U.S. Customs and Border Protection

OFFICE OF ACQUISITION

Border Wall
Mock-Up and Prototype Test
Final Report

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Revision History

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Executive Summary

The Border Wall Mockup and Prototype Test was primarily conducted in San Diego Sector during 24 October – 15 December 2017. The test team and test design were a product of a "whole Government" approach. The test event had participants from US Border Patrol (USBP), Office of Facilities and Asset Management (OFAM)), Border Patrol Tactical Unit (BORTAC), CBP Operations Support, U.S. Army Corps of Engineers (USACE), United States Special Operations Command (SOCOM) 7th Special Forces Group, and SOCOM Marine Corps Special Operations Command (MARSOC).

The Mock-up and Prototype Test was an early acquisition, non-attributional assessment of infrastructure design characteristics for the CBP Border Wall Program. The Mock-up and Prototype Test is part of a larger concept development phase to determine which design attributes most effectively and efficiently meet CBP's operational requirements for the Border Wall Program as part of an overall Impedance and Denial (I&D) capability. The purpose of the Mock-up and Prototype Test was to provide input to the Border Wall design specification team. The results of the test were not intended to provide direct conclusions or pass/fail scoring. The results of this performance characterization are one of multiple inputs the Border Wall design specification team will use to reach conclusions on border wall features and designs.

The Border Wall Mockup and Prototype Test was conducted on 8 prototypes during which 13 contract requirements were tested resulting in a performance characterization. The test event organized the 13 requirements by test approach: Breaching, Scaling, Aesthetics, Constructability, and Design Review. Breaching was timed scenarios physically penetrating the mock-ups. Scaling was timed scenarios climbing the prototypes. Aesthetics was the collection and analysis of input from 72 participants on the aesthetics of each prototype. Constructability was the observation of the prototype construction, noting and documenting construction innovations, issues, and limitations. The design review was an analysis using as-built design packages and observations from the prototype construction.

The test team designated the four solid concrete prototypes as (b) (7)(E) and the four other border wall prototypes as (b) (7)(E) The results are summarized as follows:

(b) (7)(E) s constructed (b) (7)(E) For aesthetics, (b) (7)(E) was ranked third of the eight prototypes for attractive appearance and ranked first of the eight prototypes for effective appearance. The (b) (7)(E) of (b) (7)(E) are secured on north side to (b) (7)(E) was determined to require substantial additional features, which would varying appearance and function, to accommodate (b) (7)(E). The (b) (7)(E) design was determined to require design changes for (b) (7)(E), and even with those changes, (b) (7)(E) would have substantial construction (b) (7)(E). (b) (7)(E) is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of $ (b) (5)

(b) (7)(E) is constructed (b) (7)(E) . For aesthetics, (b) (7)(E) was ranked fifth of the eight prototypes for attractive appearance and ranked fifth of the eight prototypes for effective appearance. The (b) (7)(E) of (b) (7)(E) are secured on (b) (7)(E) . (b) (7)(E) was determined to require substantial additional features, which would varying appearance and function, to accommodate (b) (7)(E) . The (b) (7)(E) design was determined to have (b) (7)(E) . (b) (7)(E) is estimated to cost $ (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5) .

(b) (7)(E) is constructed (b) (7)(E) . (b) (7)(E) has a (b) (7)(E) For aesthetics, (b) (7)(E) was ranked first of the eight prototypes for attractive appearance and ranked third of the eight prototypes for effective appearance. The (b) (7)(E) of (b) (7)(E) are secured on (b) (7)(E) . (b) (7)(E) was determined to require substantial additional features, which would varying appearance and function, to accommodate (b) (7)(E) . The (b) (7)(E) design was determined to have (b) (7)(E) . (b) (7)(E) is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5) .

(b) (7)(E) is constructed (b) (7)(E) For aesthetics, (b) (7)(E) was ranked seventh of the eight prototypes for attractive appearance and ranked fourth of the eight prototypes for effective appearance. (b) (7)(E) (b) (7)(E) . (b) (7)(E) was determined to require extensive additional features, which would varying appearance and function, to accommodate (b) (7)(E) . The (b) (7)(E) design was determined to have (b) (7)(E) . (b) (7)(E) is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

(b) (7)(E) is constructed (b) (7)(E) . (b) (7)(E) has a (b) (7)(E) . For aesthetics, (b) (7)(E) was ranked eighth of the eight prototypes for attractive appearance and ranked fourth of the eighth prototypes for effective appearance. The (b) (7)(E) (b) (7)(E) was determined to require substantial additional features, which would varying appearance and function, to accommodate (b) (7)(E) . The (b) (7)(E) design was determined to have (b) (7)(E) . (b) (7)(E) is estimated to cost $1 (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5) .

(b) (7)(E) is constructed (b) (7)(E) (b) (7)(E) has a (b) (7)(E) . For aesthetics, (b) (7)(E) was ranked second of the eight prototypes for attractive appearance and ranked third of the eighth prototypes for effective appearance. The (b) (7)(E) of (b) (7)(E) (b) (7)(E) . (b) (7)(E) was determined to require substantial additional features, which would varying appearance and function, to accommodate (b) (7)(E) . The (b) (7)(E) design was determined to have moderate construction (b) (7)(E) . (b) (7)(E) is estimated to cost $ (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5) .

(b) (7)(E) is constructed (b) (7)(E) For aesthetics, (b) (7)(E) was ranked fourth of the eight prototypes for attractive appearance and ranked seventh of the eighth prototypes for effective appearance. (b) (7)(E) (b) (7)(E) . (b) (7)(E) was determined to require minimal additional features to accommodate (b) (7)(E) and moderate additional features to accommodate (b) (7)(E). The (b) (7)(E) design was determined to have (b) (7)(E) (b) (7)(E) is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

(b) (7)(E) is constructed (b) (7)(E) . (b) (7)(E) had multiple configurations, which (b) (7)(E) For aesthetics, (b) (7)(E) was ranked sixth of the eight prototypes for attractive appearance and ranked sixth of the eighth prototypes for effective appearance. The (b) (7)(E) of (b) (7)(E) are (b) (7)(E) . (b) (7)(E) was determined to require minimal additional features to accommodate (b) (7)(E) and moderate additional features to accommodate (b) (7)(E) (b) (7)(E) is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5) .

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1 INTRODUCTION

The Mock-up and Prototype Test was an early acquisition, non-attributional assessment of infrastructure design characteristics for the Customs and Border Protection (CBP) Border Wall Program. The Mock-up and Prototype Test is part of a larger concept development phase to determine which design attributes most effectively and efficiently meet CBP's operational requirements for the Border Wall Program as part of an overall, Impedance and Denial (I&D) capability.

The purpose of this Final Report is to provide a detailed review of the test execution and test results. The test results provide a performance characterization of the eight submitted solutions with objective data on the breach deterrence, scalability, aesthetics, and other technical elements delineated in the Request for Proposal (RFPs) Requirements and listed in Appendix A.

1.1 Background

Transnational criminal organizations will exploit areas along the border that are most vulnerable, easiest to access, provide the best logistical support and allow for them to blend into border communities. The U.S. Border Patrol (USBP) relies on multiple interdependent capabilities to secure the border. They include but are not limited to domain awareness, impedance and denial, access and mobility, and mission readiness. Border wall infrastructure is the anchor to the current border security system that provides deterrence, in addition to impedance and denial.

Prototyping is an industry-tested approach to define the best solution when considering a new product or methodology. Through the construction of prototypes, CBP is partnering with industry to identify additional means and methods to construct border wall infrastructure. The prototypes will inform the final design standard which will likely continue to evolve to meet USBP's requirements. The Mock-up and Prototype Test is neither structured as a pass/fail evaluation nor will the results be used to down-select a specific prototype design. The test results inform the selection of the best attributes for inclusion in future border wall design specifications.

1.2 Test Purpose and Objectives

The purpose of the Mock-up and Prototype Test was to provide input to the Border Wall design specification team.

The objectives of the test, as documented at Test Event Gate Review 0 (TEGR-0), are as follows:

TO-1: To characterize the performance of the Solid Concrete Wall Mock-up and Prototype against the Threshold and Objective requirements in the Solid Concrete Border Wall Design/Build Indefinite Delivery Indefinite Quantity (IDIQ) Contract C.3.1 Proposal Border Wall Design Considerations.

TO-2: To characterize the performance of the Other Border Wall Mock-up and Prototype against the Threshold and Objective requirements in the Border Wall Design/Build IDIQ Contract Section C.3.1 Proposal Border Wall Design Considerations.

TO-3: To provide stakeholder and subject matter expert feedback on the Border Wall Mock-ups and Prototypes.

2 OVERALL APPROACH

The Mock-up and Prototype Test consisted of five test cases. The five test cases were breaching, scaling, aesthetics, engineering design review analysis, and constructability inspection. The breaching and scaling test cases were conducted on the mock-ups and prototypes located in San Diego Sector. The aesthetics test was conducted using a computer-based pair-wised comparison of prototype photographs. The design review analysis was conducted by engineering subject matter experts using as-built design packages and information gathered during the prototype construction. The constructability inspection was conducted by Office of Facility and Asset Management (OFAM) engineers who observed the prototype construction.

2.1 Test Documentation

Test documentation consists of test planning documents: TEGR Briefings, Test Plan, and Test Readiness Review Briefing; and test reporting documents Government Daily Status Reports, Government Quick Look Briefing, and the Final Report. These documents are summarized as follows:

2.1.1 Test Planning Documentation

- **Border Wall Mock-Up and Prototype Test Plan,** (b) (7)(E) . This document (b) (7)(E)

- **Test Event Gate Review Briefings**. These briefings present the test objectives, design, schedule, and funding to Government Stakeholder to gain the buy-in and approval to proceed to the next step of test planning for the Mock-up and Prototype Test. For this test, the briefings consist of a TEGR-0, a kick-off brief; a TEGR-1/2, a test design review and initial readiness review; TEGR-3, a test readiness review; and a TEGR-4, a quick-look brief on the test results.

2.1.2 Test Reporting Documentation

- **Daily Status Reports**. Daily Status Reports summarized the day's activities; tests executed, Test Observation Reports (TOR) and plans for the next day of testing.

- **Quick Look Briefings**. The Government Quick Look Briefing was presented after the completion of the test. The briefing provided a summary of the test cases conducted, the observations made during the test execution, and preliminary test results and findings for the test.

- **Border Wall Mock-Up and Prototype Final Report,** *ENT12-BW-14-000004***.** This document, which provides the detailed results of the test.

2.2 Test Schedule

The Breaching Test Case was executed 28 November to 16 December 2017 at (b) (7)(E). The Scaling Test Case was executed 28 November to 7 December 2017 at Border Prototype Site. The Aesthetics Paired Comparison Test Case was executed 13 November to 16 December 2017 in (b) (7)(E). The Constructability Test Case was executed 24 to 26 October 2017 at Pogo Row. The Engineering Design Review Test Case was executed over the period 28 November 2017 to 31 January 2018.

(b) (7)(E)

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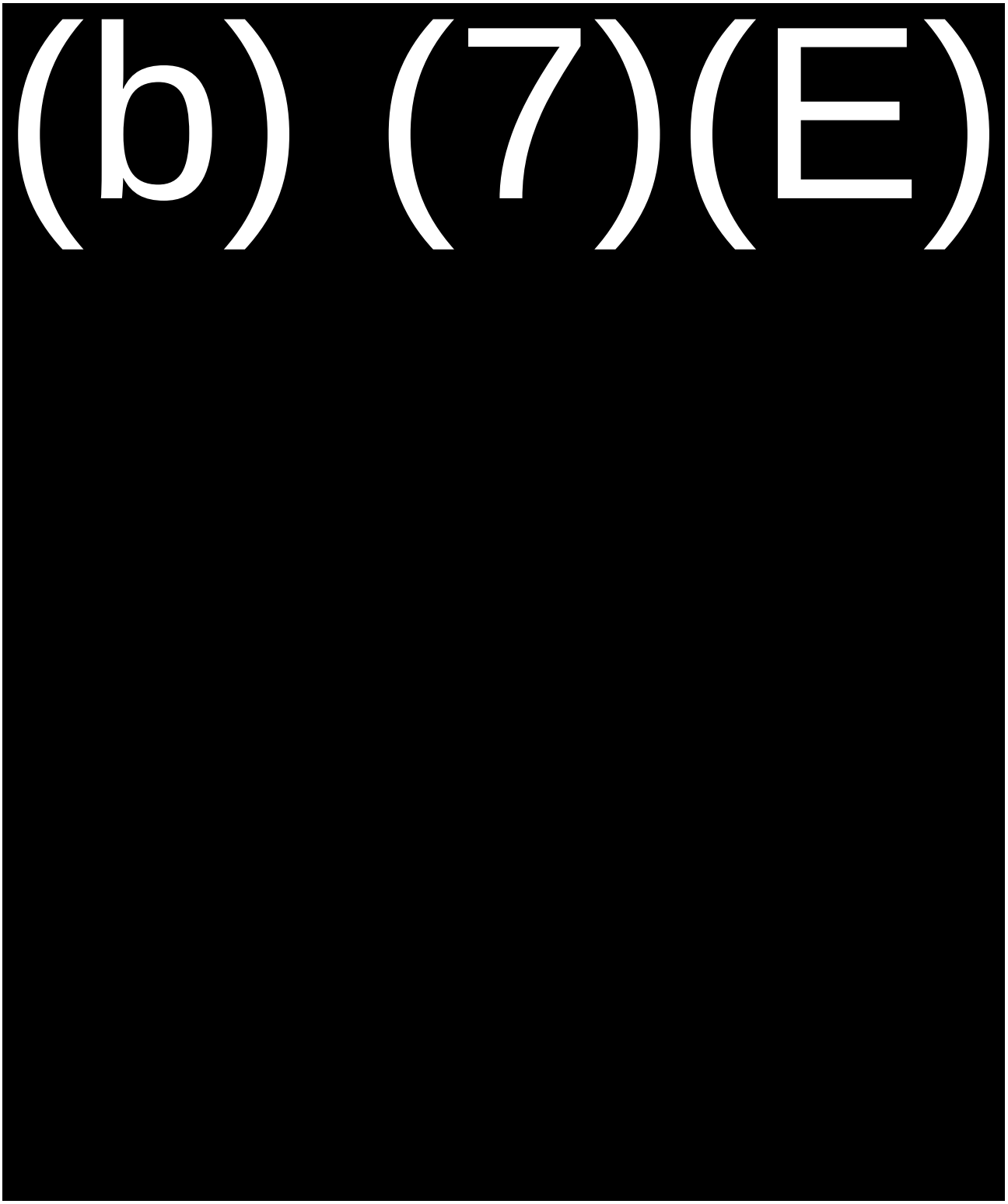
2.3 Test Location

The test was executed in three areas. (b) (7)(E)

(b) (7)(E)

Figure 1: Test Sites Map


(b) (7)(E)

2.4 Test Articles

The test evaluated the eight submitted solutions, each of which consists of a prototype, a mock-up, and an as-built design package. The body of this test report uses the term submitted solutions; however, in other contexts, submitted solutions may be referred to as the prototypes, mock-ups and prototypes, or other similar terms.

2.4.1 Prototype Test Articles

The contract requirements for the solid concrete border wall and other border wall required the prototypes to be (b) (7)(E) and meet all of the border wall requirements specified within the Government RFP, with the exception of the (b) (7)(E) . The Government awarded eight contracts, and eight prototypes were built. All the prototypes are (b) (7)(E) The test team designated the four solid concrete prototypes as (b) (7)(E) through (b) (7)(E) (numbered west to east) and the four other border wall prototypes as (b) (7)(E) through (b) (7)(E) (numbered west to east), as depicted in Figure 4.

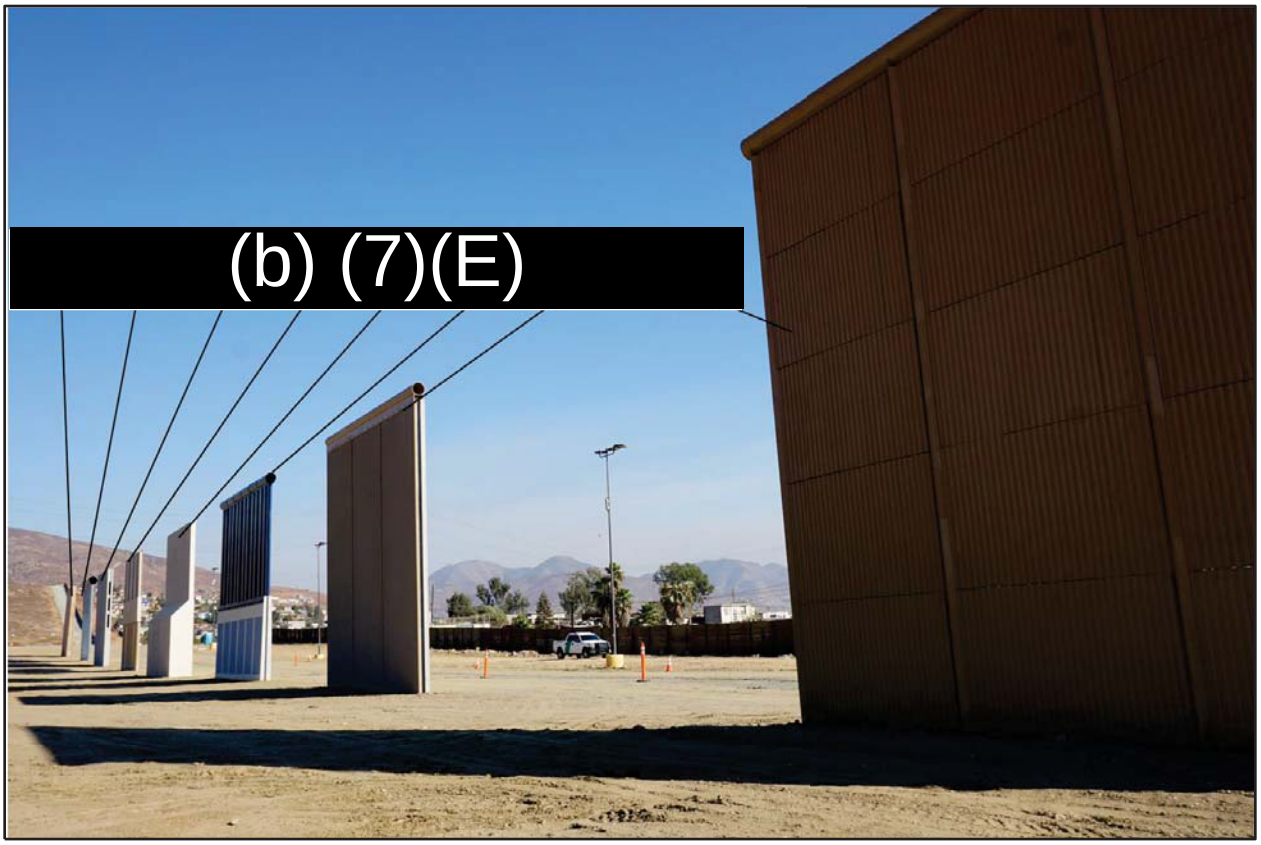


Figure 4: Border Prototypes Site

2.4.2 Mock-up Test Articles

The contract requirements for the solid concrete border wall and other border wall required the mock-ups to be a (b) (7)(E) mock-up of an exemplar section of its corresponding prototype. The mock-ups replicated the structural design of the prototype's (b) (7)(E) The test team referred to the four solid concrete mock-ups as (b) (7)(E) through (b) (7)(E) and the four other border wall mock-ups as (b) (7)(E) through (b) (7)(E) as shown in Figure 5. The (b) (7)(E) was unique from the other mock-ups in that the (b) (7)(E) . Of the eight (b) (7)(E) that made up the (b) (7)(E) there were (b) (7)(E)

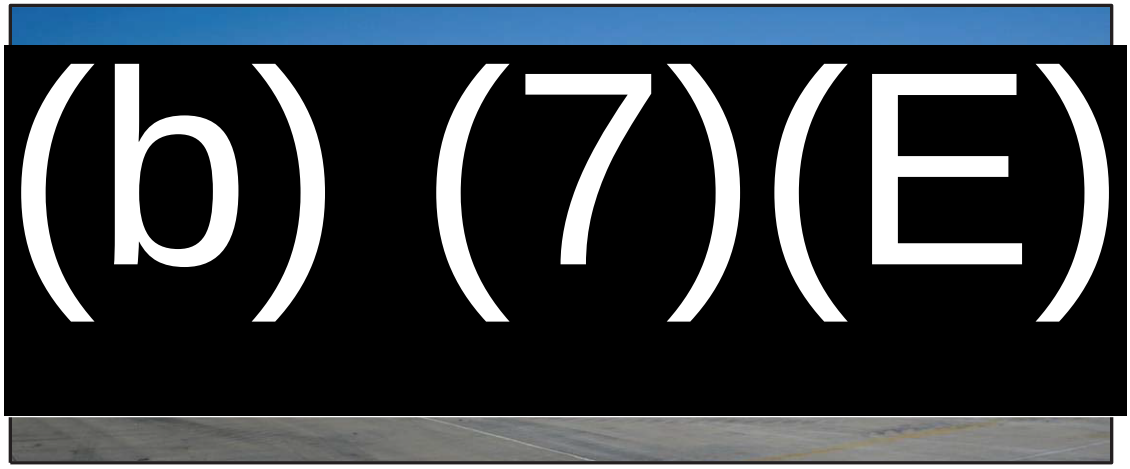


Figure 5: Mock-ups at (b) (7)(E)

2.4.3 As-built Design Package Test Articles

The as-built design package test articles are the contractually required as-built design packages submitted to the Government at the end of the construction period, an example page is shown in Figure 6. Eight contractors submitted as-built design package test articles. The as-built design packages were aggregated by OFAM in the document Border Wall Prototypes Description Packages.

