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REPORT:
Load Testing of the Zat™ Walkway Bracket

REPORT DATE: April 11, 2024

PREPARED FOR: Fab-Form Industries Ltd
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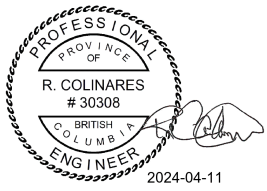
V3M 6W1

PREPARED BY: Jon Colinares, P.Eng
Element Consulting Engineers Ltd.

Element Consulting Engineers certifies that all testing witnessed as documented within this report, adheres to the relevant standards outlined, as applicable. I further affirm that the results presented are factual and accurately represent the findings of the conducted tests.

Jon Colinares, P.Eng.



EGBC Permit to Practice #1001230

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1. INTRODUCTION

Fab-Form Industries Ltd. was tasked by Element Consulting Engineers to supervise and confirm the strength tests of the Zat™ Walkway Bracket within the context of its use as an access scaffold platform as defined in CSA S269.2 *Access Scaffolding for Construction Purposes*. Since the Zat Walkway Bracket is typically used as a pouring platform for Insulated Concrete Form (ICF) construction (ie, formwork), it was necessary to conduct testing, as specified by CSA scaffolding and formwork codes, as summarized below.

i) Walkway Brackets: tested for vertical loads as per CSA S269.1-16 *Falsework & Formwork*
ii) Guardrail Post Support- tested for horizontal loads as per CSA S269.2-16 *Access Scaffolding for Construction Purposes*

Jon Colinares, a licensed professional engineer with Element Consulting Engineers oversaw the preparation and testing process, ensuring tests were performed in accordance with the relevant sections of the standards and results are factual.

1.1 Test Location

All tests were assembled and conducted at the Fab-Form facility, located at #19, 1610 Derwent Way, Delta, BC.

1.2 Specimen Description

Zat™ Walkway Bracket is a 10-gauge steel structural component, typically used as a pouring platform and forms part of the Zont™ Bracing System used in Insulated Concrete Form (ICF) construction. See Figure 1, and refer to Appendix A for detailed Zat™ Bracket specifications.

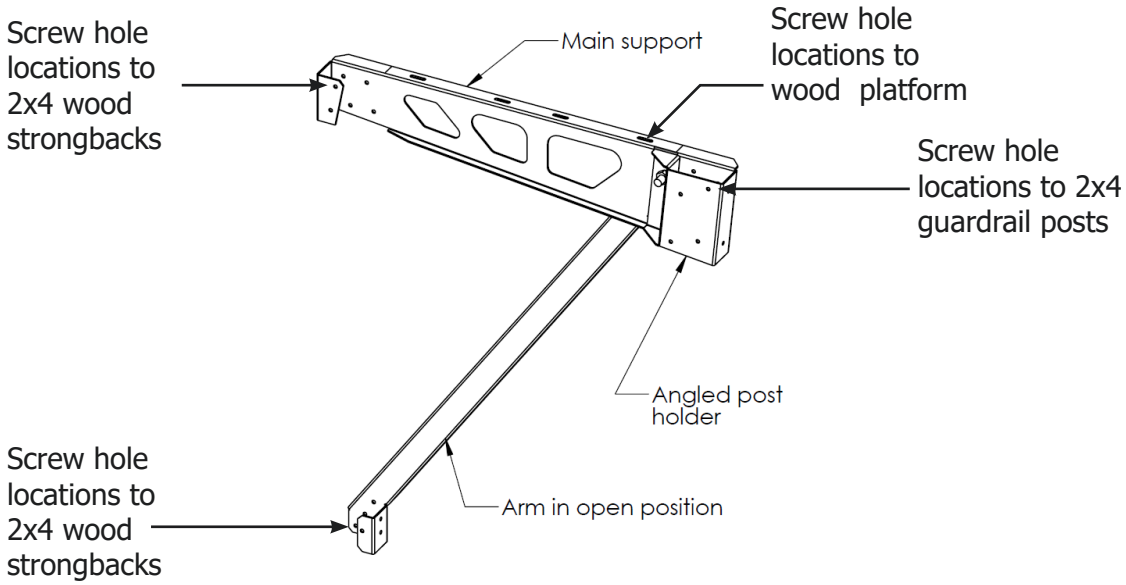

Figure 1: Zat™ Walkway Bracket Detail

1.3 Sampling

Three random samples of Zat™ Brackets were selected for each load test. The samples were selected at the test location and witnessed by Element Consulting Engineers.

