteria for seismic actions. As part of this criteria, products should demonstrate that they do not pose a safety hazard due to collapse or due to subassemblies becoming detached.

Leco Sales therefore engaged Holmes Solutions to undertake seismic testing on their Quantum series cabinet system.

3 TESTING PROTOCOL

Currently there is no New Zealand Standard covering shake-table testing of engineering systems for seismic qualification, however the building code cites New Zealand Standard 4219 – Seismic Performance of Engineering Systems in Buildings, which includes within its scope a means of compliance with the amenity (operational continuity) and life safety performance requirements of the building code. Specifically, commentary C2.4 refers the designer to the use of overseas standards, providing the design actions are not less than those determined in accordance with NZS 4219.

The testing protocol adopted for this project is generally in accordance with ICC-ES AC-156 (AC-156), with the exception that the generic International Building Code (IBC) based required response spectra (which define the level of shaking applied to units during testing) are replaced by floor response spectra generated to meet the NZS 1170.5 upper bound design earthquake characteristics for parts and components (and thereby NZS 4219 section 4), as detailed in section 6.2.

8 TEST RESULTS – DB-1

SHAKE-TABLE SEISMIC TESTING – TEST REPORT	
UNIT UNDER TEST (UUT):	1 of 2
MANUFACTURER:	Leco Sales
MODEL LINE:	Quantum Cabinet Switchboard
MODEL NUMBER:	DB-1
SERIAL NUMBER:	
TEST DATE:	06/12/2023

TEST SETUP IMAGES

TESTING MOUNTING DETAILS

Back of UUT screwed to fixture using six 65mm 14G/M6 type 17 screws. Adaptor plate was fixed to the shake-table with 15 M20 G8.8 hex head screws.

REQUIRED RESPONSE SPECTRA (RRS)

Test Protocol(s):	ICC-ES AC-156									
Design Location(s):	New Zealand									
Earthquake Loadings Standard:	NZS 1170.5									
Design Factors	Site Class:	E	Z:	0.6	R:	1.8	N:	1.0	Rp:	2.0
Spectra Ordinates	Cph(Tp<0.75s):		3.6		Cph(Tp>1.5s):		N/A[1]			
	Cpv(Tp<0.75s):		2.5		Cpv(Tp>1.5s):					

UUT PROPERTIES

MASS (kg)	DIMENSIONS (mm)			LOWEST NATURAL FREQUENCY (Hz)		
	Width	Depth	Height	Front-Back (X)	Side-Side (Y)	Up-Down (Z)
100	1300	200	1800	N/A[2]		

PRODUCT CONSTRUCTION SUMMARY

Sheetmetal enclosure supporting all subcomponents.

[1] Outside range of ICC-ES AC-156 excitation frequencies

[2] Panel construction - no resonant frequencies less than 10Hz with significant mass participation factors identified.

9 TEST RESULTS – DB-2

SHAKE-TABLE SEISMIC TESTING – TEST REPORT	
UNIT UNDER TEST (UUT):	2 of 2
MANUFACTURER:	Leco Sales
MODEL LINE:	Quantum Cabinet Switchboard
MODEL NUMBER:	DB-2
SERIAL NUMBER:	
TEST DATE:	06/12/2023

TEST SETUP IMAGES

TESTING MOUNTING DETAILS

Base of the UUT fixed to adaptor plate using six M8 hex bolts. Back of UUT screwed to fixture using six 65mm 14G/M6 type 17 screws. Adaptor plate was fixed to the shake-table with 14 M20 Socket-head Screws.

REQUIRED RESPONSE SPECTRA (RRS)

Test Protocol(s):	ICC-ES AC-156									
Design Location(s):	New Zealand									
Earthquake Loadings Standard:	NZS 1170.5									
Design Factors	Site Class:	E	Z:	0.6	R:	1.8	N:	1.0	Rp:	2.0
Spectra Ordinates	Cph(Tp<0.75s):		3.6		Cph(Tp>1.5s):		N/A[3]			
	Cpv(Tp<0.75s):		2.5		Cpv(Tp>1.5s):					

UUT PROPERTIES

MASS (kg)	DIMENSIONS (mm)			LOWEST NATURAL FREQUENCY (Hz)		
	Width	Depth	Height	Front-Back (X)	Side-Side (Y)	Up-Down (Z)
120	1500	200	1275	N/A[4]		

PRODUCT CONSTRUCTION SUMMARY

Sheetmetal enclosure supporting all subcomponents.

[3] Outside range of ICC-ES AC-156 excitation frequencies

[4] Panel construction - no resonant frequencies less than 10Hz with significant mass participation factors identified.