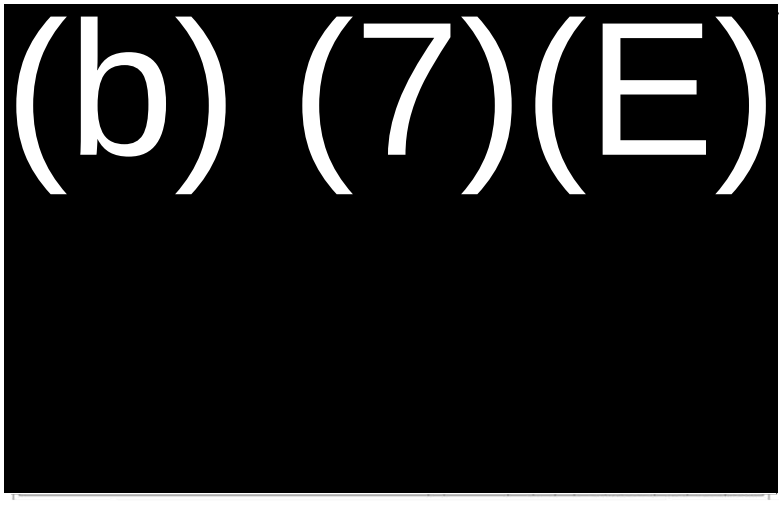


Figure 6: As-built Design Example

2.5 Test Team

Table 1 identifies the Integrated Test Team that supported execution of the Mock-up and Prototype Test.

The test team consisted of personnel from CBP Enterprise Services Office of Acquisition, CBP Operations Support Capability and Requirements Division (CRD), CBP OFAM, United States Army Corps of Engineers (USACE), and breaching and scaling experts. The breaching and scaling experts were personnel from Border Patrol Special Operations Group Element Border Patrol Tactical Unit (BORTAC), National and United States Special Operations Command (USSOCOM), 7th Special Forces Group and Marine Special Operations Command (MARSOC) Raiders.

Table 1: Team Organization

Mock-up and Prototype Integrated Test Team			
Team Count	Role	Assignment	Test Site Location
1	Test Director	Responsible for external communications, and overall coordination	Pogo Row/Border Prototype Site
2	Test Manager	Government Lead	Pogo Row/Border Prototype Site
3	SE Director	Technical Authority	Pogo Row/Border Prototype Site
4	Test Lead - Prototype	Responsible for scaling test	Border Prototype Site
5	Data Collector - Prototype	Scaling team 1, runs video camera, collects scaling times	Border Prototype Site
6	Data Collector - Prototype	Scaling team 2, runs video camera, collects scaling times	Border Prototype Site
7	Data Manager - Prototype	Records all scaling data, responsible for all scaling forms and execution flow	Border Prototype Site
8	Field Test Coordinator - Prototype	Manages test site, coordinates and organizes site logistics	Border Prototype Site
9	Test Lead - Mock-up	Responsible for breaching test	Pogo Row
10	Test Site Coordinator	Manages test site, coordinates and organizes site logistics	Pogo Row
11	Data Collector - Mock-up	Breaching trial 1, runs video camera, collects breaching times	Pogo Row
12	Data Collector - Mock-up	Breaching trial 2, runs video camera, collects breaching times	Pogo Row
13	Data Collector - Mock-up	Breaching trial 3, runs video camera, collects breaching times	Pogo Row
14	Data Manager - Mock-up	Records all breaching data, responsible for all breaching forms and execution flow	Pogo Row
15	Test Execution Analyst - Mock-up	Analyzes data, drafts test report and quick look brief	Pogo Row
16	Construction Subject Matter Expert	Ensures breaching procedures and safety being adhered to	Pogo Row

17	Construction Subject Matter Expert	Ensures breaching procedures and safety being adhered to	Pogo Row
18	Construction Subject Matter Expert	Ensures breaching procedures and safety being adhered to	Pogo Row
19	Breaching and Scaling Lead	Leads and coordinates breachers and scalers	USBP
20	Breacher - BORTAC	Breaches mock-up	Pogo Row
21	Breacher - BORTAC	Breaches mock-up	Pogo Row
22	Breacher - BORTAC	Breaches mock-up	Pogo Row
23	Breacher - BORTAC	Breaches mock-up	Pogo Row
24	Breacher - BORTAC	Breaches mock-up	Pogo Row
25	Breacher - BORTAC	Breaches mock-up	Pogo Row
26	Breacher - BORTAC	Breaches mock-up	Pogo Row
27	Breacher - BORTAC	Breaches mock-up	Pogo Row
28	Breacher - BORTAC	Breaches mock-up	Pogo Row
29	Breacher - BORTAC	Breaches mock-up	Pogo Row
30	Scaler - BORTAC	Scalers Prototype	Border Prototype Site
31	Scaler - BORTAC	Scalers Prototype	Border Prototype Site
32	Scaler - BORTAC	Scalers Prototype	Border Prototype Site
33	Scaler - BORTAC	Scalers Prototype	Border Prototype Site
34	Scaler - BORTAC	Scalers Prototype	Border Prototype Site
35	Scaler - BORTAC	Scalers Prototype	Border Prototype Site
36	Breacher - SFG	Breaches mock-up	Pogo Row
37	Breacher - SFG	Breaches mock-up	Pogo Row
38	Breacher - SFG	Breaches mock-up	Pogo Row
39	Breacher - SFG	Breaches mock-up	Pogo Row
40	Breacher - SFG	Breaches mock-up	Pogo Row
41	Breacher - SFG	Breaches mock-up	Pogo Row
42	Breacher - SFG	Breaches mock-up	Pogo Row
43	Breacher - SFG	Breaches mock-up	Pogo Row
44	Breacher - SFG	Breaches mock-up	Pogo Row
45	Breacher - SFG	Breaches mock-up	Pogo Row
46	Scaler - SFG	Scalers Prototype	Border Prototype Site
47	Breacher - MARSOC	Breaches mock-up	Pogo Row
48	Breacher - MARSOC	Breaches mock-up	Pogo Row
49	Human Factors SME	Creates and executes paired comparison aesthetics testing	Pogo Row
50	Design Review POC	Leads and coordinates test design review	USACE
51	Design Review Lead	Executes test design review	USACE
52	Design Review Civil Engineer	Civil Engineer SME	USACE
53	Design Review Structural Engineer	Structural Engineer SME	USACE

2.6 Plan Deviations

This section describes the deviations from the test plan that occurred during the test.

- Minor Deviation – A minor deviation is a change to the test resulting from an issue that is not system related. A Test Lead is authorized to make the necessary documentation, schedule, or event changes to successfully execute or continue to execute test events. An example of a minor deviation would be if at the start of a scaling trial, the scaler is not properly belayed and needs to fix the belay and restart.
- Moderate Deviation – A moderate deviation is a change to the test resulting from an issue that is system related but can be resolved in less than one shift. The Test Director is authorized to make the necessary documentation, schedule, or event changes to successfully execute or continue to execute test events. An example of a moderate deviation would be if during a scaling trial, a part of the prototype is damaged, and the maintenance action will be less than a shift, but in order to continue the test event, personnel assignments and test event structure for that shift may have to be altered somewhat to accommodate continuation of the test event.
- Major Deviation – A major deviation is a change to the test resulting from an issue that is system related and cannot be resolved in one shift. An example of a major deviation is a crack in a mock-up under test that extends into other test quadrants. Before a major deviation to the test plan is executed, the Test Director will inform the Program Manager or the Program Manager's delegate, who will make a decision on how to proceed. Once the decision is made by the Program Manager or the Program Manager's delegate, the Test Director will carry out his guidance, make appropriate deviations to the test plan, and continue to execute the test.

2.6.1 Major Deviations

Removal of BT-1 breaching technique

The BT-1 breaching technique using the (b) (7)(E) breaching technique proved to be ineffective and was removed from the breaching test case.

(b) (7)(E) breaching technique on (b) (7)(E) mock-up stopped

The compromised structural integrity of (b) (7)(E) caused by the (b) (7)(E) led to unsafe conditions resulting in the technique being stopped and the (b) (7)(E) portion not executed.

(b) (7)(E) technique added to breaching test case on (b) (7)(E) mock-up

Based on input of breaching expert, (b) (7)(E) technique was executed on quadrant of (b) (7)(E) with no planned breach.

2.6.2 Moderate Deviations

Reschedule breaching test case techniques to make (b) (7)(E) breaching last technique

The (b) (7)(E) breaching technique was rescheduled to be last breaching technique on each mock-up, since the technique had the potential to impact the structural integrity of the entire mock-up.

(b) (7)(E) breaching team change

The (b) (7)(E) proved less effective than anticipated on some mock-ups and caused the (b) (7)(E) be highly physically taxing on the breaching team (b) (7)(E)

Addition of (b) (7)(E) to BT-6, (b) (7)(E)

Initially the (b) (7)(E) .

2.6.3 Minor Deviations

(b) (7)(E) was used in BT-3, (b) (7)(E)

The (b) (7)(E) was not explicitly mentioned in the (b) (7)(E) technique, however, due to the overall consistency with the technique and expert breaching input, the (b) (7)(E) saw was added to the BT-3 technique.

(b) (7)(E) breaching technique performed with (b) (7)(E) on (b) (7)(E)

Although the test plan called for (b) (7)(E) .

2.7 Training

The test team was trained, during the test preparation and dry run period, 28 November to 1 December 2017, prior to the execution of testing.

2.8 Equipment

Table 2 lists the equipment used by the test team to perform their duties.

Table 2: Test Team Equipment List

Resource	Purpose
(b) (7)(E)	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling

(b) (7)(E) [redacted]	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Scaling
	Breaching
	Breaching
	Breaching
	Breaching
	Breaching
	Breaching
	Breaching
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(b) (7)(E)	Breaching
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	Breaching
	Breaching
	Breaching
	Breaching
	Breaching
	Breaching
	Breaching
	Aesthetics
	Data Management
	Data Management

2.9 Data Verification and Validation

Data Verification and Validation (V&V) was performed by:

- Data Collector
- Data Manager
- Test Lead

V&V Activities included:

- Confirm completeness of data forms
- Confirm format of data elements and data results meet expected results
- Tracking of test procedure results to the requirements and test objectives

Key data elements for V&V were:

- Data forms
- Photographs
- Recorded Video
- Test Observation Reports

3 RESULTS

The five test cases were breaching, scaling, aesthetics paired comparison, engineering design review, and constructability. Table 3 lists the test cases and the reference names for the requirements under test. The results for each requirement are in the corresponding Test Case section below. The requirement reference names include TR and OR to designate Threshold Requirement and Objective Requirement, respectively. Table 4, Table 15, Table 29, Table 43, and Table 52 list the requirement reference names and full requirement text for each test case.

Table 3: Test Cases

Test Case	Requirements
Breaching	(b) (7)(E)
Scaling	
Aesthetics Paired Comparison	
Constructability	
Engineering Design Review	

The Mockup and Prototype Test utilized three methods for requirements verification: Test, Inspection, and Analysis. The specific tests and methods were as follows:

Test

- Breaching Test Case – (b) (7)(E)
- Scaling Test Case
  - (b) (7)(E)
  -
- Aesthetics Paired Comparison Test Case – Quantitative test of observers' qualitative opinion of the aesthetics of the Prototypes

Inspection

- Constructability – Provided performance characterization statement from the OFAM construction experts that observed the prototype construction

Analysis

- Engineering Design Review – Provided performance characterization statement from Design Review Board, consisting of USACE engineers, Design Specification Team, and OFAM representatives, of the full design package

3.1 Breaching Test Case

The Breaching Test Case characterized the performance of the submitted solutions' capability to deter a threat with tools to breach the border wall. Teams of breaching experts from BORTAC, SOCOM, and MARSOC used breaching techniques, with predetermined sets of tools, to attempt to create (b) (7)(E), in the border wall mock-ups. The test team attempted to breach each mock-up with (b) (7)(E). The Breaching Test Case was executed at Pogo Row.

3.1.1 Requirements

Table 4 lists the breaching requirements for both the Solid Concrete and Other Border Wall mock-up.

Table 4: Mockup Breaching Requirements

Solid Concrete Wall Reference Name	Other Border Wall Reference Name	Requirement
(b) (7)(E)		

3.1.2 Test Case Execution

The Breaching Test Case consisted of four teams (team A, team B, team C, and team D) that used breaching techniques, with predetermined sets of tools, to attempt to create (b) (7)(E) diameter breach in the border wall mock-ups.

The breach size was verified to be (b) (7)(E) shown in Figure 7.

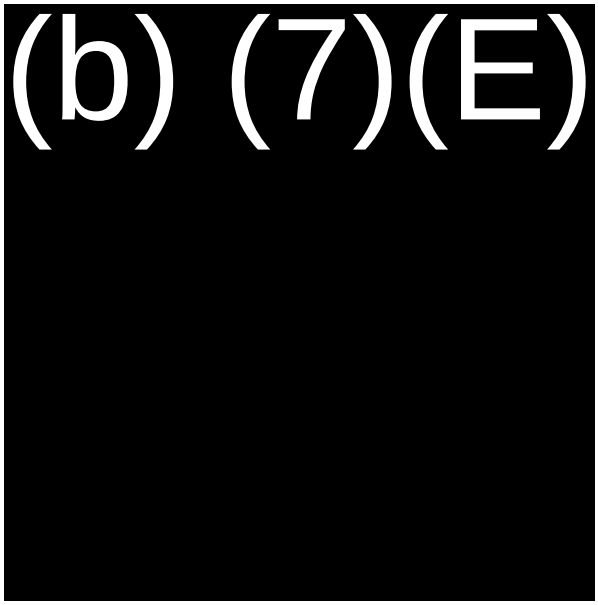


Figure 7: Breach Size Measurement Disc

An overview of the breaching techniques that were applied to the mock-ups are depicted in Figure 8.

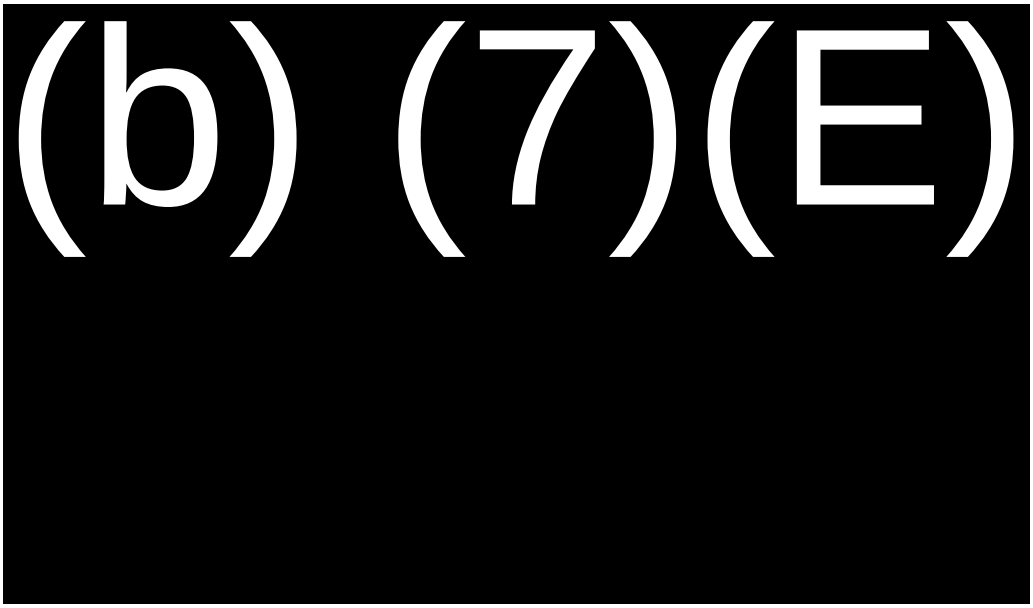


Figure 8: Mock-up Breaching Scenarios for Each Mock-up

The breachers were split into four breaching teams and assigned specific breaching techniques with pre-determined tool sets. The techniques assigned to each team are presented in Table 5.

Table 5: Breaching Team Assignments

Team	Number of Breachers	Technique 1	Technique 2
A	(b) (7)(E)	BT-4*	BT-7
B		BT-2	BT-6
C		BT-3	BT-5
D		BT-1	BT-8

* (b) (7)(E) of BT-4 was executed by team A; however (b) (7)(E) for BT-4 was executed by all teams.

The breaching test case execution consists of these high-level steps:

- Breachers attempted to make a (b) (7)(E) diameter breach in the mock-up
- Breachers had a (b) (7)(E) diameter measurement tool and the border wall was considered breached when the tool was passed through the mock-up
- For (b) (7)(E) the wall was considered breached when (b) (7)(E) were made
- Breaching was observed by a data collector who recorded the breaching progress and time
- Breaching progress was recorded and photographed at (b) (7)(E) intervals. In the case of BT-4 (b) (7)(E) breaching progress was recorded and photographed beyond (b) (7)(E)
- Video was recorded for all breaching attempts
- Breachers provided observations in Test Observation Reports

3.1.2.1 Breaching Technique BT-1

Breaching technique BT-1 used a (b) (7)(E) as the primary tool with secondary tools of (b) (7)(E), shown in Figure 9.

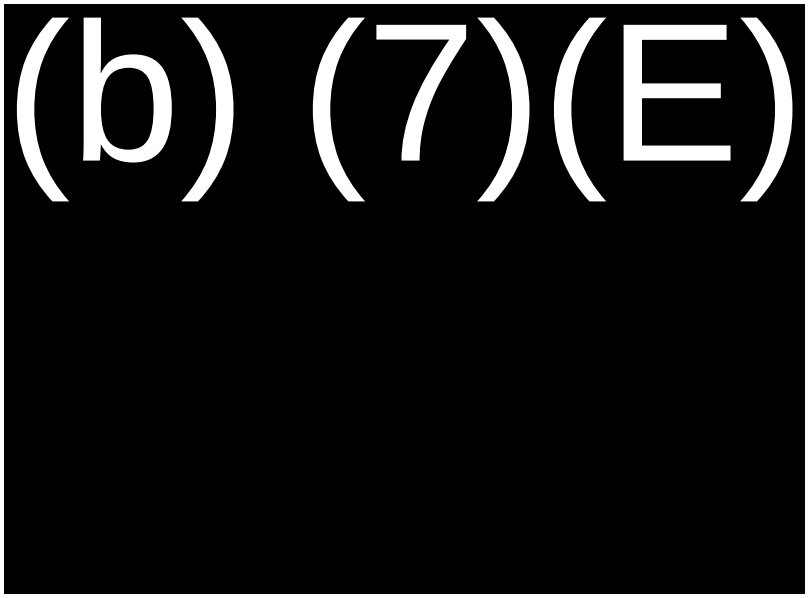


Figure 9: (b) (7)(E)

During breaching tool practice, the breaching experts determined that the Breaching Technique BT-1 was (b) (7)(E) on the Border Wall mock-ups.

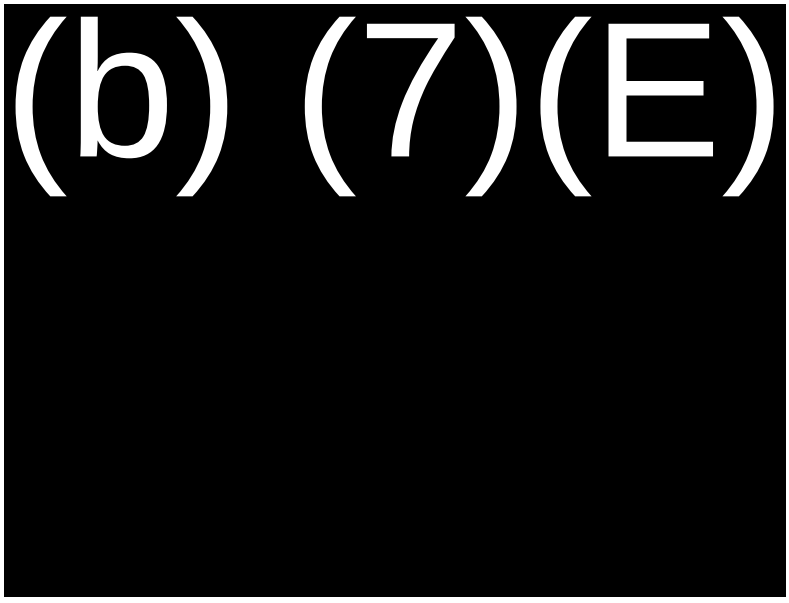


Figure 10: (b) (7)(E)

3.1.2.2 Breaching Technique BT-2

Breaching technique BT-2 used a (b) (7)(E) as a primary tool with secondary tools of (b) (7)(E). The (b) (7)(E) used was a (b) (7)(E), show in Figure 11. BT-2 used (b) (7)(E) including (b) (7)(E) and are shown in Figure 12.