1.4 Test Assembly

Zat™ Brackets were assembled to simulate end-use conditions of a typical access/pouring platform that forms part of the Zont™ Bracing system used for the construction of ICFs. Refer to Figure 2 below for complete test assembly.

Three sets of Zat™ brackets were used in the assembly with the spacings as shown in Figure 2.

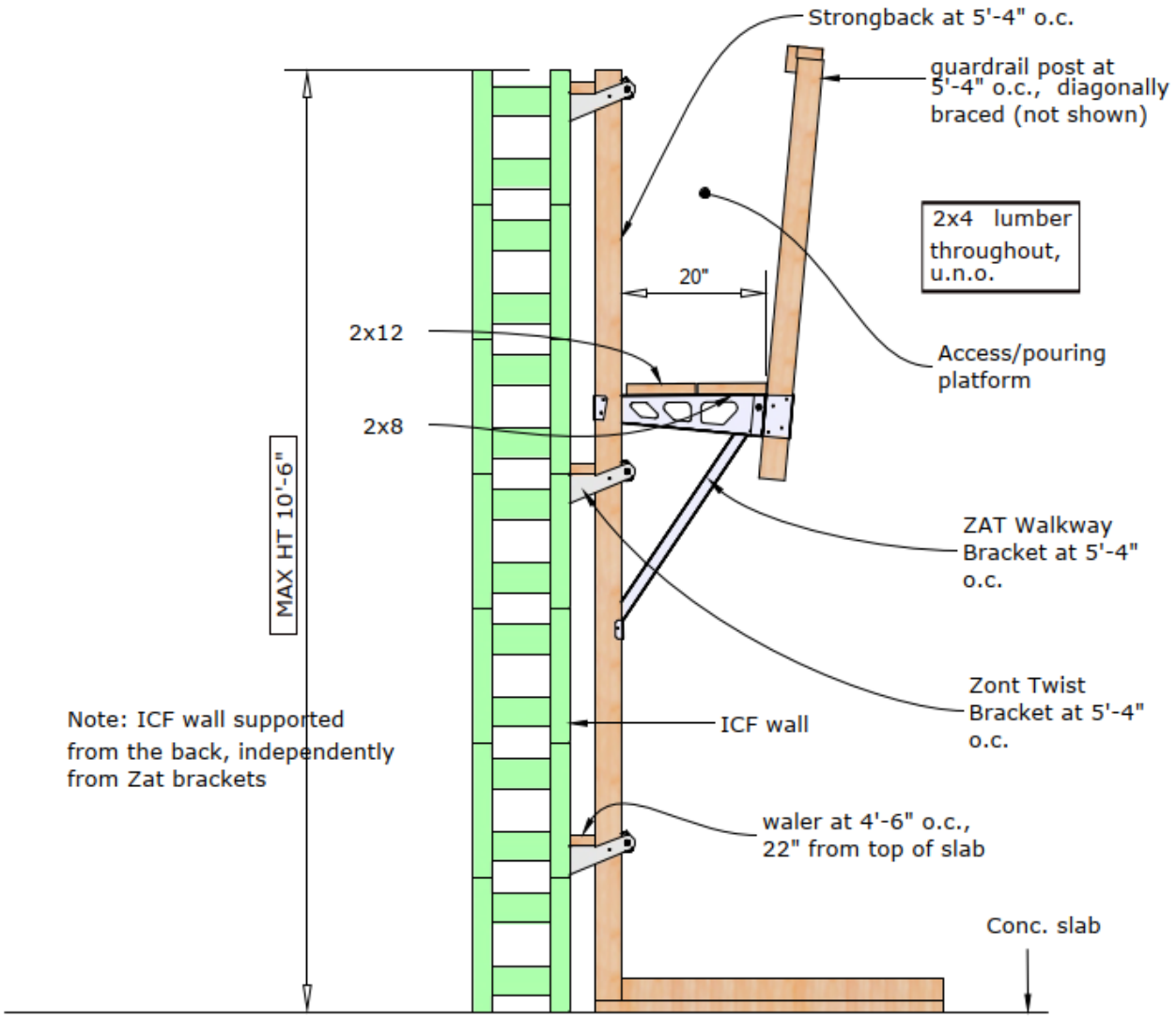

Figure 2: Test Assembly

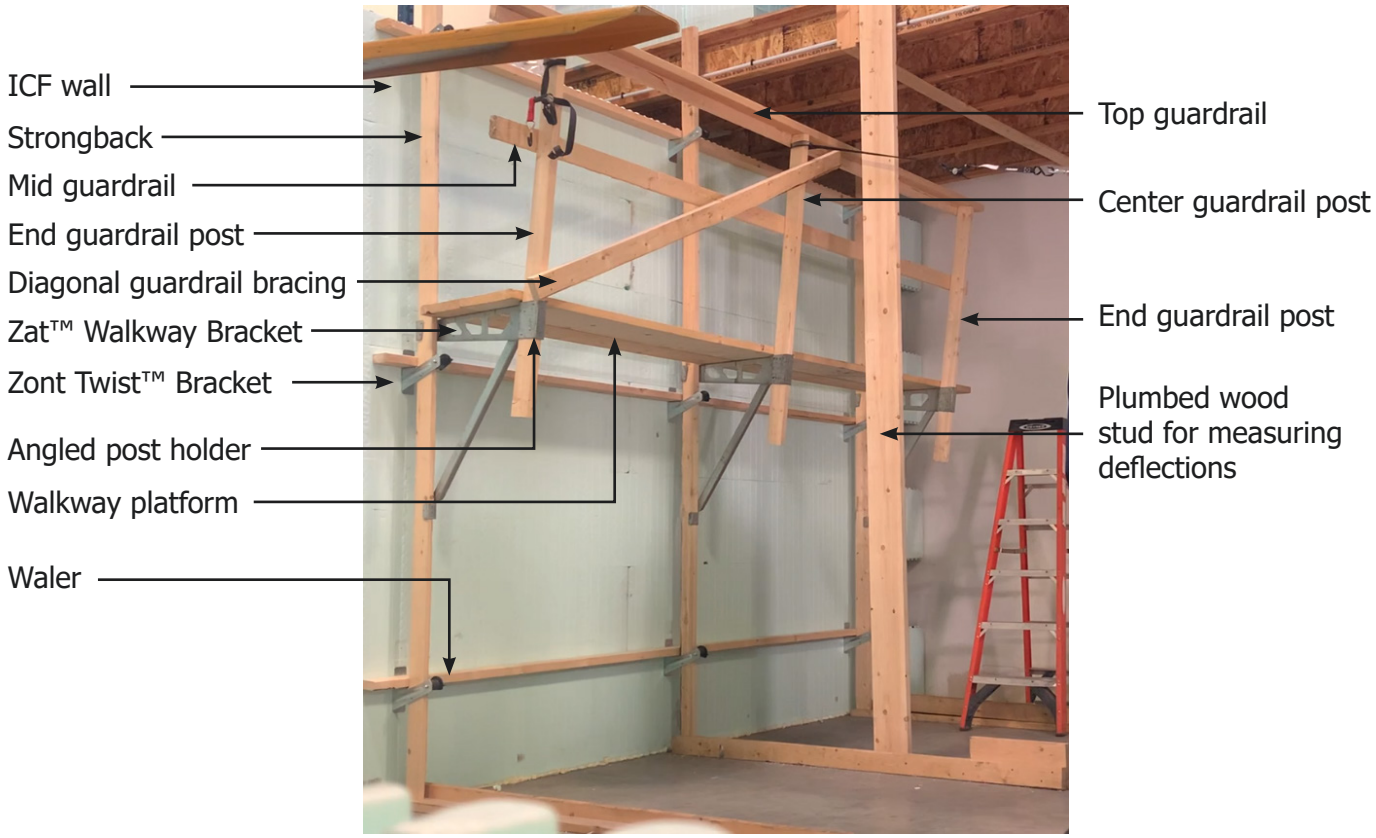

Figure 3: Test Assembly

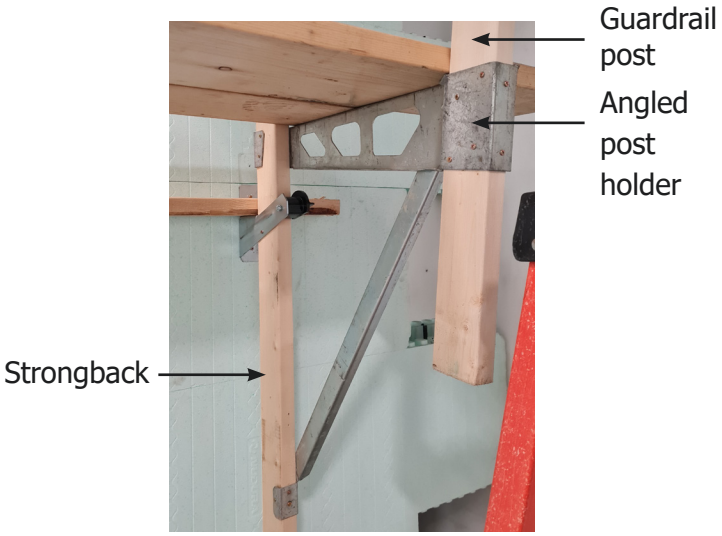

Figure 4: Zat™ Bracket connection to Strongback and guardrail

Figure 5: Zat™ Bracket connection to walkway platform

The main support and arm of the Zat™ Brackets were secured to vertical 2x4 wood strongbacks and to the underside of the wood planks comprising the platform. This was done using #8 x 1 ½" long coarse thread screws at the pre-marked hole locations.

The strongbacks and 2x4 walers were supported by Zont Twist™ Brackets that connected to the ICF web ties. Support for the kicker plates was made up of two 2x4s were screwed to the slab and the bottom of each strongback. The ICF wall was restrained from movement during each load test.

Guardrail posts consisting of wood 2x4 were positioned into the angled post holder of the Zat™ Bracket and fastened into place at the pre-marked hole locations. The height of the guardrail posts measured 45 in from