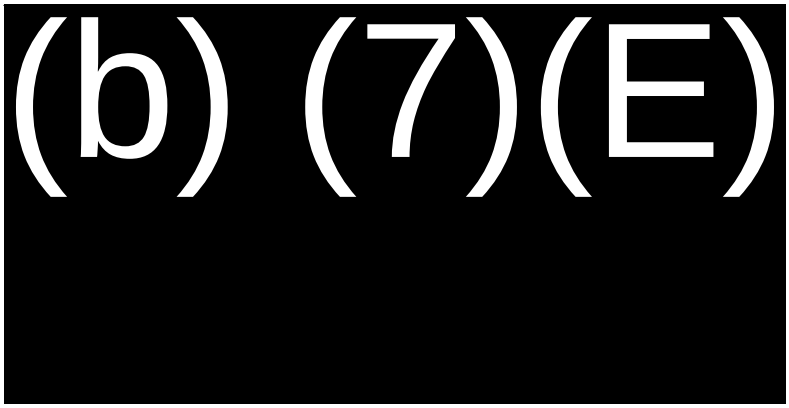


Figure 11: (b) (7)(E)

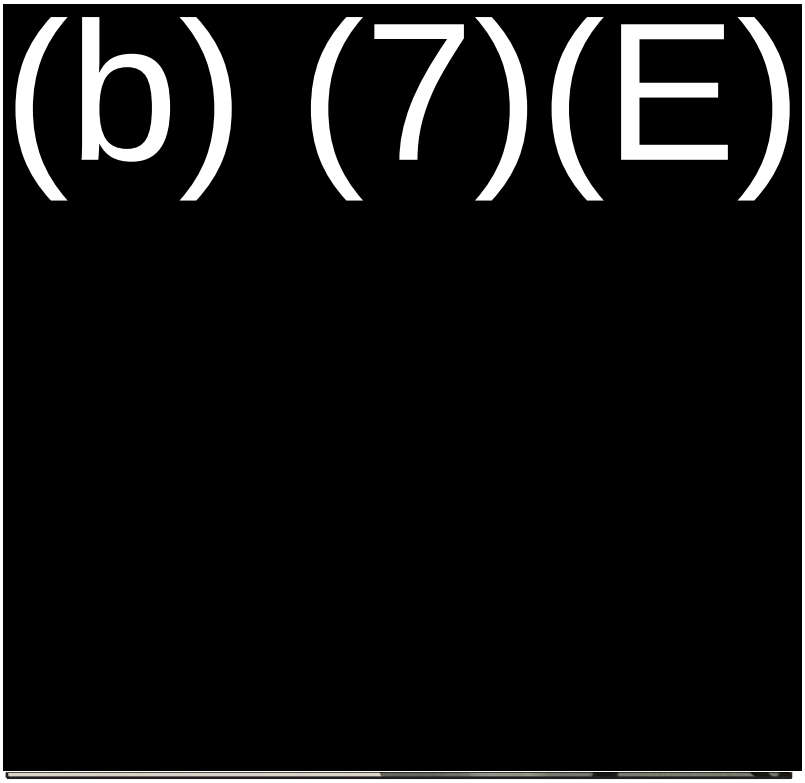


Figure 12: (b) (7)(E)

The BT-2 breaching technique used the (b) (7)(E), shown in Figure 19, was used (b) (7)(E).

3.1.2.3 Breaching Technique BT-3

Breaching technique BT-3 used a (b) (7)(E) as a primary tool with secondary tools of a (b) (7)(E) used was an (b) (7)(E), shown in Figure 13.

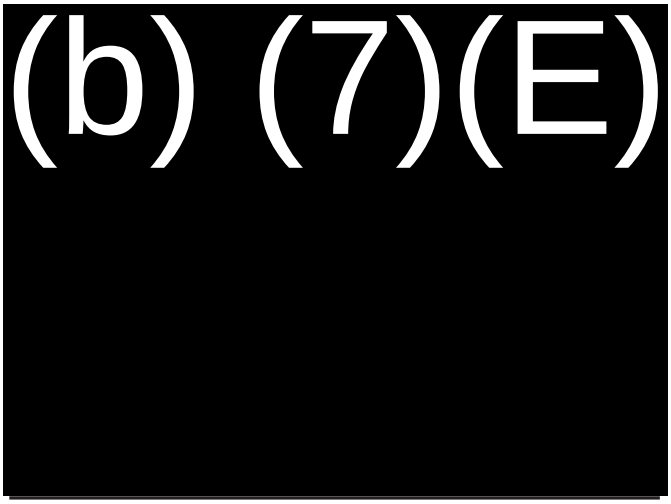


Figure 13: (b) (7)(E)

The BT-3 breaching technique used the (b) (7)(E) and (b) (7)(E) to (b) (7)(E), supplemented by (b) (7)(E).

3.1.2.4 Breaching Technique BT-4

Breaching technique BT-4 used an (b) (7)(E) shown in Figure 14, as the primary tool with secondary tools of (b) (7)(E), shown in Figure 19, and (b) (7)(E), shown in Figure 12. The (b) (7)(E) used was (b) (7)(E)

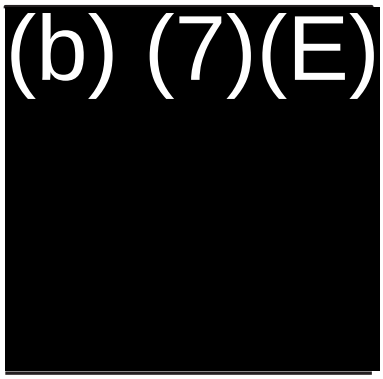


Figure 14: (b) (7)(E)

During the breaching tool practice, the breaching experts observed that (b) (7)(E) Further, it was observed that the (b) (7)(E) Based on the breaching expert observation of the (b) (7)(E) performance against (b) (7)(E) the BT-4 breaching technique was modified. (b) (7)(E) The breacher tool practice application of the (b) (7)(E) on (b) (7)(E) is shown in Figure 15.

(b) (7)(E)

Figure 15: (b) (7)(E) ***on*** (b) (7)(E)

3.1.2.5 Breaching Technique BT-5

Breaching technique BT-5 used an (b) (7)(E), represented in Figure 16, as the primary tool with secondary tool of (b) (7)(E). The (b) (7)(E) used was a (b) (7)(E) and (b) (7)(E) as shown in Figure 17.

Breaching technique BT-5 used the concept of (b) (7)(E). Due to design differences in (b) (7)(E) the application of this technique varied.

For breaching mock-up (b) (7)(E) the (b) (7)(E) was used (b) (7)(E) of the mock-up. (b) (7)(E).

For (b) (7)(E) the (b) (7)(E) The completed execution of the technique is shown in Figure 126.

For (b) (7)(E) the (b) (7)(E) was used to (b) (7)(E).

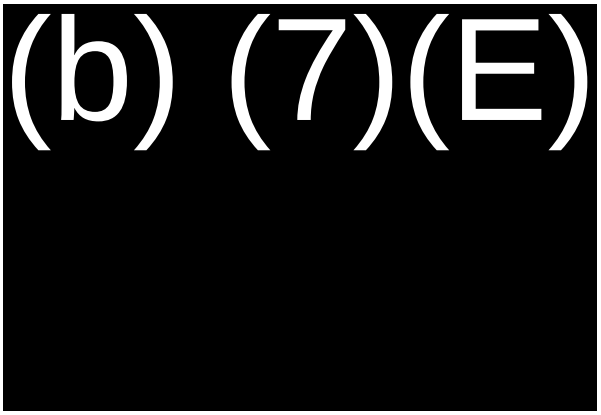


Figure 16: (b) (7)(E)

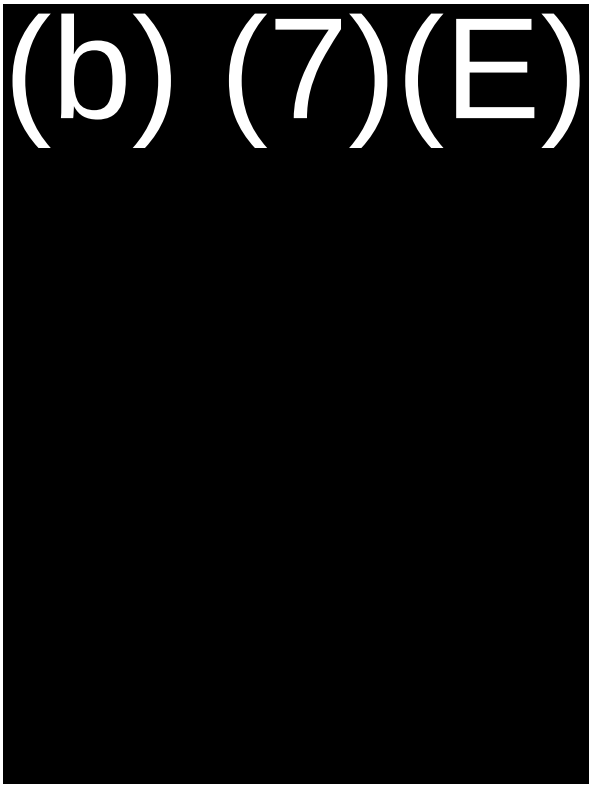


Figure 17: (b) (7)(E)

3.1.2.6 Breaching Technique BT-6

Breaching technique BT-6 used a (b) (7)(E) as the primary tool with secondary tool of a (b) (7)(E). The (b) (7)(E) used was a (b) (7)(E) (b) (7)(E), shown in Figure 18.

Breaching technique BT-6 used (b) (7)(E). Due to design differences in (b) (7)(E) (b) (7)(E), the application of this technique varied.

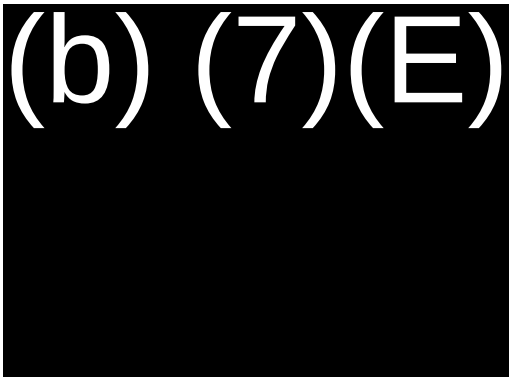


Figure 18: (b) (7)(E)

For breaching mock-up (b) (7)(E), the (b) (7)(E) was used to (b) (7)(E)

For breaching mock-up (b) (7)(E), th (b) (7)(E)

3.1.2.7 Breaching Technique BT-7

Breaching technique BT-7 used (b) (7)(E) as shown Figure 19.

Breaching technique BT-7 used (b) (7)(E). Due to design differences in the (b) (7)(E) (b) (7)(E) the application of this technique varied.

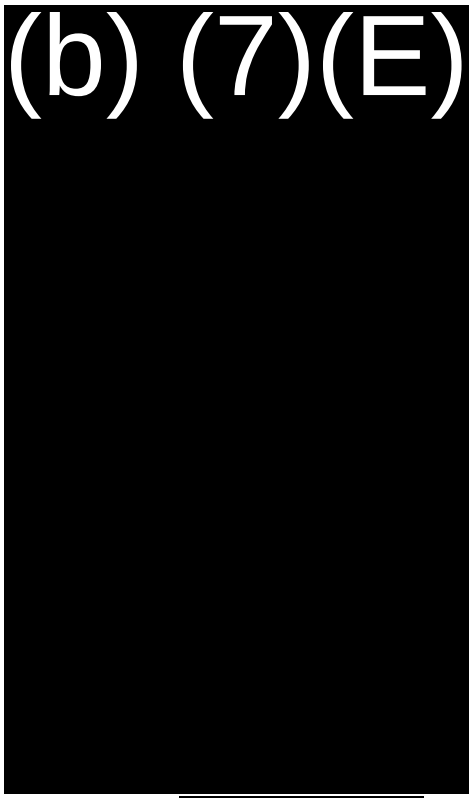


Figure 19: (b) (7)(E)

For breaching mock-u (b) (7)(E)

For breaching mock-up (b) (7)(E)

3.1.2.8 Breaching Technique BT-8

Breaching technique BT-8 used (b) (7)(E), shown in Figure 20.

For (b) (7)(E), the (b) (7)(E)

For (b) (7)(E).

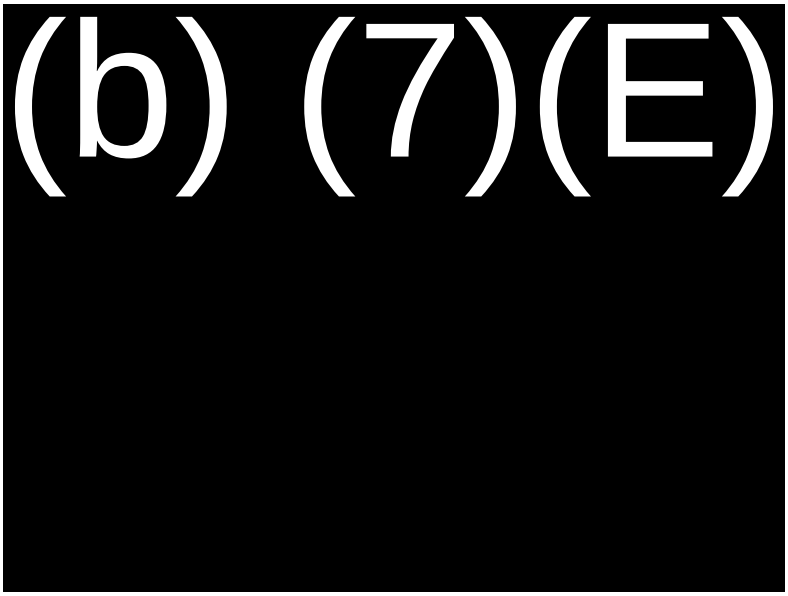


Figure 20 (b) (7)(E)

3.1.3 Analysis

The following sections describe the data collected and analysis performed for each breaching technique.

3.1.3.1 Breaching Technique BT-1 Data and Analysis

The BT-1 technique was not executed and no data was collected, and therefore, no analysis was performed.

3.1.3.2 Breaching Technique BT-2 Data and Analysis

The data collected was the start time of the breaching attempt, the "breach time" when the (b) (7)(E) was created or a notation that the (b) (7)(E), pictures of the breaching process at (b) (7)(E) and video of the complete breaching attempt. Significant observations during the breaching attempt were recorded using a TOR.

Analysis consisted of subtracting the breach time from the start time to calculate the "time to breach".

3.1.3.3 Breaching Technique BT-3 Data and Analysis

The data collected was the start time of the breaching attempt, the "breach time" when the [redacted] breach was created or a notation that the [redacted], pictures of the breaching process [redacted], and video of the complete breaching attempt. Significant observations during the breaching attempt were recorded using a TOR.

Analysis consisted of subtracting the breach time from the start time to calculate the "time to breach".

3.1.3.4 Breaching Technique BT-4 Data and Analysis

The data collected was the start time of the breaching attempt, the "breach time" when the [redacted] breach was created. [redacted] the start of the BT-4 breaching technique. Significant observations during the breaching attempt were recorded using a TOR.

Analysis consisted of reviewing the photographs of the breaching and structural integrity comprise to characterize the breach progress done by the technique. The review resulted in a characterization of the mock-ups resistance to the technique.

3.1.3.5 Breaching Technique BT-5 Data and Analysis

The data collected was the start time of the breaching attempt, the "breach time" when the [redacted] breach was created or a notation that the [redacted] pictures of the breaching process at [redacted], and video of the complete breaching attempt. Significant observations during the breaching attempt were recorded using a TOR.

Analysis consisted of subtracting the breach time from the start time to calculate the "time to breach".

3.1.3.6 Breaching Technique BT-6 Data and Analysis

The data collected was the start time of the breaching attempt, the "breach time" when the [redacted] was created or a notation that the [redacted], pictures of the breaching process at [redacted], and video of the complete breaching attempt. Significant observations during the breaching attempt were recorded using a TOR.

Analysis consisted of subtracting the breach time from the start time to calculate the "time to breach".

3.1.3.7 Breaching Technique BT-7 Data and Analysis

The data collected was the start time of the breaching attempt, the "breach time" when the [redacted] reach was created or a notation that [redacted] pictures of the breaching process at [redacted] and video of the complete breaching attempt. Significant observations during the breaching attempt were recorded using a TOR.

Analysis consisted of subtracting the breach time from the start time to calculate the "time to breach".

(b) (7)(E) [redacted]

(b) (7)(E) [redacted] (b) (7)(E) [redacted] (b) (7)(E) [redacted]

(b) (7)(E) [redacted]

(b) (7)(E) [redacted]

(b) (7)(E) [redacted]

(b) (7)(E) [redacted] (b) (7)(E) [redacted]

(b) (7)(E) [redacted] (b) (7)(E) [redacted] (b) (7)(E) [redacted] (b) (7)(E) [redacted] (b) (7)(E) [redacted] (b) (7)(E) [redacted] (b) (7)(E) [redacted]

(b) (7)(E) [redacted]

3.1.4.1 Mock-up (b) (7)(E)

The (b) (7)(E) represents the (b) (7)(E) Mock-up (b) (7)(E) is shown in Figure 21 and Figure 22.

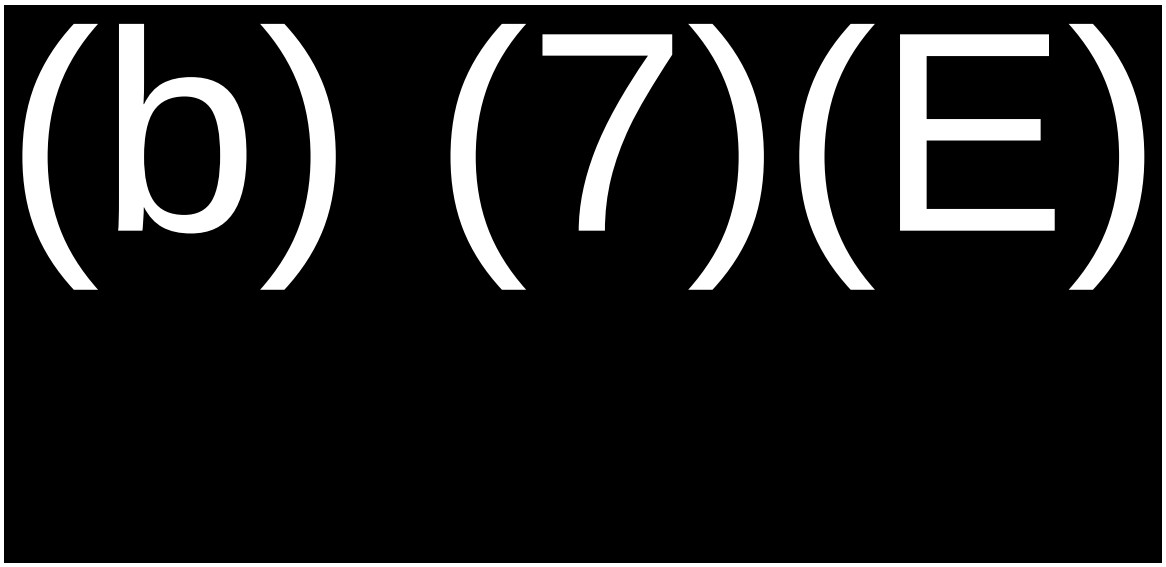


Figure 21: Mock-up (b) (7)(E)

Figure 22: Mock-up (b) (7)(E) ***Side View***

Table 7 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 7: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	

3.1.4.1.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

Stakeholder and subject matter expert was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observations is documented in TORs 30 and 106, Appendix B.

Breaching experts observed:

- (b) (7)(E)

- (b) (7)(E)

3.1.4.1.2 Breaching Technique BT-2 ((b) (7)(E) *)*

The (b) (7)(E) by breaching technique BT-2, (b) (7)(E) . The progress of the breaching is shown in Figure 23, Figure 24, Figure 25, and Figure 26.