the walkway platform level to top of guardrail. Horizontal 2x4 wood guardrails were fastened to each guardrail post 24 in above the platform level. For the longitudinal load test, an additional 2x4 was screwed to two adjacent guardrails forming a diagonal brace. Fasteners used to secure all 2x4 wood material were #8 by minimum 2 ½" long coarse thread screws.

1.5 Conclusions

Fab-Form conducted the load testing on the test assembly, supervised by a licensed professional engineer from Element Consulting Engineers. The test results indicated that the Zat™ Brackets, when assembled to end-use conditions, successfully sustained a minimum vertical load of 1,800 lb without any apparent damage or deformation to the Zat™ Bracket component or any component of the Zont™ Bracing system.

Consequently, the Zat™ Brackets complied with the load specifications for medium-duty access platforms (50 psf live load), in accordance with Section 6.2.3(b) *Live Loads on Access Scaffold Platforms of CSA S269.2-16*.

In addition, per Section 6.6.2 of CSA S269.2-16, a horizontal load no less than 259 lb was applied in the longitudinal and transverse direction of the walkway system. The loads were applied to the top of a guardrail post 42 in above the platform level. The results showed no sign of visible damage to the tested Zat™ Brackets, the guardrail post or any component of the Zont™ Bracing system.

Consequently, the Zat Brackets complied with the load specifications required to support 2x4 guardrail posts, together with a guardrail system consisting of top rails, mid rails, and bracing.

2. WALKWAY BRACKET - VERTICAL LOAD TESTS

The purpose of this load testing is to evaluate the vertical load capacity of the Zat™ bracket within the context of its application in an access walkway system. Specifically, the test aims to determine if the Zat™ bracket can sustain a live load of 50 lb/ft^2, in alignment with the criteria for "*medium duty*" applications as outlined in section 6.2.3(b) of the CSA S269. 2-16 standard.

2.1 Testing Period

All tests were conducted on January 15, 2024.

2.2 Applicable Standards

Vertical load testing was conducted following Clause 9.3.9 Methods For Testing And Rating Walkway Brackets of CSA S269.1-16, "*Falsework and Formwork*," where applicable.

2.3 Test Apparatus

Testing apparatus included a manual strap puller rated for 4000 lb, calibrated hanging crane scale rated for 1000 kg, and 1/2 inch diameter threaded rod. See Appendix B.

Vertical load was applied manually using the strap puller. The puller was connected to the hanging scale which was anchored independent of the test assembly to the concrete slab with an eye-bolt. Metal hooks were used to connect and secure the other end of the puller to the threaded rod.

The threaded rod was positioned between a 2x8 and 2x12 plank supported by the Zat™ Brackets to simulate the walkway platform. The rod was secured through two layers of wood 2x4 resting on top of the planks along the width of the platform with a nut and washer. This provided a stiffer connection allowing the point load to be more evenly distributed along the bearing length of the Zat™ Bracket.

Deflections including elastic recovery (deflections measured after applied load is removed) at the platform level were marked on a plumbed wooden stud, set up independent from the test structure and measured using a carpenter square.

Figure 6: Vertical deflections measure with a carpenter square.

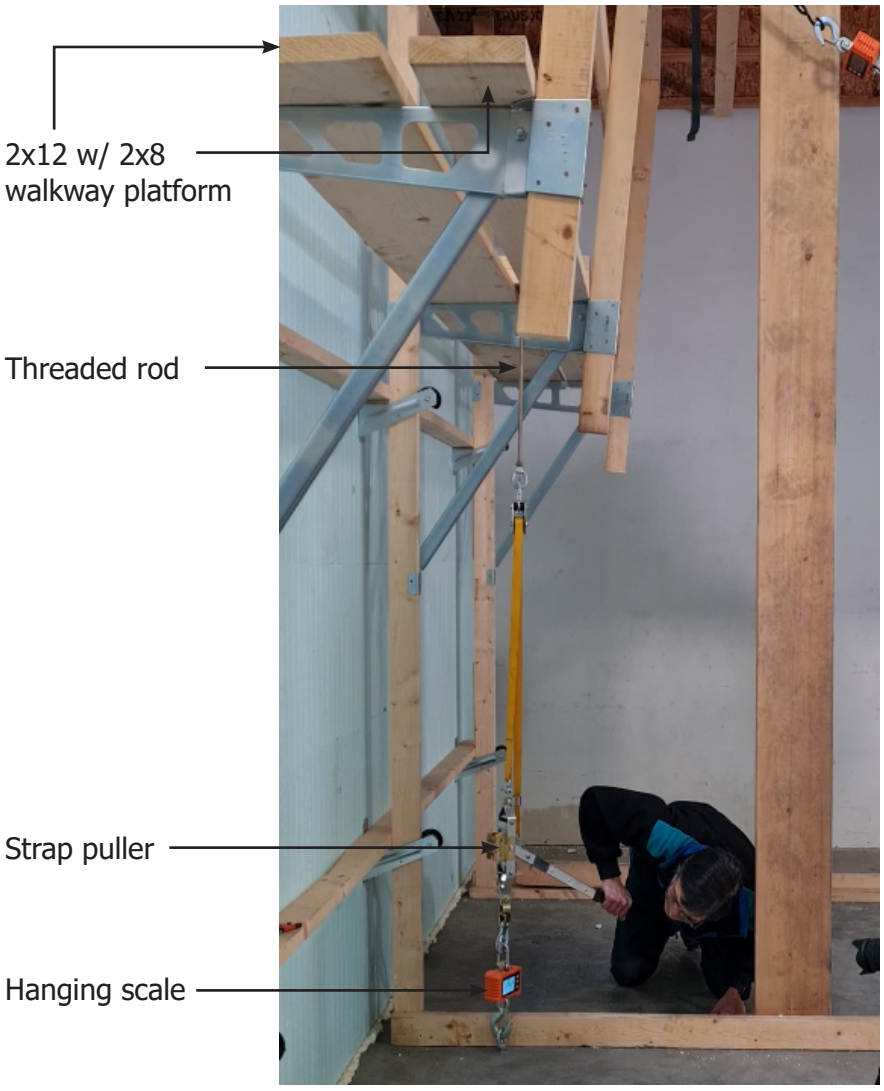

Figure 7: Application of vertical load test

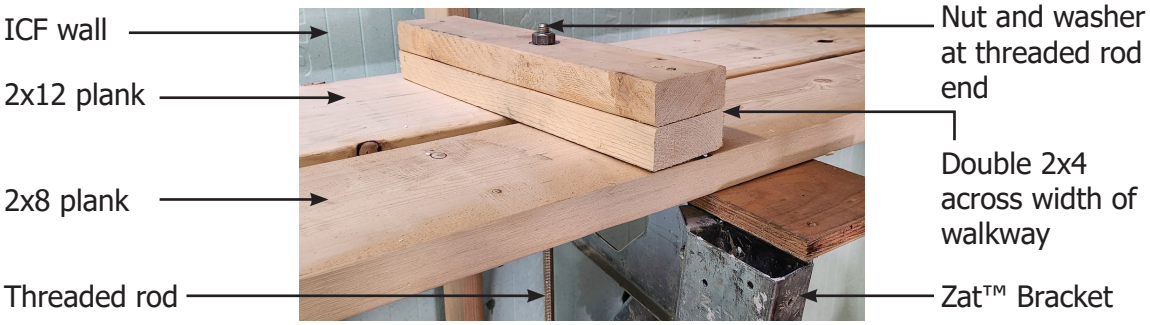

Figure 8: View of threaded rod connection to walkway platform.

2.4 Test Procedure

A load of at least 1,800 lb was exerted at a distance 12 in from the face of the strongback, using a minimum rate of 200 lb per minute, per Section 9.3.9.2 of CSA S269.1-16. Upon reaching this threshold, the applied load was held steady while final deflection was measured. Elastic recovery deflection was measured after the load was removed.

Recorded data included both the applied loads and resulting deflections, as well as any visible signs of damage to the tested Zat™ Bracket component and bracing system.

Three separate tests were conducted, employing fresh Zat™ Bracket specimens for each individual load test.

Figure 9: View of scale connected to slab and strap puller. Vertical load test.

2.5 Test Requirements

In lieu of an applied uniformly distributed load over the walkway system of the test assembly, a point load was applied to the center Zat™ Bracket and distributed over the width of the walkway, as described under "Test Apparatus."

To comply with duty rating of "medium duty" for access scaffolding, in accordance with Section 6.3.2(b) of CSA S269.2-16, the platform must demonstrate it can support a minimum uniform load of 50 lb/ft^2. As a result, the corresponding minimum point load that the Zat™ Bracket must support is 1,800 lb with a 4:1 safety factor.