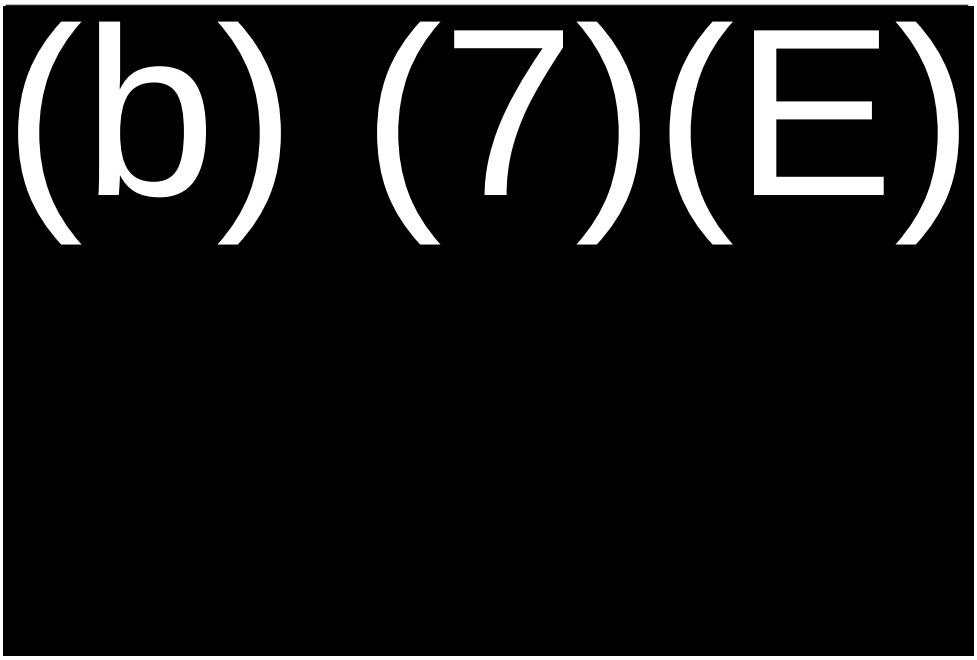


Figure 23: Breaching (b) (7)(E)

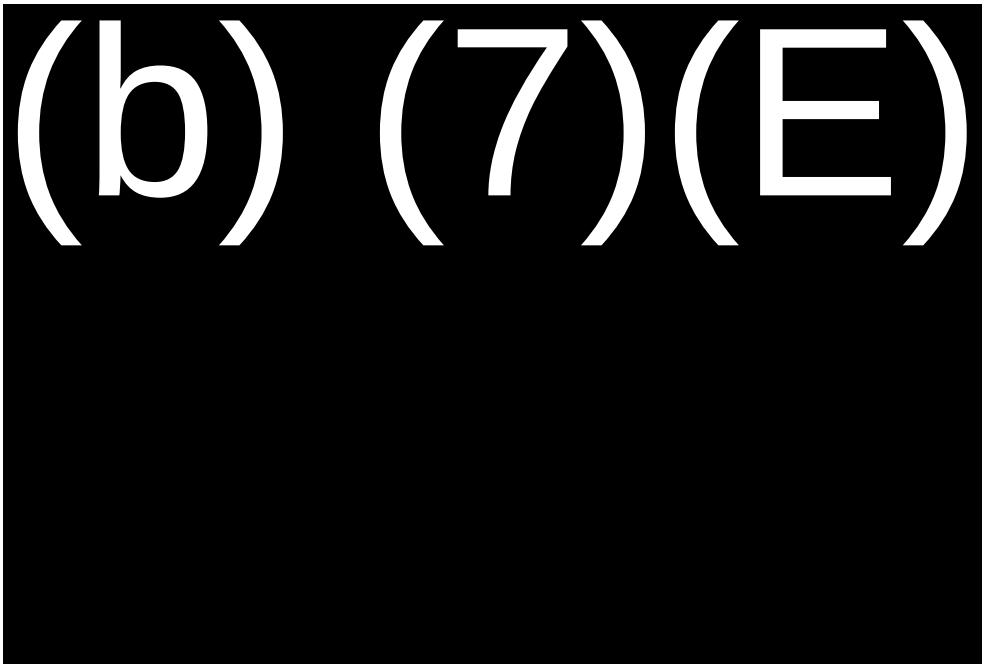


Figure 24: Breaching (b) (7)(E)

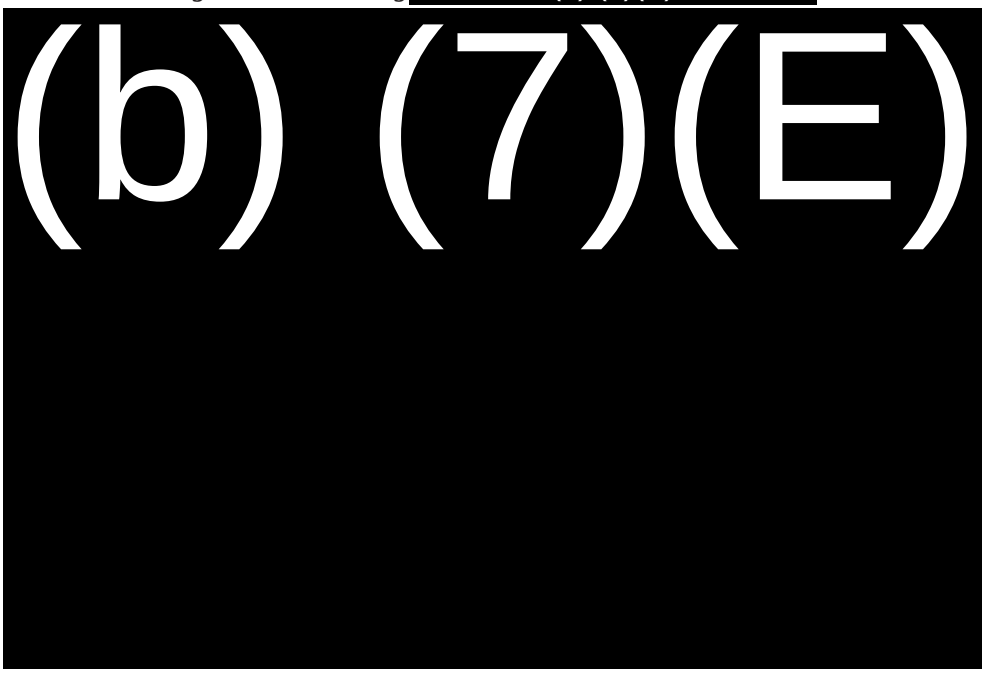


Figure 25: Breached (b) (7)(E)

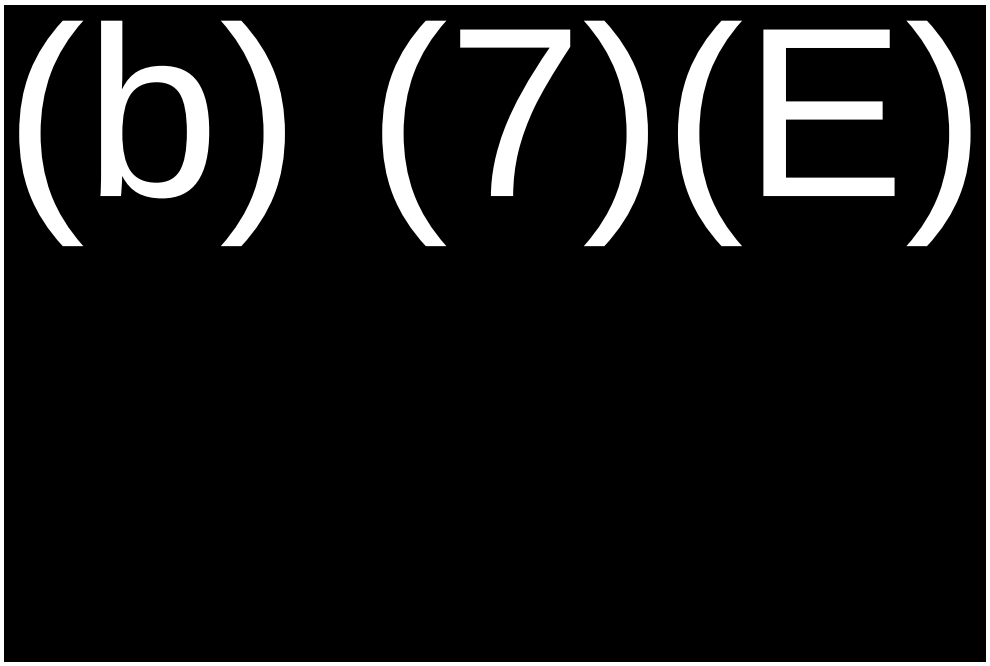


Figure 26 (b) (7)(E)

3.1.4.1.3 Breaching Technique BT-3 (b) (7)(E)

The (b) (7)(E) . The progress of the breaching is shown in Figure 27, Figure 28, Figure 29, Figure 30, Figure 31, Figure 32, and Figure 33.

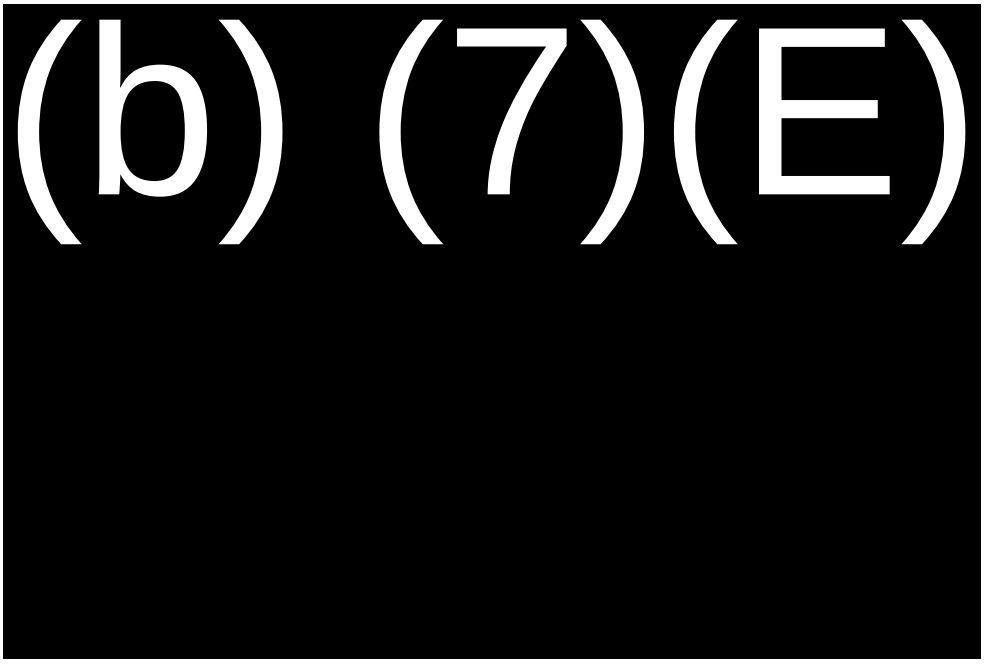


Figure 27: Breaching (b) (7)(E)

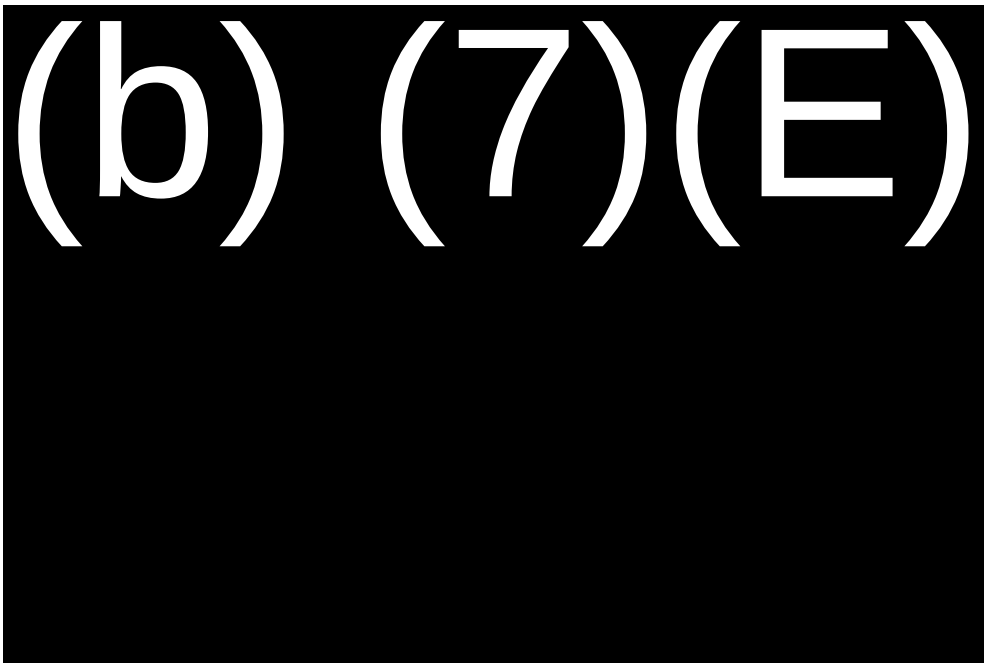


Figure 28: Breaching (b) (7)(E)

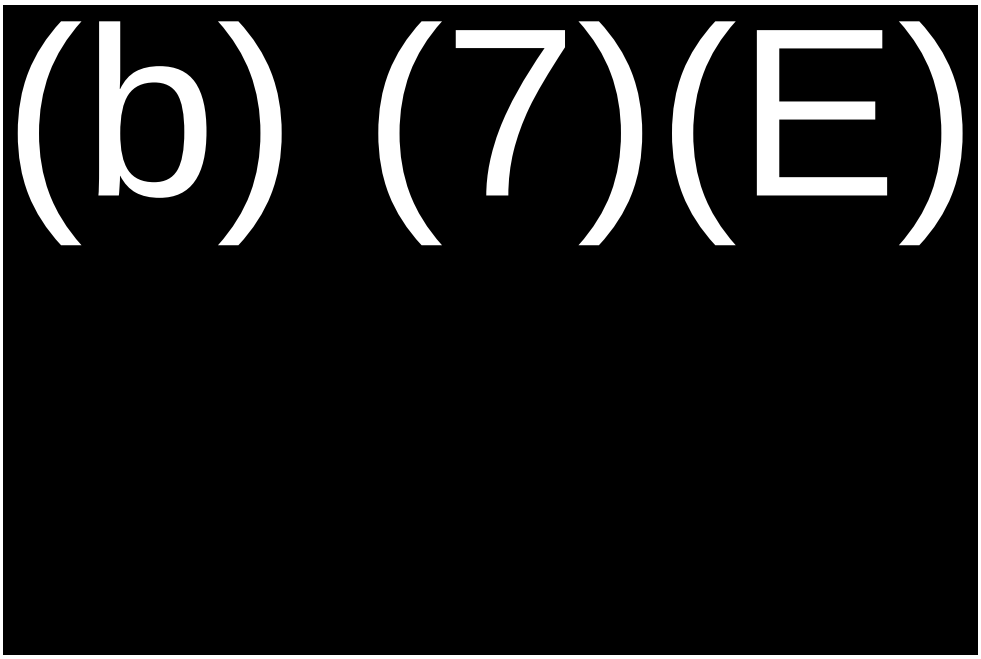


Figure 29: Breaching (b) (7)(E)

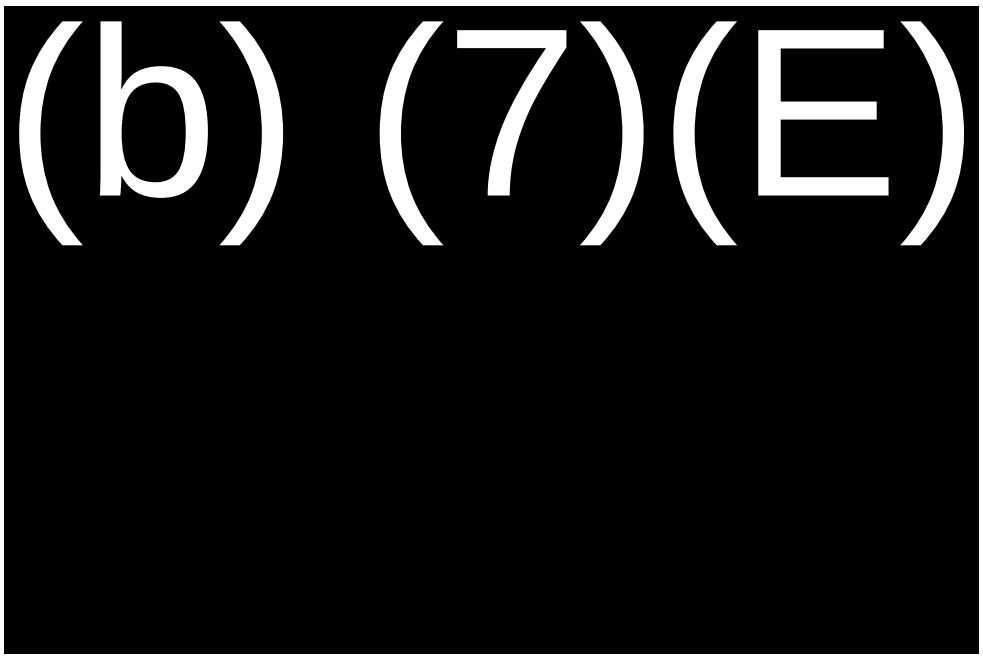


Figure 30: Breaching (b) (7)(E)

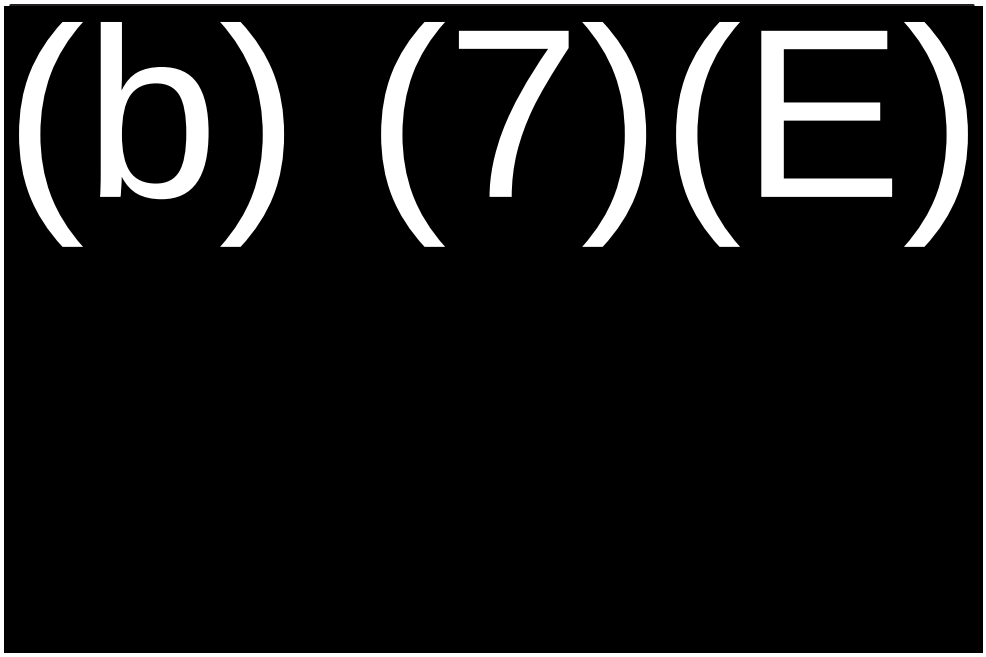


Figure 31: Breaching (b) (7)(E)

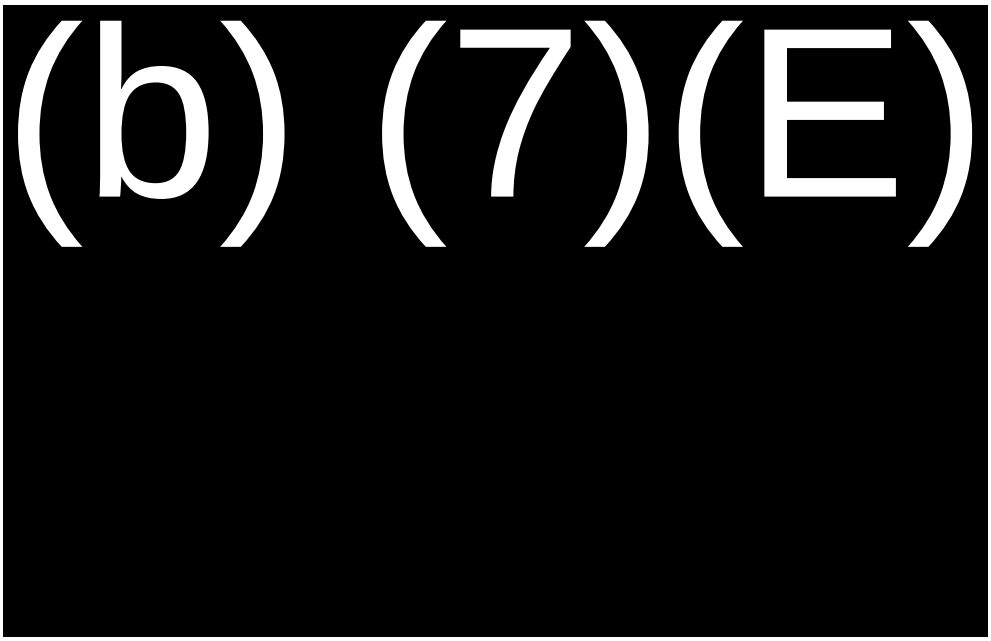


Figure 32: Breached (b) (7)(E)

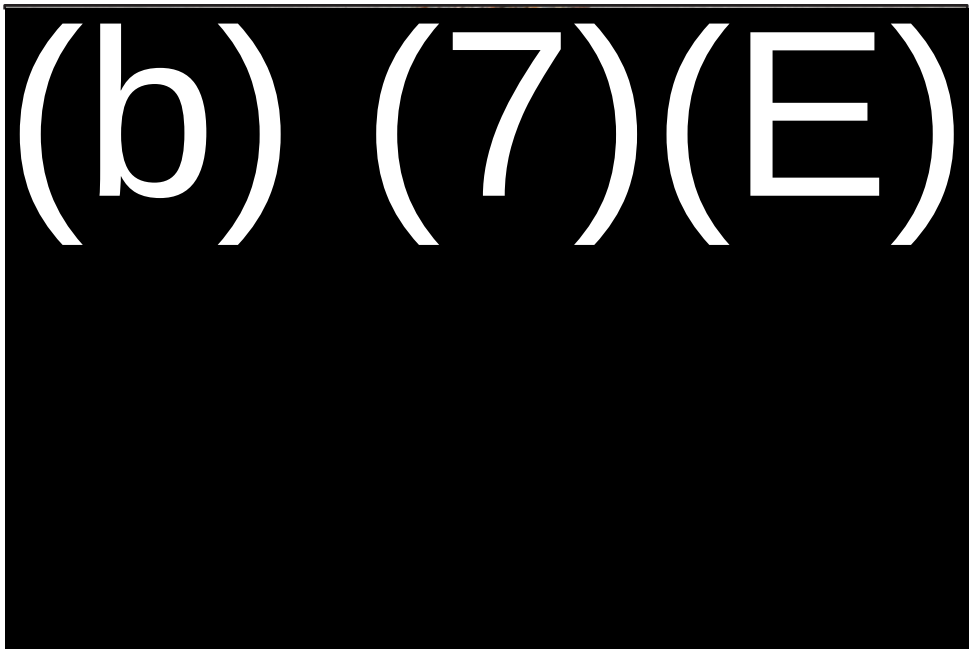


Figure 33: (b) (7)(E) ***Breach Measurement***

3.1.4.1.4 Breaching Technique BT-4 ((b) (7)(E)

The (b) (7)(E) by breaching technique BT-4, (b) (7)(E) The progress of the breaching is shown in Figure 34, Figure 35, Figure 36, Figure 37, and Figure 38.