The calculation is shown below.

- Uniform load applied along the walkway system: UDL = 50 lb/ft^2
- Spacing of Zat™ Bracket components: s = 5'-4" (5.33ft)
  This is the maximum allowable spacing, as recommended by the Fab-Form.
- Width of walkway: W = 20" (1.67ft)
- Factor of safety: FoS = 4

- Point load applied at Zat™ Bracket:

  P = (UDL) x (s) x (W) x FoS = (50 lb/ft^2) x (5.33ft) x (1.67ft) x 4 = 1,778 lb ~1,800 lb

2.6 Vertical Load Test Results

Required load threshold: 1,800 lb.

Applied load rate: 200 lb/min

SAMPLE ID	LOAD, kN (lb)	DEFLECTION, mm (in)	ELASTIC RECOVERY, mm (in)	OBSERVATIONS
#1-1	8.5 (1,900)	18 (0.69)	5 (0.20)	No visible signs of damage or deformation. No visible signs of shearing or pullout of fasteners.
#1-2	8.1 (1,819)	10 (0.39)	3 (0.12)	
#1-3	8.4 (1,881)	15 (0.59)	3 (0.12)	

While the primary aim of the test was to evaluate the load-bearing capacity of the Zat™ Bracket, it is noteworthy that subsequent inspections revealed no visible damage to the bracing system.

3. GUARDRAIL POST SUPPORT - HORIZONTAL LOAD TESTS

The objective of the horizontal load test is to verify the ability of Zat™ brackets to support a 2x4 wood guardrail system, subjected to resist horizontal point loads of not less than 259 lb, in accordance with CSA S269.2-16 standard.

The Zat™ bracket consists of an angled post holder (see Figure 1, Section 1.2), which allows for the installation of a 2x4 guardrail post, which then provides primary support for the wood guardrail system. This report pertains only to the Zat™ bracket's ability to resist horizontal loads applied to the guardrail post as part of a stable guardrail system, and is not meant to test the supported guardrail system itself. The guardrail system must be adequately braced in order to prevent overloading Zat™ brackets.

The horizontal loads were applied in the longitudinal (parallel to walkway) and transverse (normal to walkway) directions.

3.1 Testing Period

All tests were conducted on January 23, 2024.

3.2 Applicable Standards

In accordance with CSA S269.2-16, Section 6.6.2 *Loads on guardrail posts*, the Zat bracket guardrail posts were tested to resist a minimum point load of 259 lbs applied at the level of the top rail. As per Section 6.6 *Loads on guardrails, midrails, and stair handrails*, a factor of safety of 4:1 does not apply to the 259 lb test load.

Relevant sections from Section 8.7 *Methods for testing guardrail scaffold component*s were used to conduct the testing.

3.3 Test Apparatus

Testing apparatus included a manual strap puller rated for 4000 lb and a calibrated hanging crane scale rated for 1000 kg. See Appendix B.

Horizontal forces were by manual operation of a strap puller. The hanging scale was integrated into the setup by connecting it to the strap puller. An additional strap was looped around the guardrail post and affixed to the opposite end of the hanging scale, ensuring accurate force measurement. Metal hooks facilitated secure attachments among the scale and puller.

Horizontal forces were exerted on the guardrail posts at a height of 42 in from the platform surface which should cover minimum guardrail height requirements for most jurisdictions in North America. Similarly, deflections were recorded at the same elevation of 42 in above the platform.

In the case of transverse loading, deflections were measured at the tested guardrail post and marked on a plumbed wood stud that was set up independent from the test structure and measured using a carpenter square. For longitudinal loading, deflections were measured using a tape measure from a fixed wall independent of the test structure.

3.4 Test Procedure

A horizontal load of at least 259 lb was exerted at the guardrail post 42 in above the platform level. The loads were applied at rate of 130 lb per minute. Upon reaching the load threshold, the corresponding horizontal deflection was recorded.

Transverse load tests were conducted at the center Zat™ Bracket and guardrail post. Longitudinal load tests were conducted at the end Zat™ Bracket and guardrail post.

Figure 10: Application of transverse horizontal load at center post.

In the case of longitudinal load tests, a 2x4 wood was used as diagonal bracing between the center guardrail and end guardrail post providing additional longitudinal restraint. The bracing was fastened to the guardrail posts with #8-2 ½ long screws. The bracing is required to prevent overloading Zat™ brackets for longitudinal load testing.

Figure 11: Application of longitudinal load at end post.

Figure 12: Connection of diagonal brace at end post.

Before introducing any load, a baseline with zero deflection was established. Following the application of a minimum 259-lb load, this load was maintained to measure the final deflection. Elastic recovery deflection was measured after the load was removed.

Recorded data included both the applied loads and resulting deflections, as well as any visible signs of damage to the tested Zat™ Bracket component and bracing system.

Three separate tests were conducted for each longitudinal and transverse load, employing fresh Zat™ Bracket and guardrail post specimens for each individual load test.

3.5 Test Requirements

Per Section 6.6.2 of CSA S269.2-16, guardrails posts must be designed to resist a minimum horizontal load of 259 lb applied in any direction at the top of the post. This test was conducted to verify the Zat™ Bracket component can support the guardrail post when subjected to no less than 259 lb.

The load applied during the test, at a rate of 130 lb/min, deviates from the required 50 lb/min outlined in Section 8.7.4 of CSA S269.2-16. Given the test's goal to assess the structural integrity of the Zat™ Bracket, rather than focusing on the guardrail post or its load/deflection characteristics, it was deemed permissible to employ a higher loading rate for this evaluation.

3.6 Horizontal Load Results

Required load threshold: 259 lb.
Applied load rate: 130 lb/min.

LOAD DIRECTION	SAMPLE ID	LOAD, kN (lb)	DEFLECTION, mm (in)	ELASTIC RECOVERY, mm (in)	OBSERVATIONS
Longitudinal	#2-1	1.16 (262)	38 (1.50)	8 (0.31)	No visible signs of damage or deformation. No visible signs of shearing or pullout of fasteners.
	#2-2	1.18 (266)	37 (1.46)	4 (0.16)	
	#2-3	1.27 (285)	47 (1.85)	9 (0.35)	
Transverse	#3-1	1.21 (271)	30 (1.18)	8 (0.31)	
	#3-2	1.19 (268)	39 (1.54)	7 (0.28)	
	#3-3	1.21 (271)	41 (1.61)	9 (0.35)	

While the primary aim of the test was to evaluate the capacity of the capacity of the Zat™ Bracket, it is noteworthy that subsequent inspections revealed no visible damage to the bracing system.