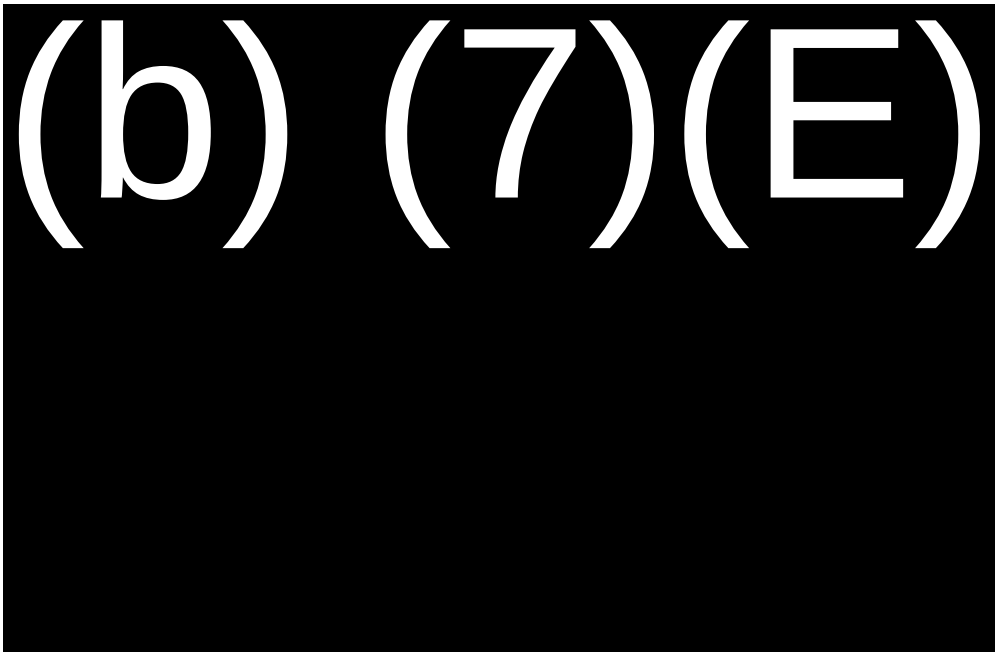


Figure 34: Breaching (b) (7)(E)

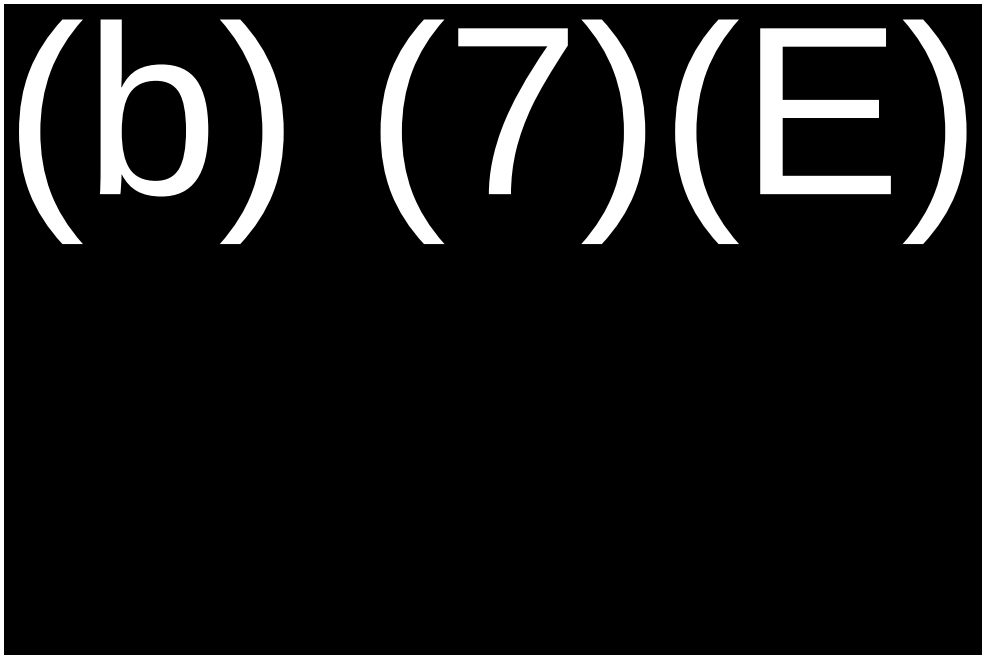


Figure 35: Breaching (b) (7)(E)

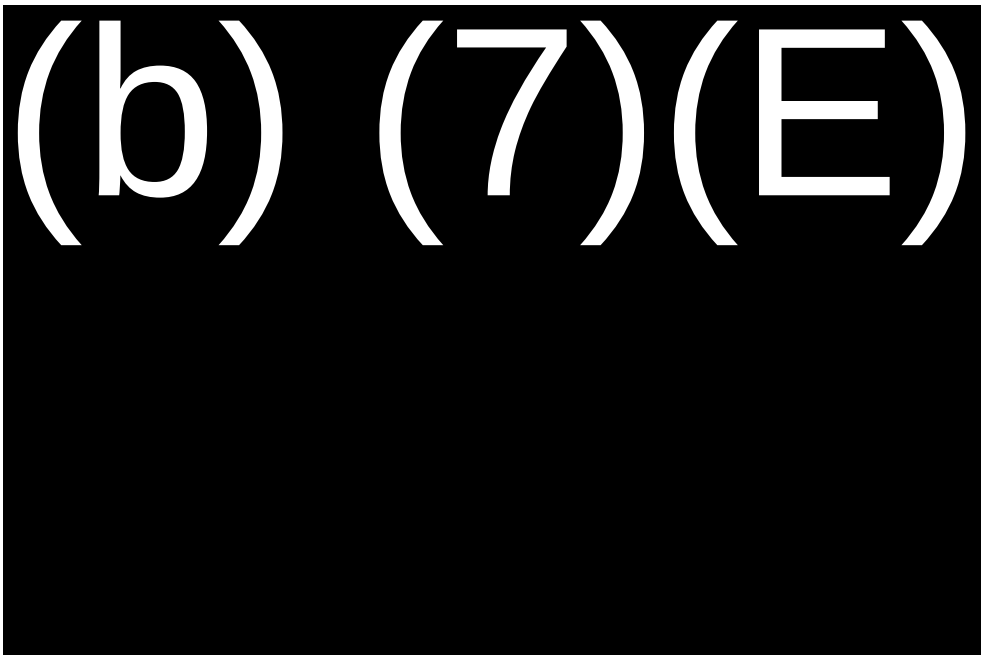


Figure 36: Breaching (b) (7)(E)

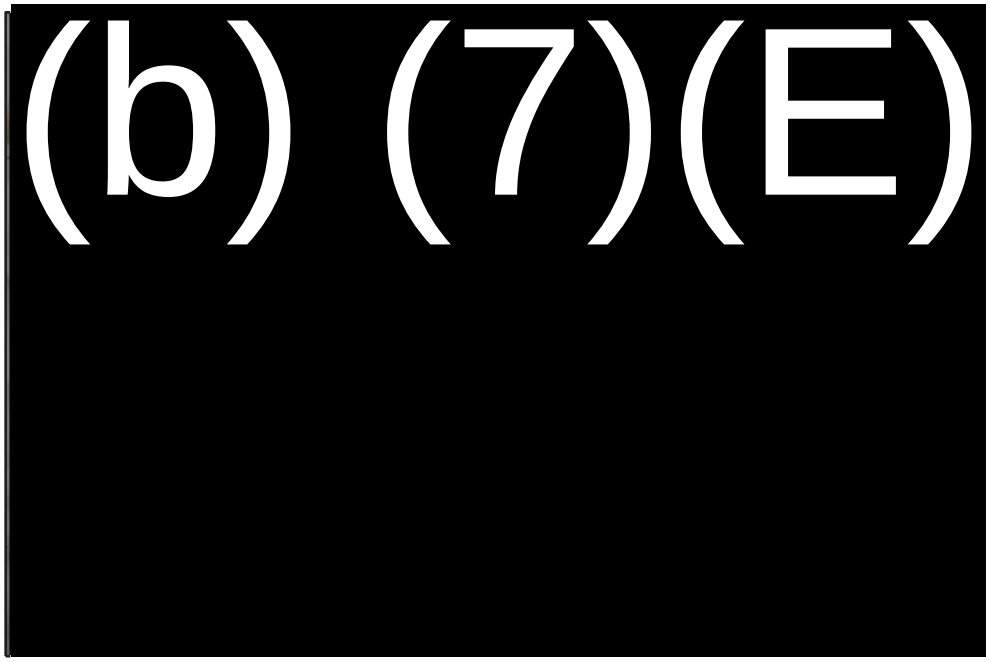


Figure 37: Breaching (b) (7)(E)

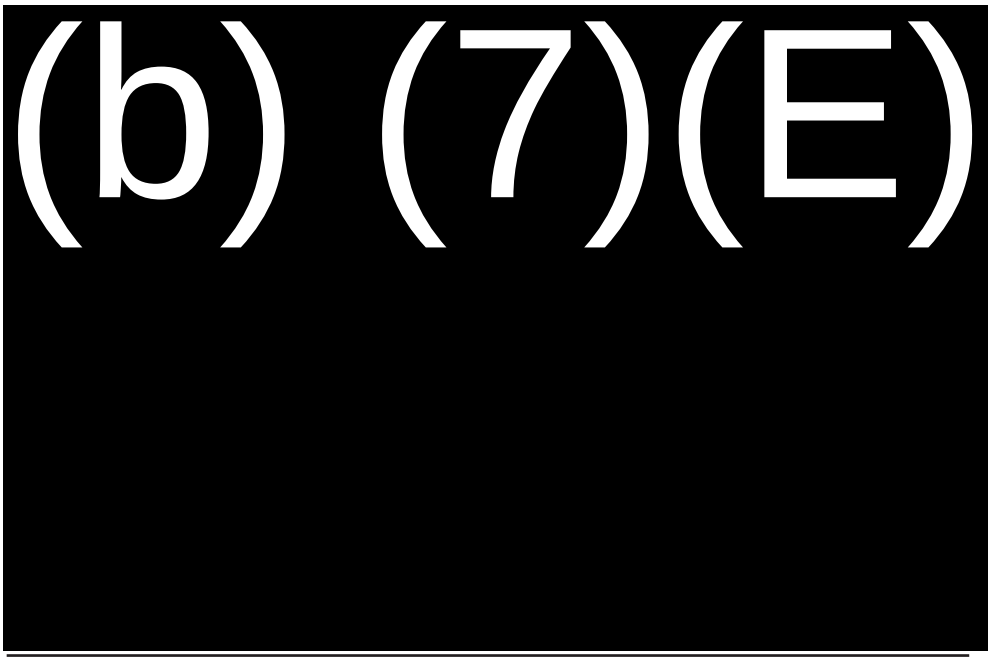


Figure 38: Breaching (b) (7)(E)

3.1.4.2 Mock-up (b) (7)(E)

The (b) (7)(E) Mock-up (b) (7)(E) is shown in Figure 39 and Figure 40.

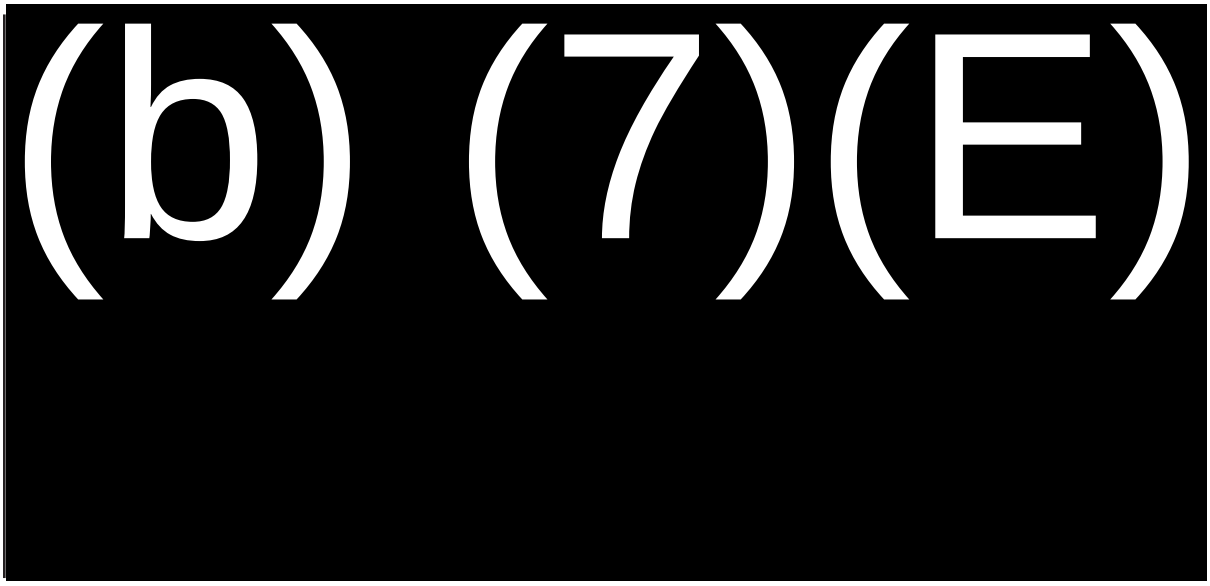


Figure 39: Mock-up (b) (7)(E)

Figure 40: Mock-up (b) (7)(E) ***Side View***

Table 8 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 8: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	

3.1.4.2.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

No breaching feedback collected.

3.1.4.2.2 Breaching Technique BT-2 (b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-2, the (b) (7)(E) . The progress of the breaching is shown in Figure 41, Figure 42, Figure 43, Figure 44, and Figure 45.

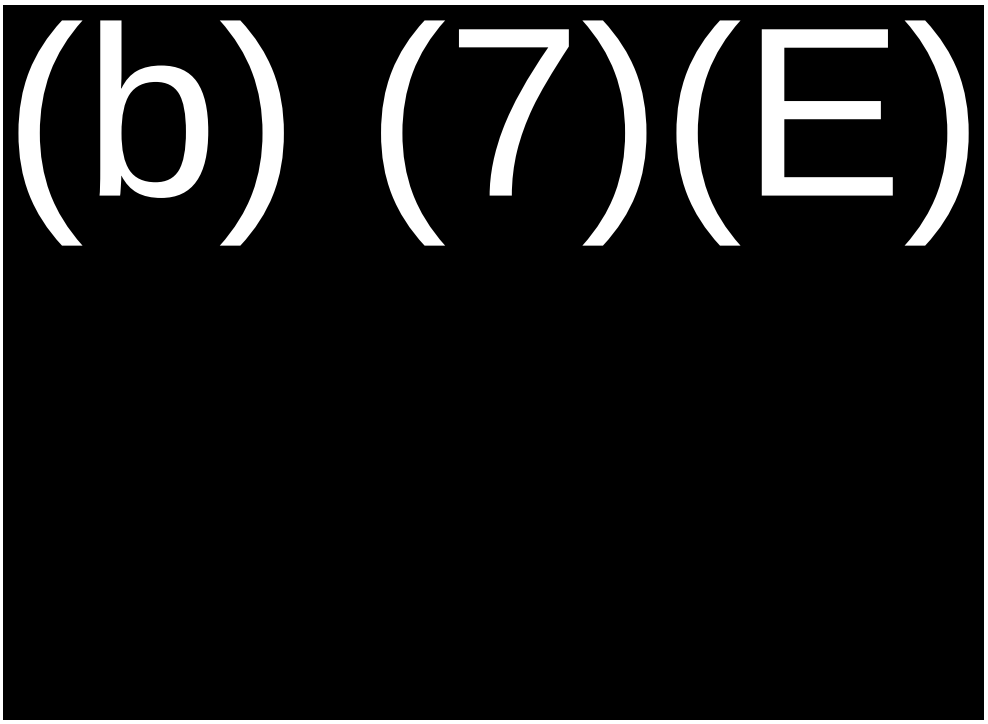


Figure 41: Breaching (b) (7)(E)

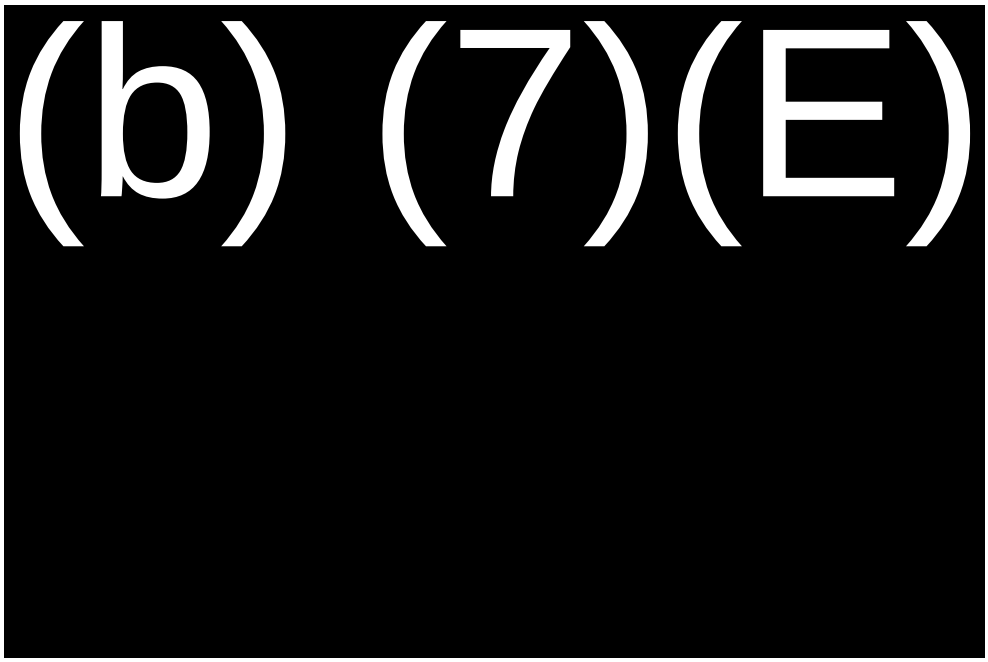


Figure 42: Breaching (b) (7)(E)

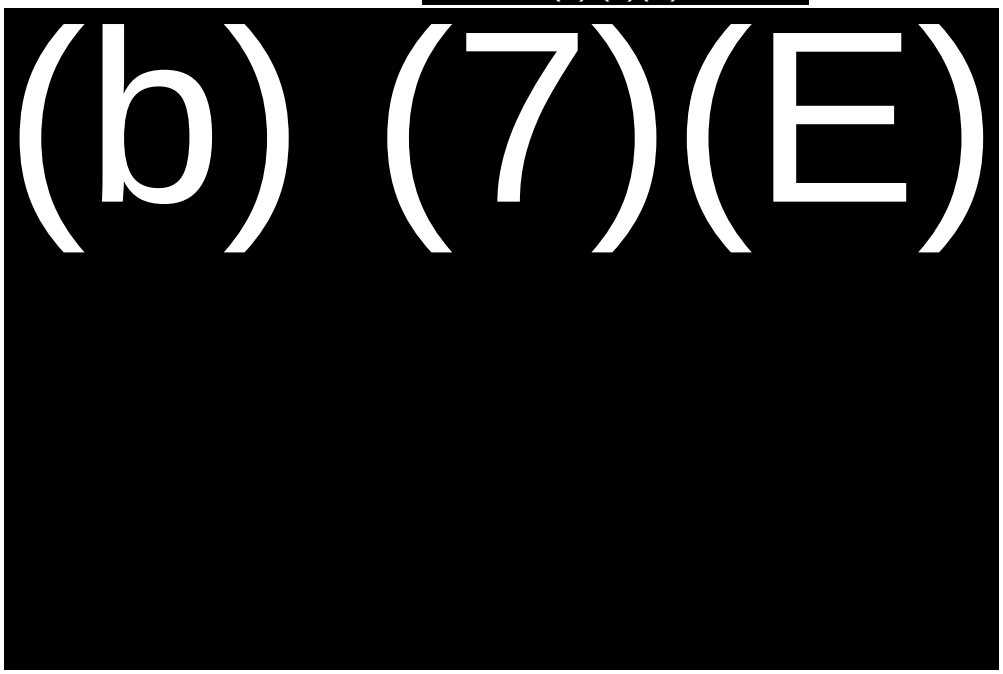


Figure 43: Breaching (b) (7)(E)

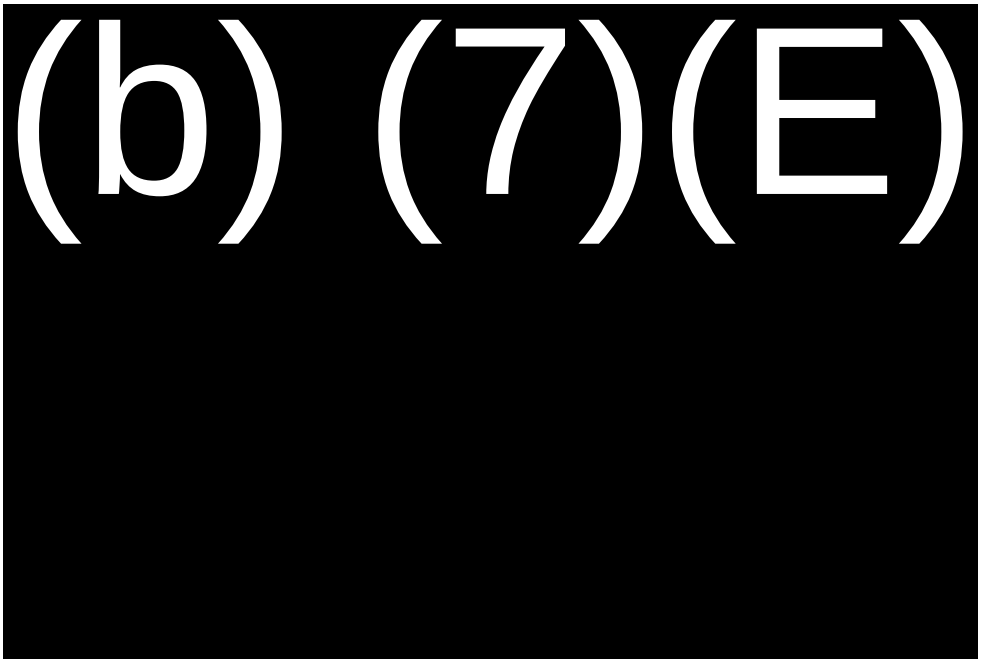
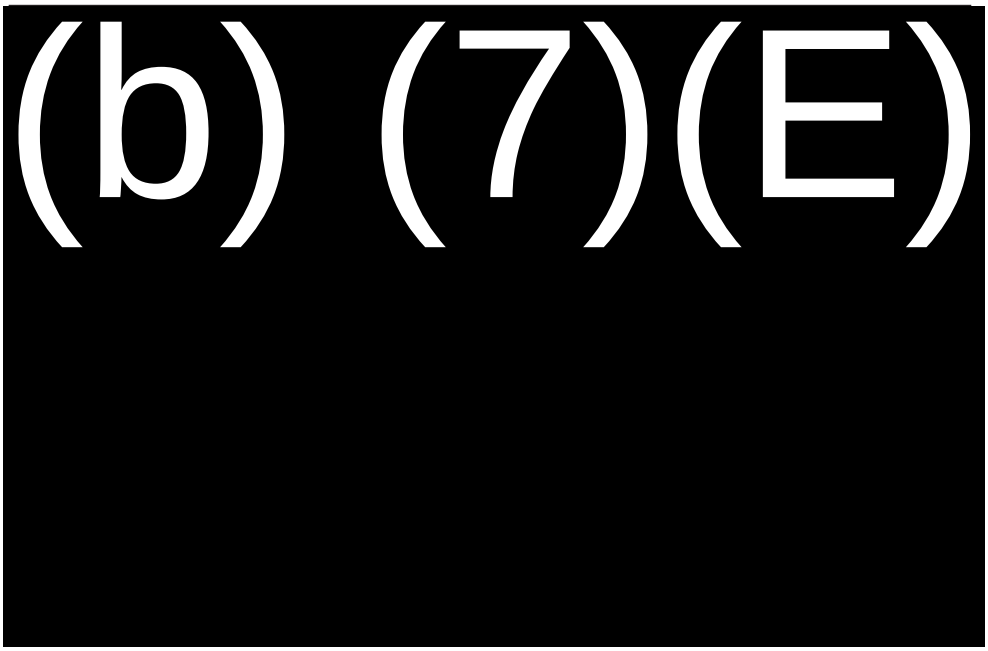


Figure 44: Breaching (b) (7)(E)



45: Breaching (b) (7)(E)

3.1.4.2.3 Breaching Technique BT-3 (b) (7)(E)

The (b) (7)(E) deterred the creation of a (b) (7)(E) breach by breaching technique BT-3, (b) (7)(E) . The progress of the breaching is shown in Figure 46, Figure 47, Figure 48, Figure 49, and Figure 50.

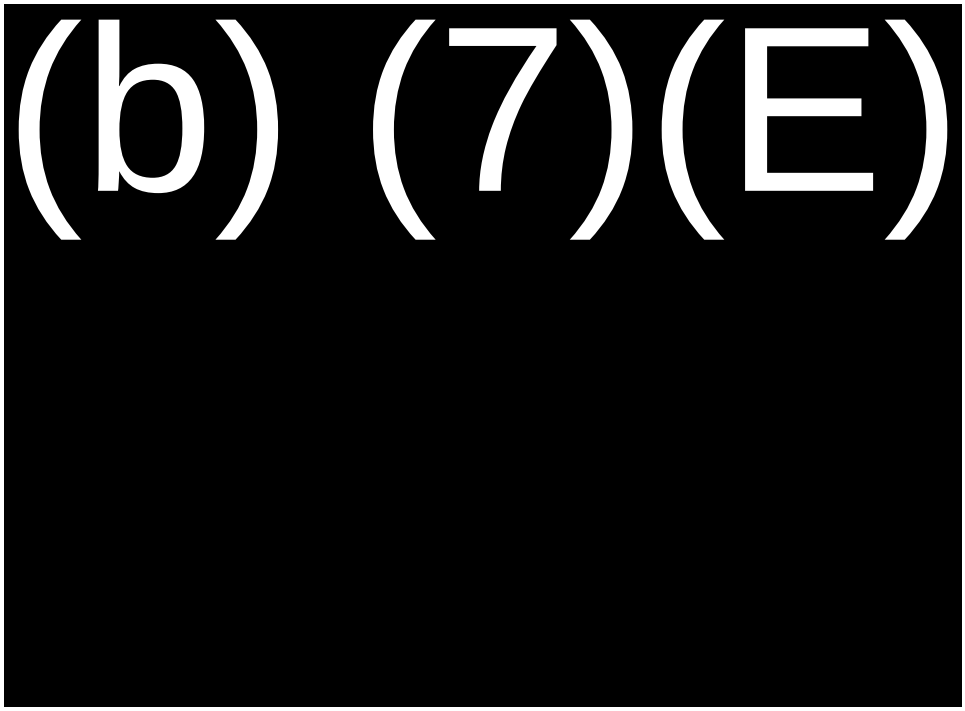


Figure 46: Breaching (b) (7)(E)

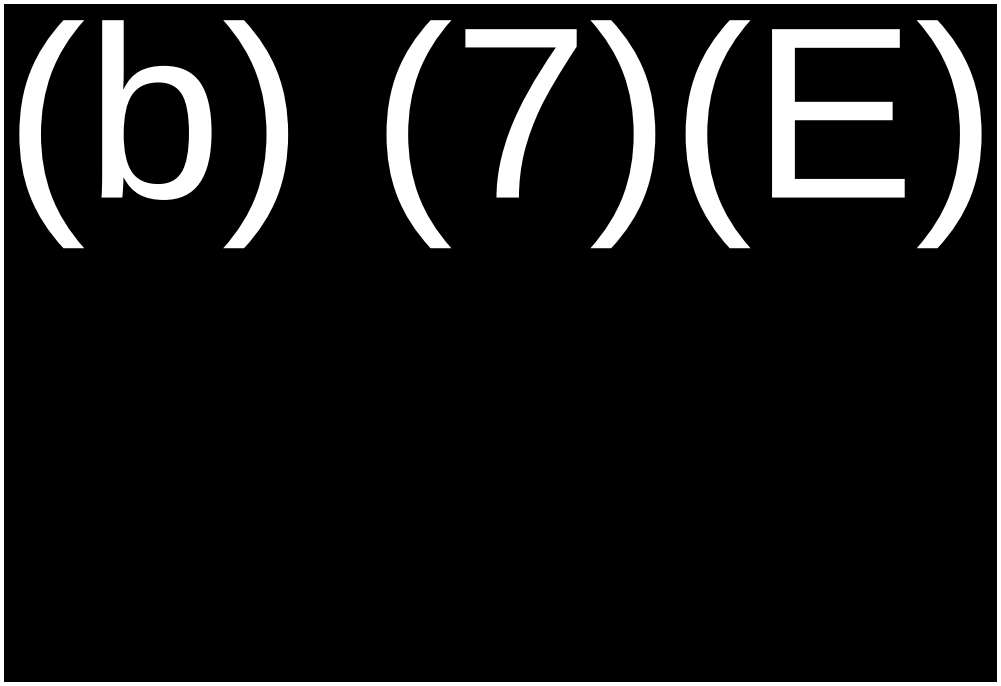


Figure 47: Breaching (b) (7)(E)

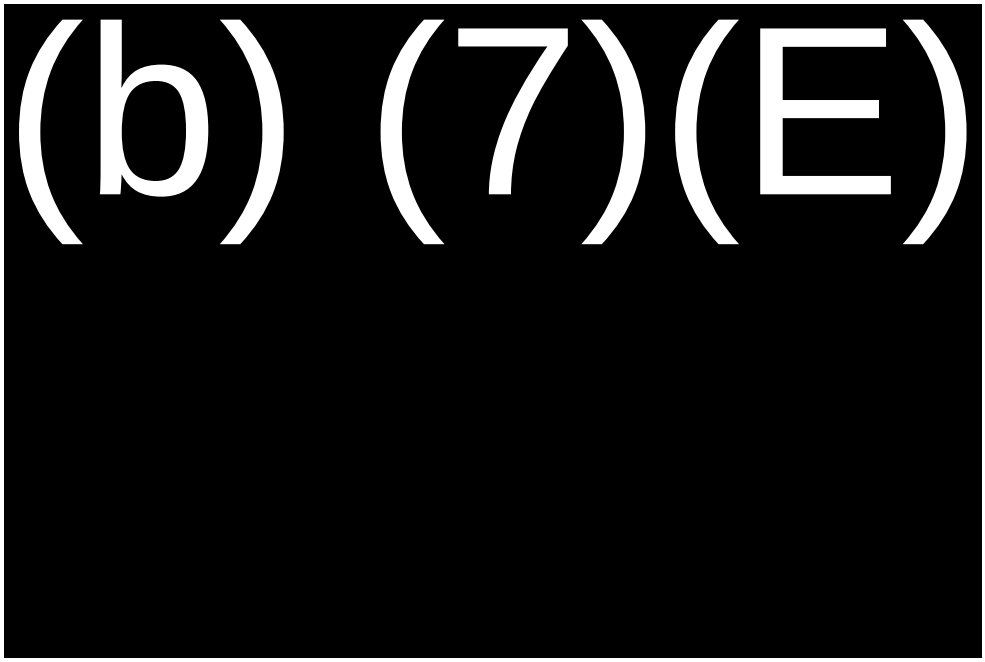


Figure 48: Breaching (b) (7)(E)

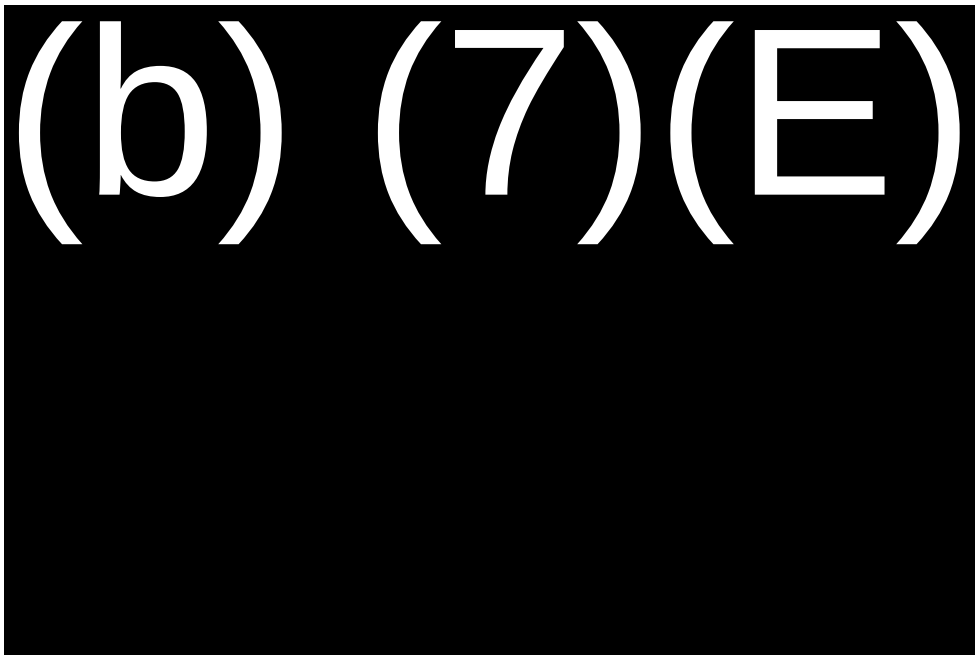


Figure 49: Breaching (b) (7)(E)

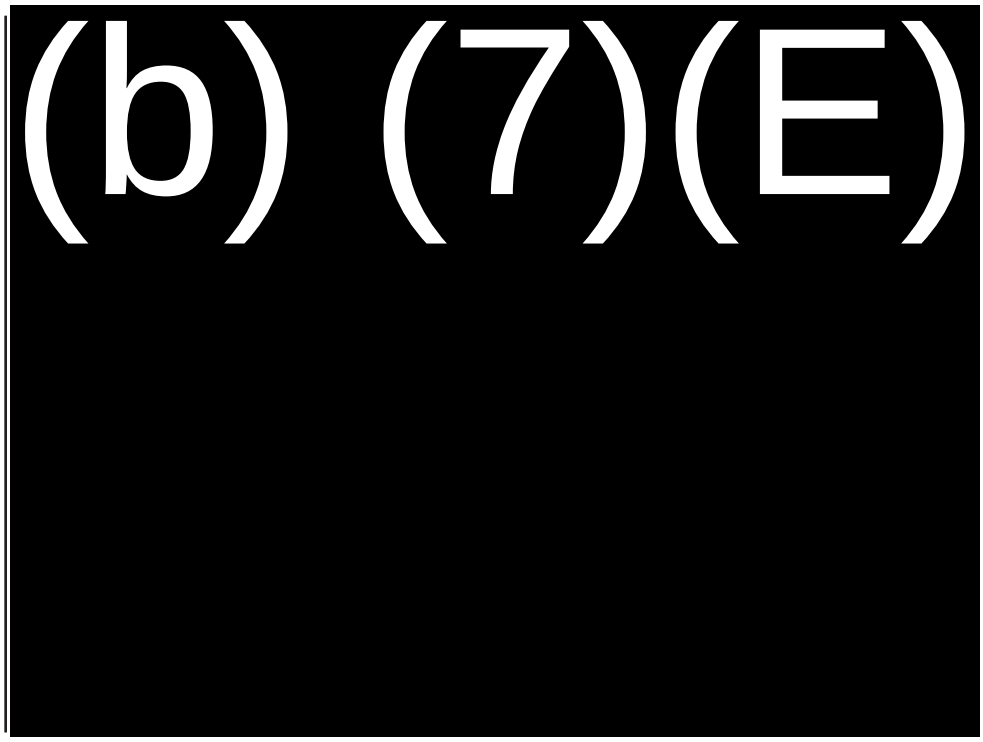


Figure 50: Breaching (b) (7)(E)

3.1.4.2.4 Breaching Technique BT-4 ((b) (7)(E)

The C-2M deterred the creation of a (b) (7)(E) breach by breaching technique BT-4, the (b) (7)(E) (b) (7)(E) The progress of the breaching is shown in Figure 51, Figure 52, Figure 53, Figure 54, Figure 55, Figure 56, and Figure 57.

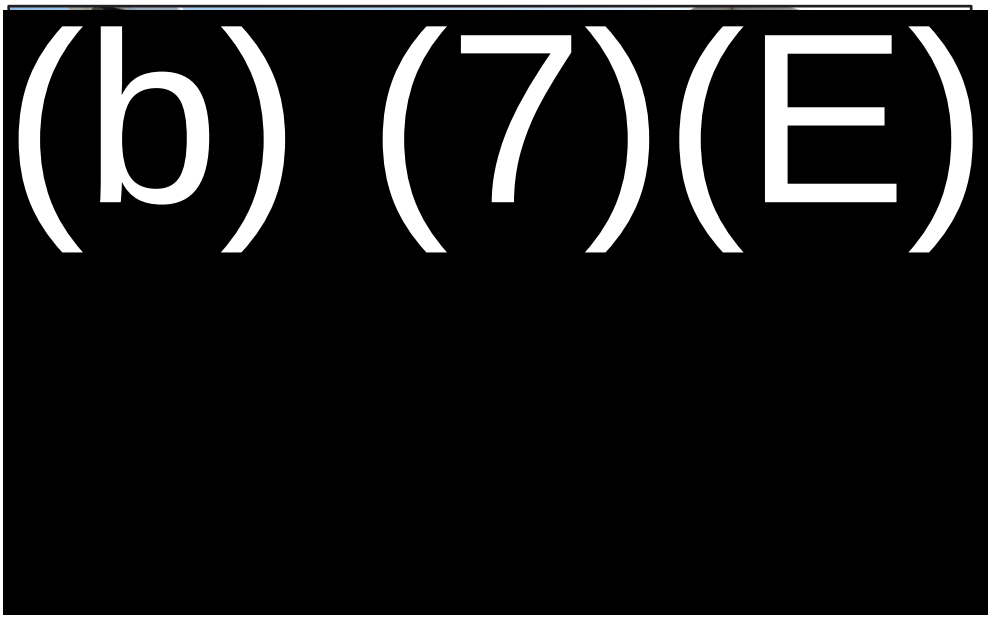


Figure 51: Breaching (b) (7)(E)

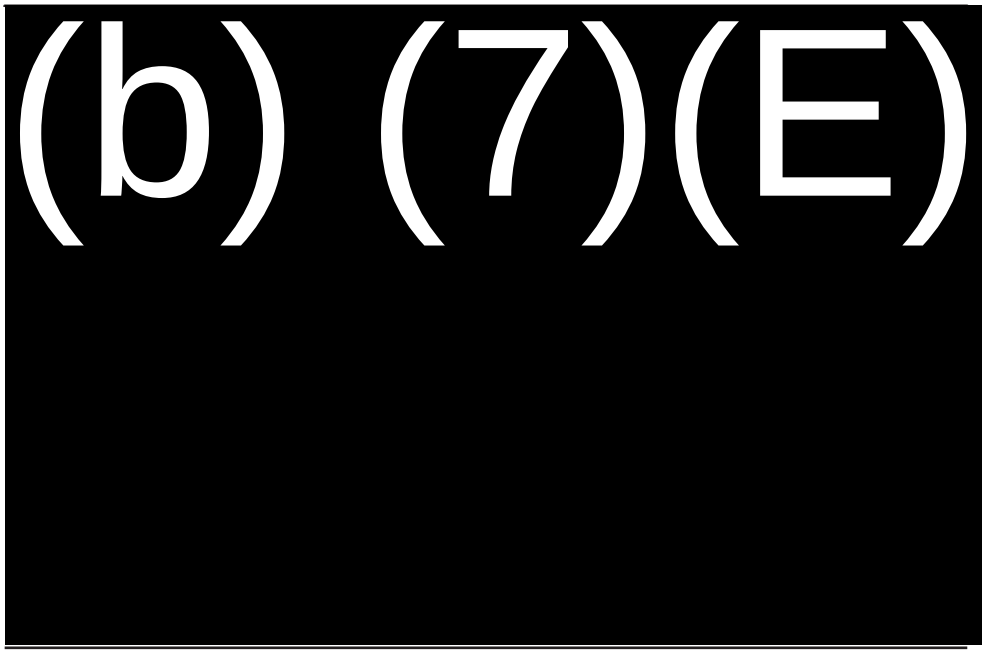


Figure 52: Breaching (b) (7)(E)

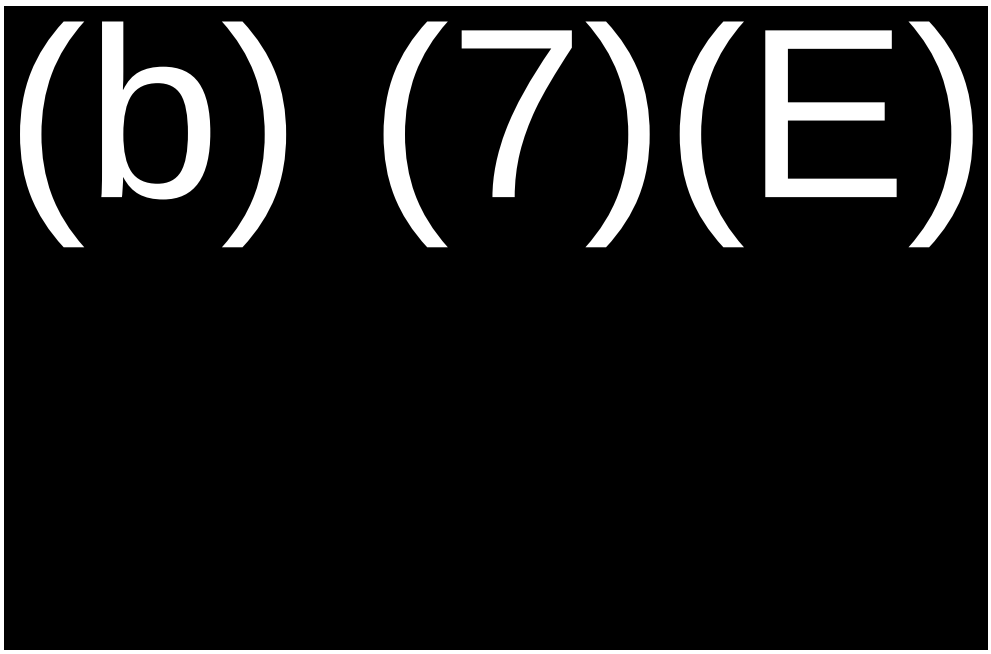


Figure 53: Breaching (b) (7)(E)

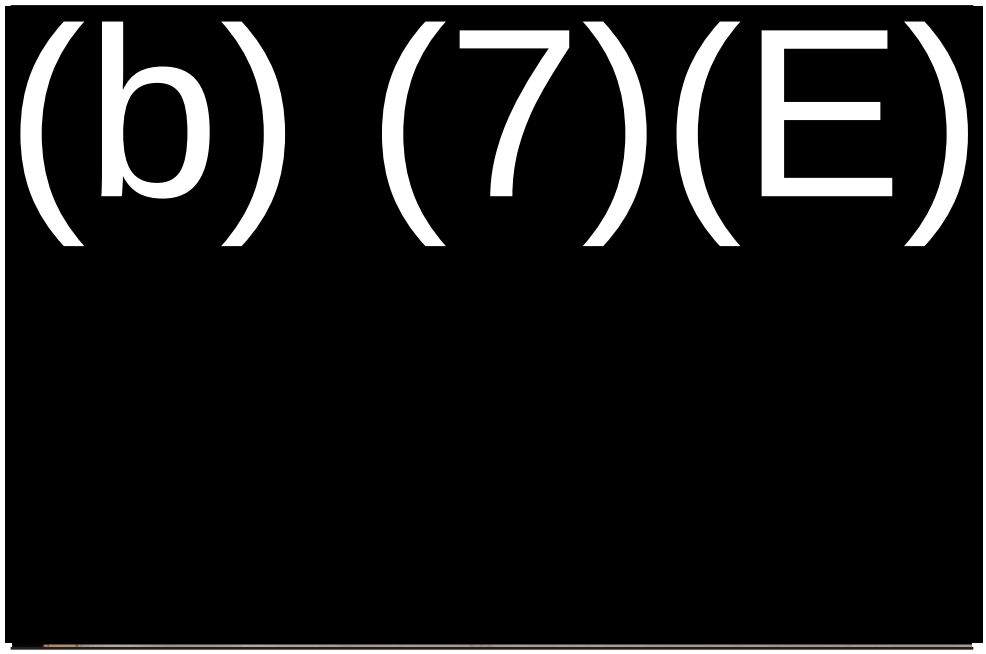


Figure 54: Breaching (b) (7)(E)

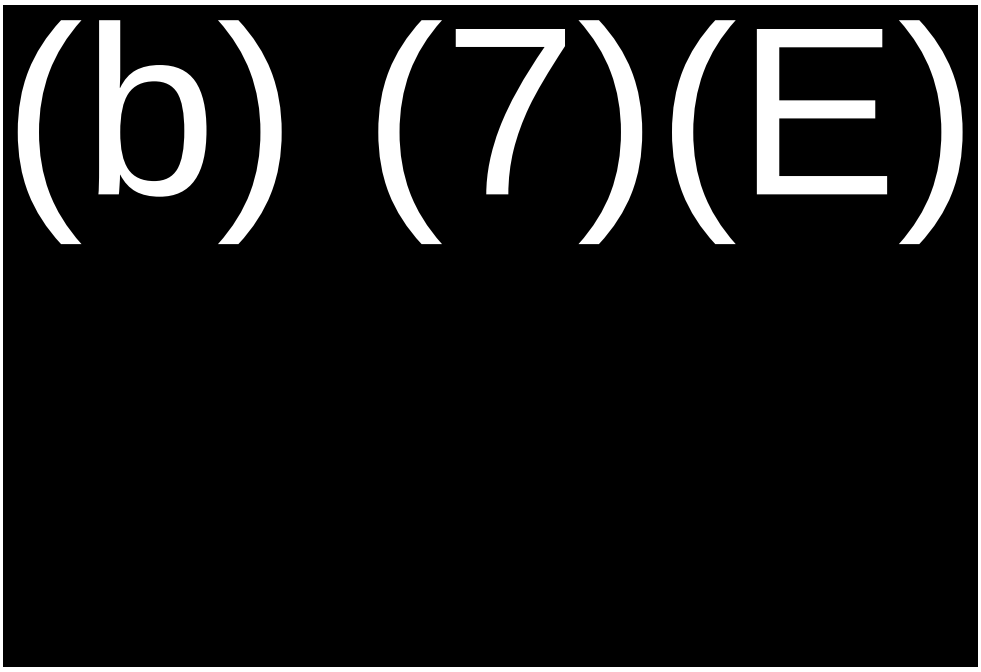


Figure 55: Breaching (b) (7)(E) ***(Top View)***

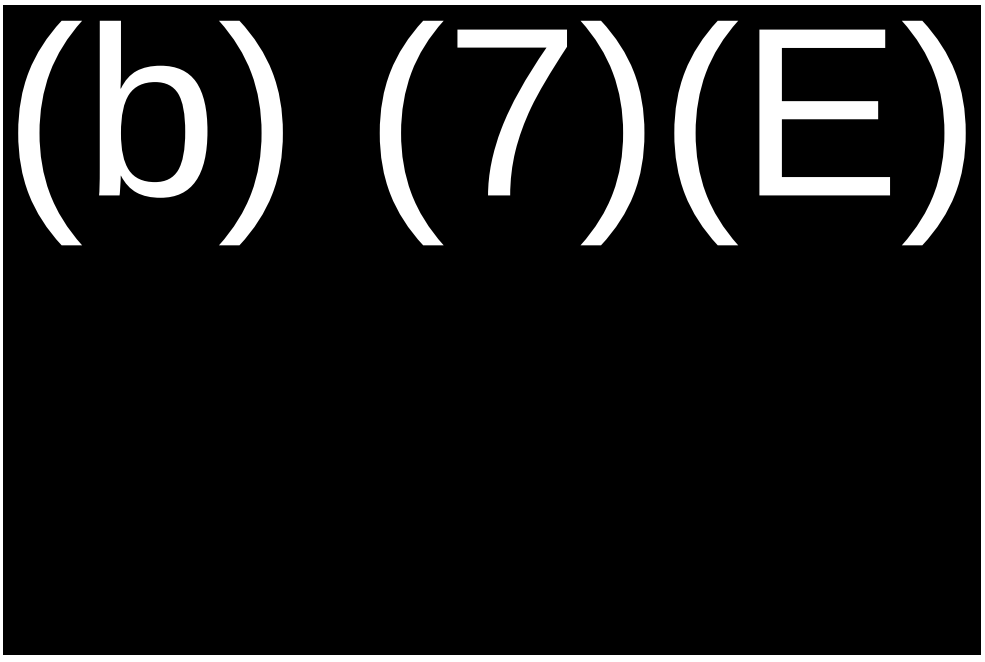


Figure 56: Breaching (b) (7)(E)

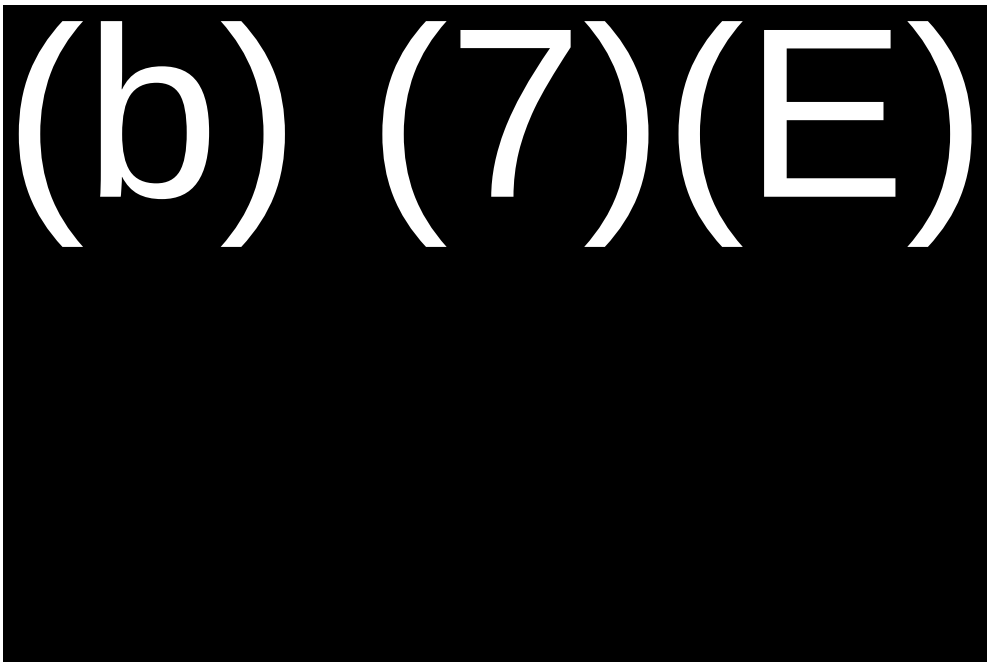


Figure 57: Breaching (b) (7)(E)

3.1.4.3 Mock-up (b) (7)(E)

The C-3M represents the (b) (7)(E) Mock-up (b) (7)(E) is shown in Figure 58 and Figure 59.

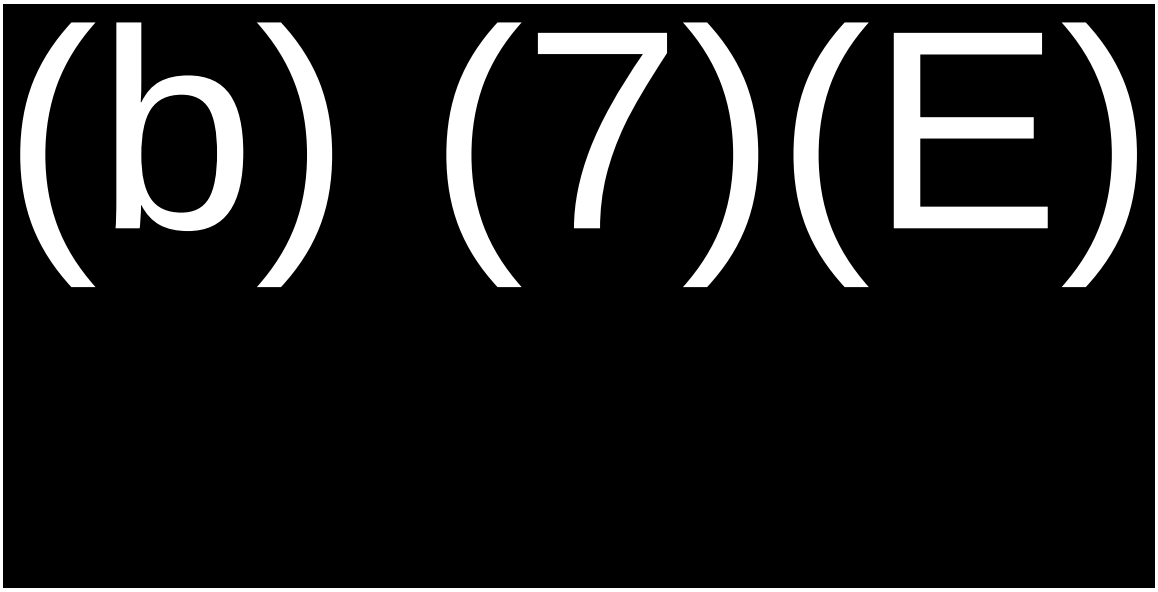


Figure 58: Mock-up (b) (7)(E) ***Figure 59: Mock-up*** (b) (7)(E) ***Side View***

Table 9 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 9: (b) (7)(E) Breaching Review Performance Characterization Statement

Requirement	Performance Characterization Statement
(b) (7)(E)	The mock-up of the submitted solution deterred the creation of a (b) (7)(E) breach by: (b) (7)(E) The mock-up of the submitted solution was not breached by (b) (7)(E)

3.1.4.3.1 C-3M Stakeholder and Subject Matter Expert Feedback

Stakeholder and subject matter expert feedback was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observations is document in TORs 105 and 108, Appendix B.

Breaching experts observed:

- (b) (7)(E)
- Breachers observed that the concrete of mock-up (b) (7)(E)
-
- (b) (7)(E)

3.1.4.3.2 Breaching Technique BT-2 ((b) (7)(E) *)*

The (b) (7)(E) deterred the creation of a (b) (7)(E) by breaching technique BT-2, the (b) (7)(E) . The progress of the breaching is shown in Figure 60, Figure 61, Figure 62, Figure 63, and Figure 64.

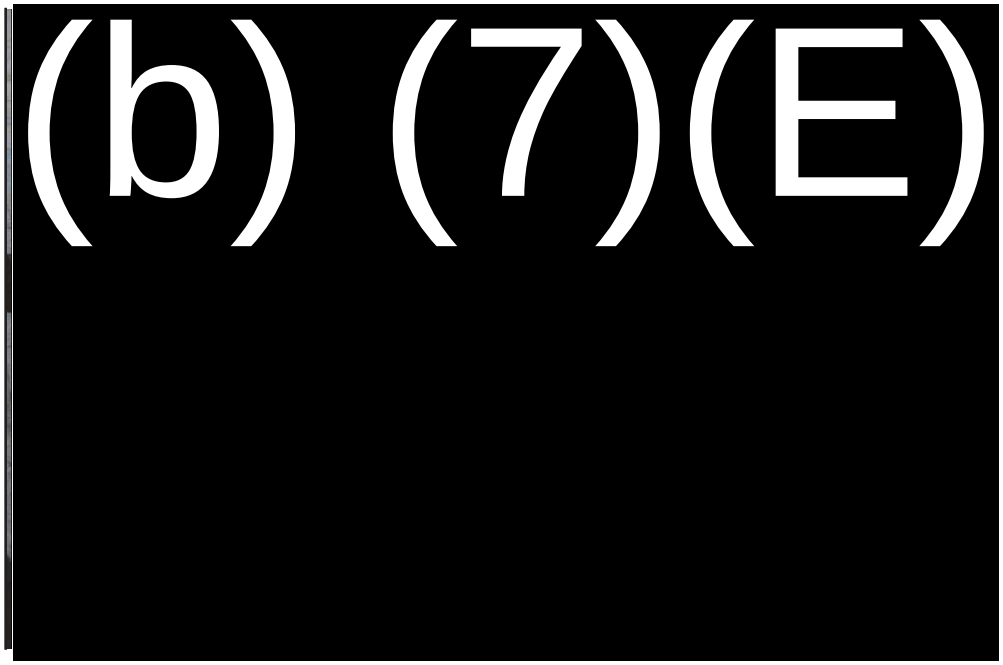


Figure 60: Breaching (b) (7)(E)

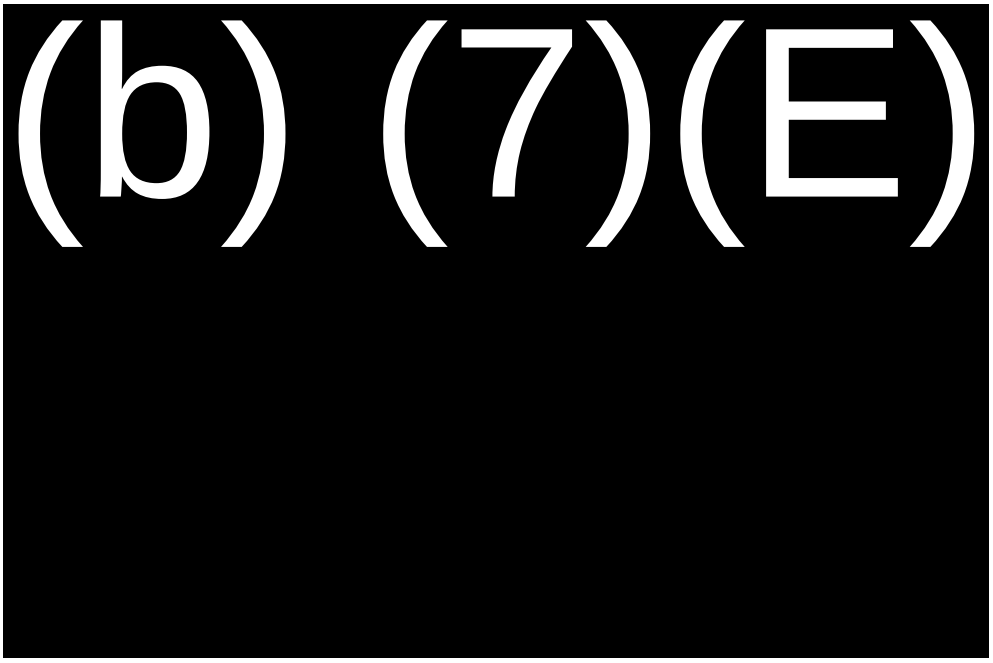


Figure 61: Breaching (b) (7)(E) ***inutes***

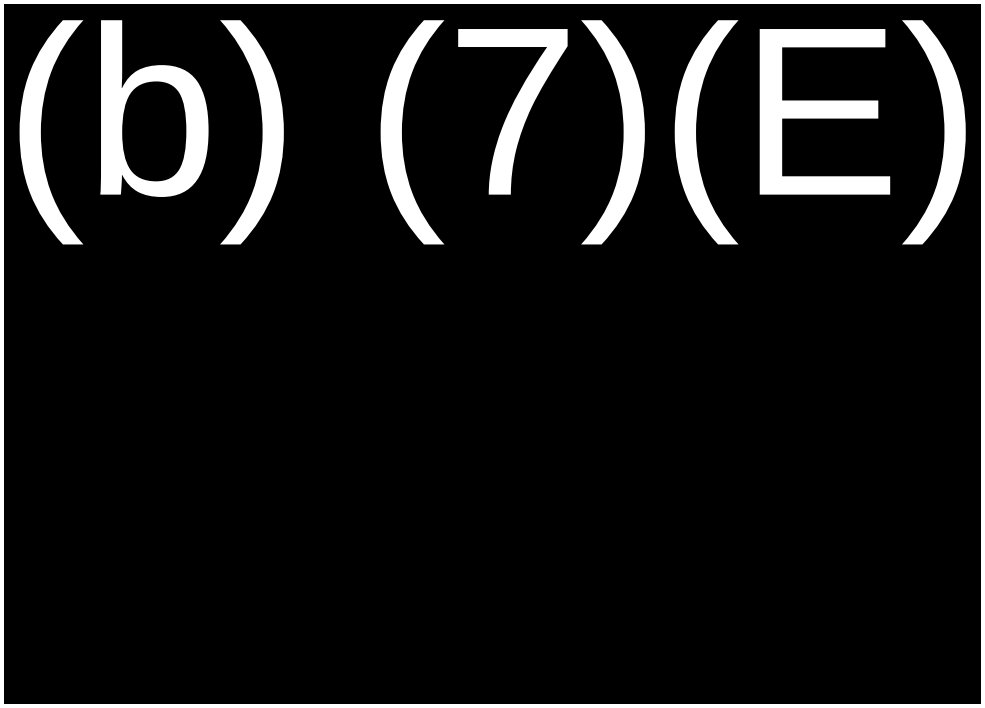


Figure 62: Breaching (b) (7)(E)

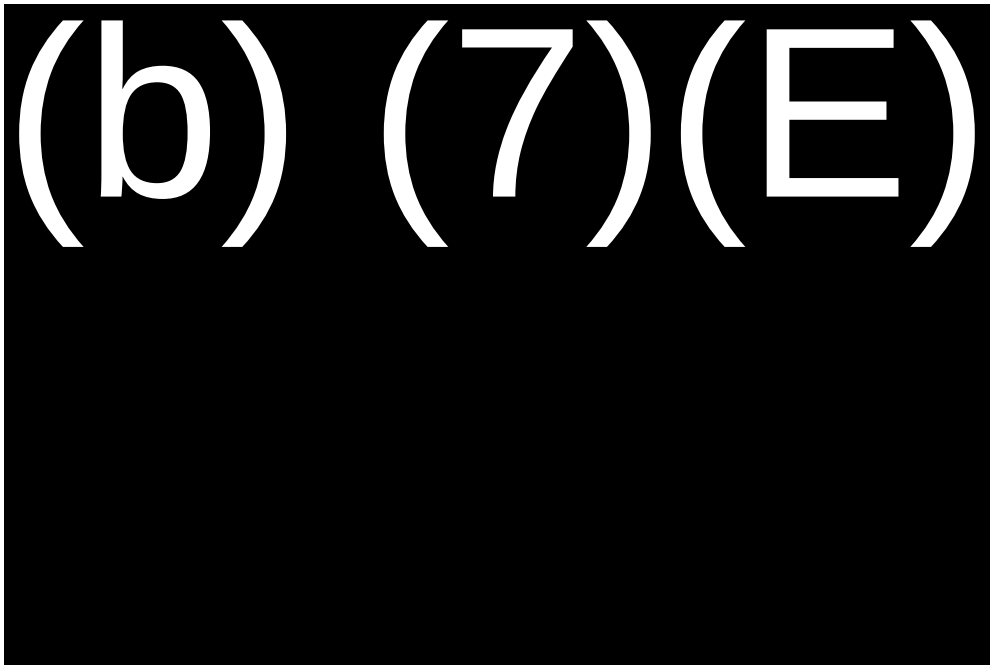


Figure 63: Breaching (b) (7)(E)

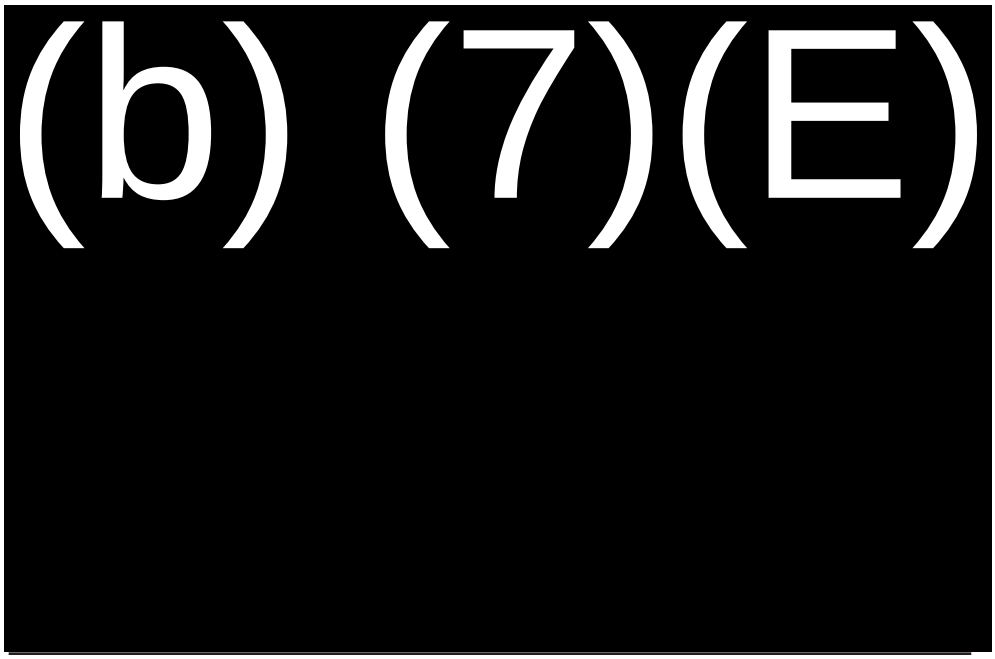


Figure 64: (b) (7)(E) ***Breach Measurement***

3.1.4.3.3 Breaching Technique BT-3 (b) (7)(E)

The (b) (7)(E) deterred the creation of a (b) (7)(E) breach by breaching technique BT-3, (b) (7)(E) The progress of the breaching is shown in Figure 65, Figure 66, Figure 67, Figure 68, and Figure 69.

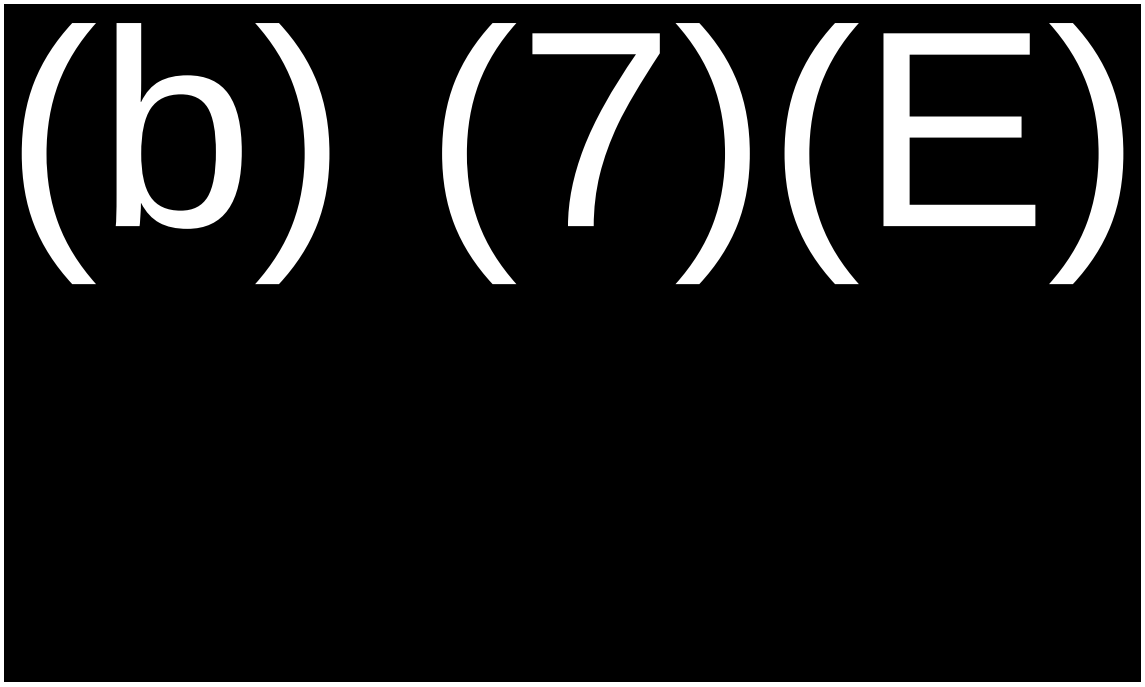


Figure 65: Breaching (b) (7)(E)

Figure 66: Breaching (b) (7)(E)

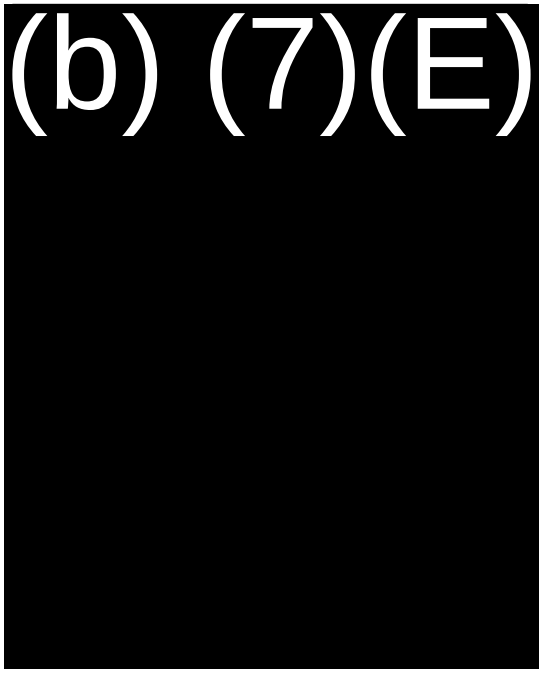


Figure 67: Breaching (b) (7)(E)

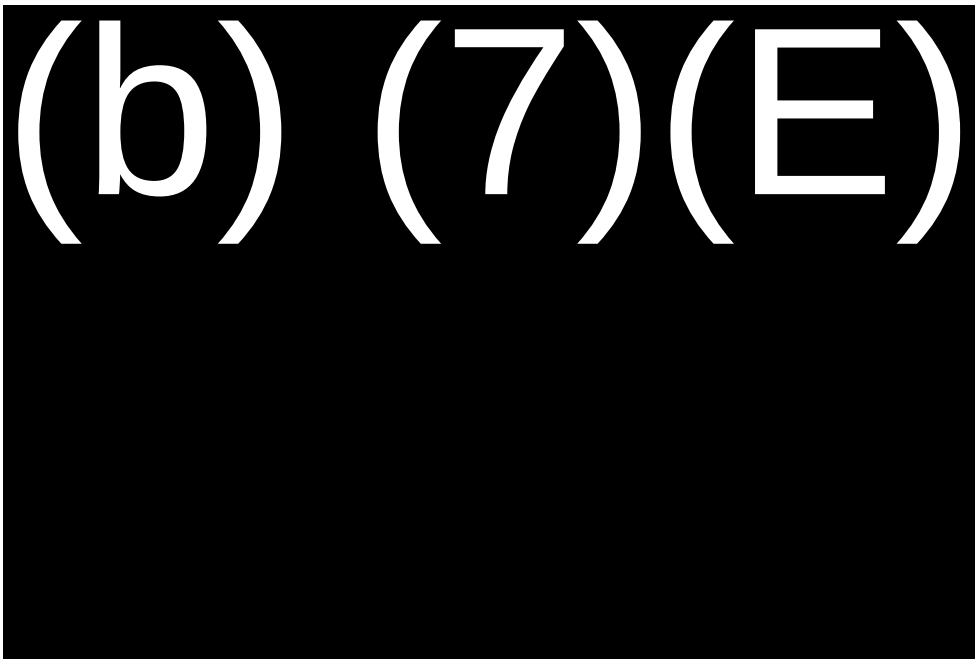


Figure 68: Breaching (b) (7)(E)

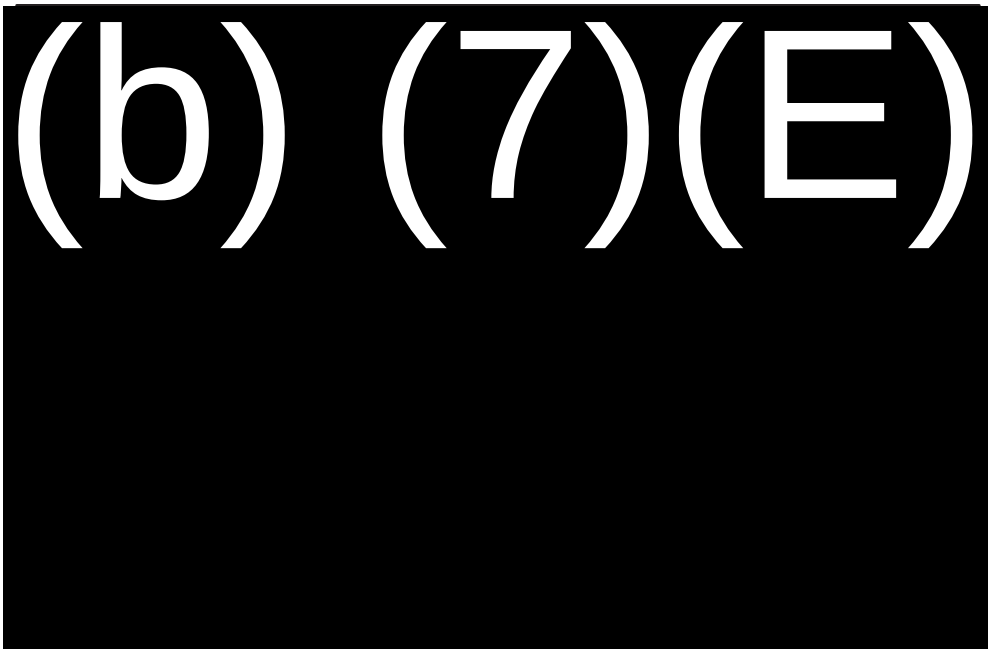


Figure 69: (b) (7)(E) ***Breach Measurement***

3.1.4.3.4 Breaching Technique BT-4 ((b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-4, the (b) (7)(E) The progress of the breaching is shown in Figure 70, Figure 72, and Figure 73.

(b) (7)(E)

Figure 70: Breaching (b) (7)(E)

(b) (7)(E)

Figure 71: Breaching (b) (7)(E)

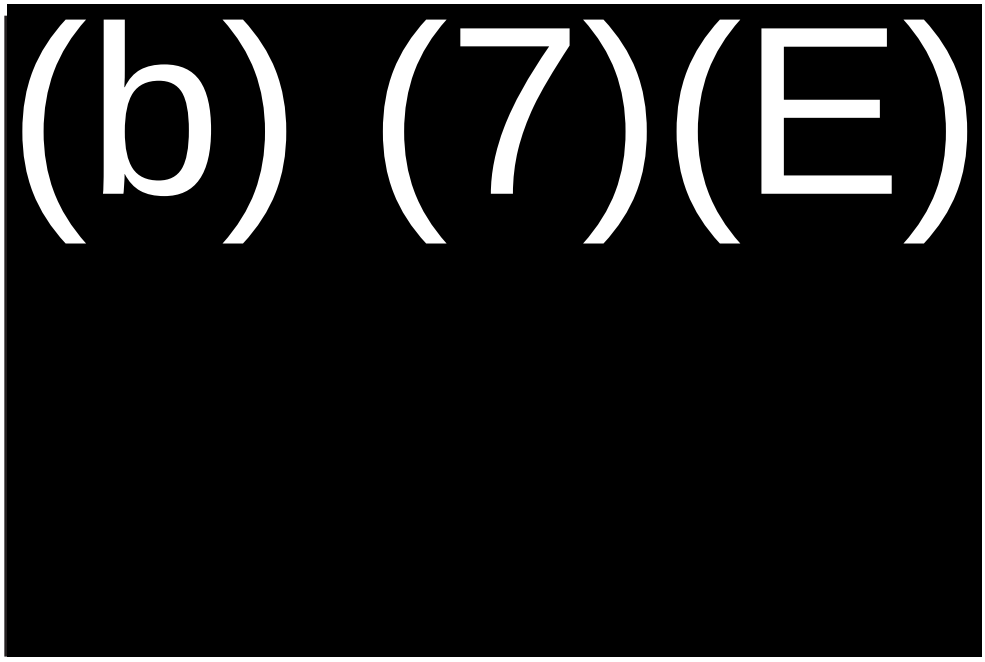


Figure 72: Breaching (b) (7)(E)

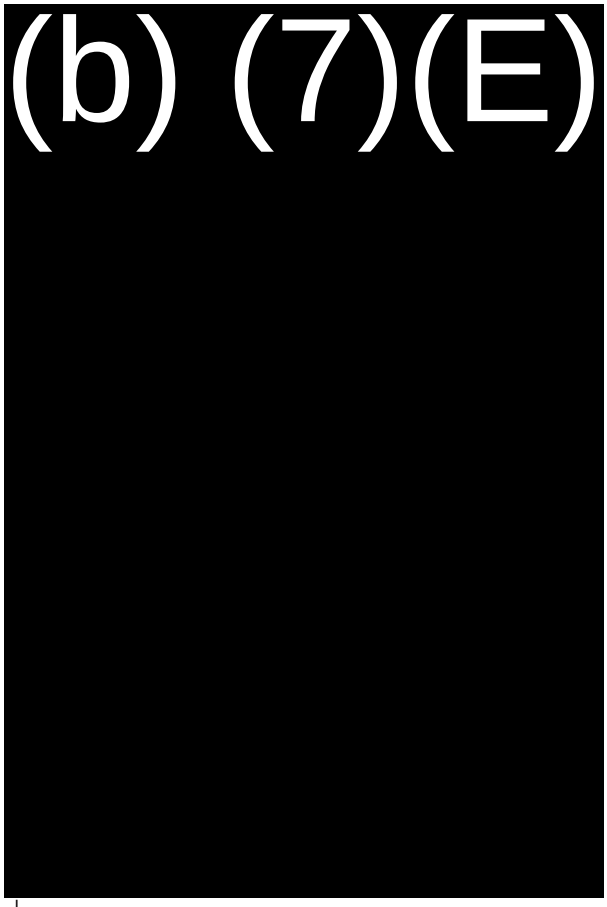


Figure 73: (b) (7)(E) ***Side View*** (b) (7)(E)

3.1.4.4 Mock-up (b) (7)(E)

The (b) (7)(E) represents the (b) (7)(E) . Mock-up (b) (7)(E) is shown in Figure 21 and Figure 22.

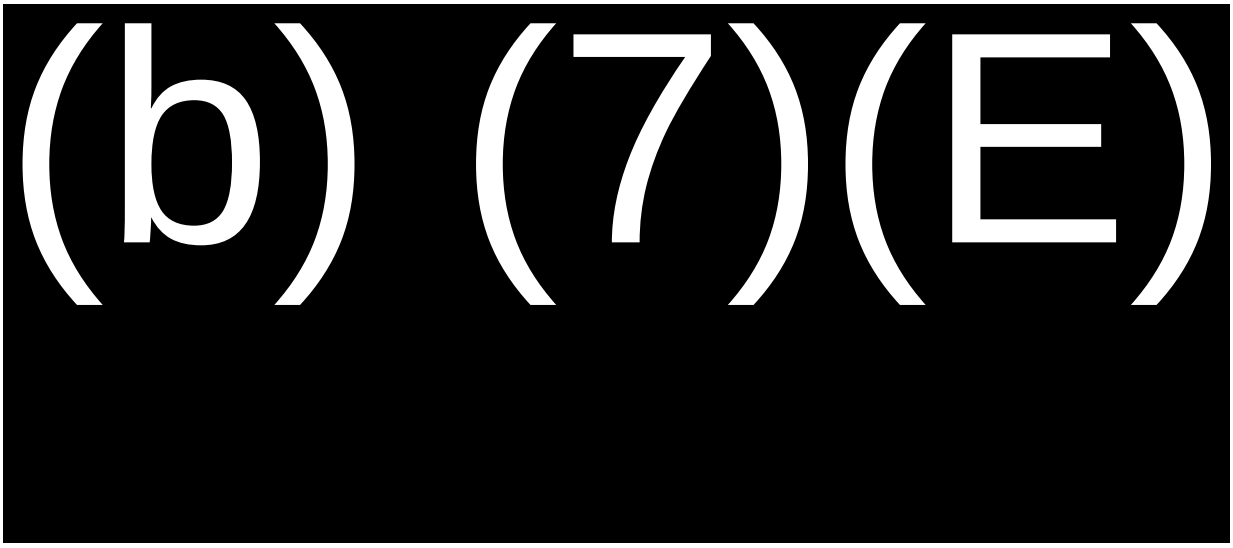


Figure 74: Mock-up (b) (7)(E)

Figure 75: Mock-up (b) (7)(E) ***ide View***

Table 10 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 10: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	The mock-up of the submitted solution deterred the creation of a (b) (7)(E) breach by: (b) (7)(E)

3.1.4.4.1 C-4M Stakeholder and Subject Matter Expert Feedback

Stakeholder and subject matter expert was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observation is documented in TOR 109, Appendix B.

Breaching experts observed:

- (b) (7)(E)

- (b) (7)(E)

3.1.4.4.2 Breaching Technique BT-2 ((b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-2, (b) (7)(E) . The progress of the breaching is shown in Figure 76, Figure 77, Figure 78, Figure 79, and Figure 80.

(b) (7)(E)

Figure 76: Breaching (b) (7)(E)

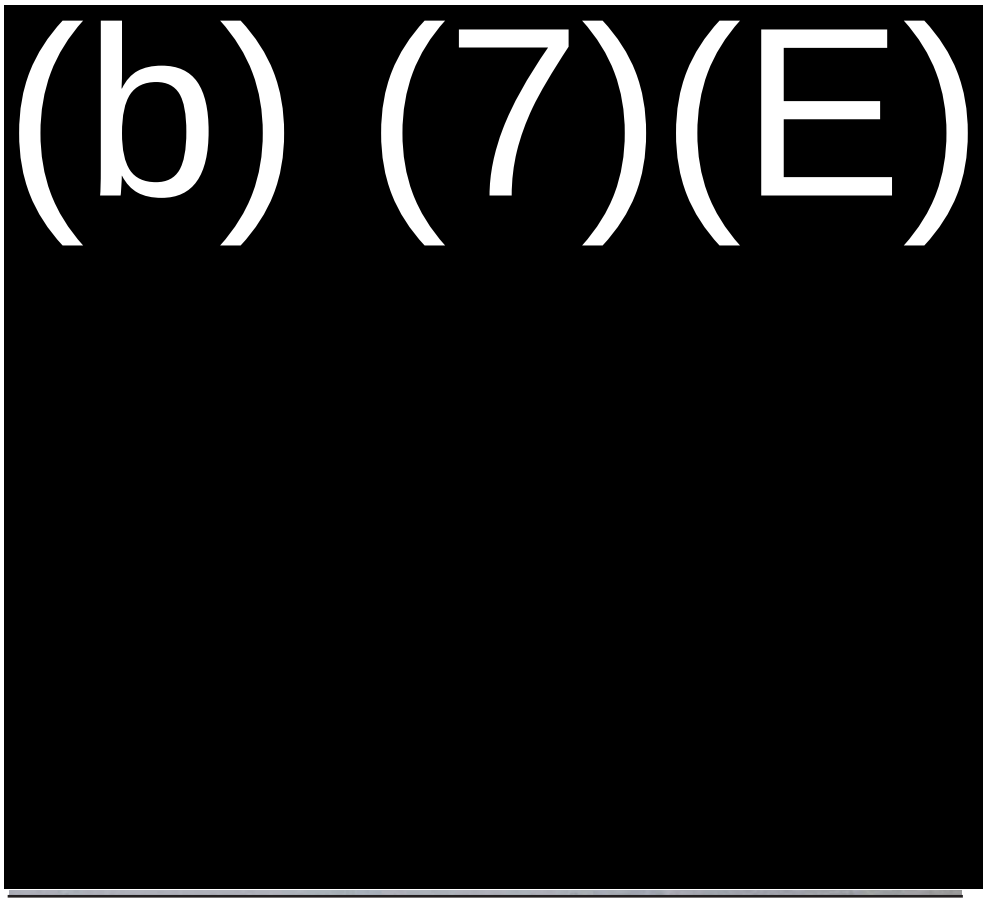


Figure 77: Breaching (b) (7)(E)

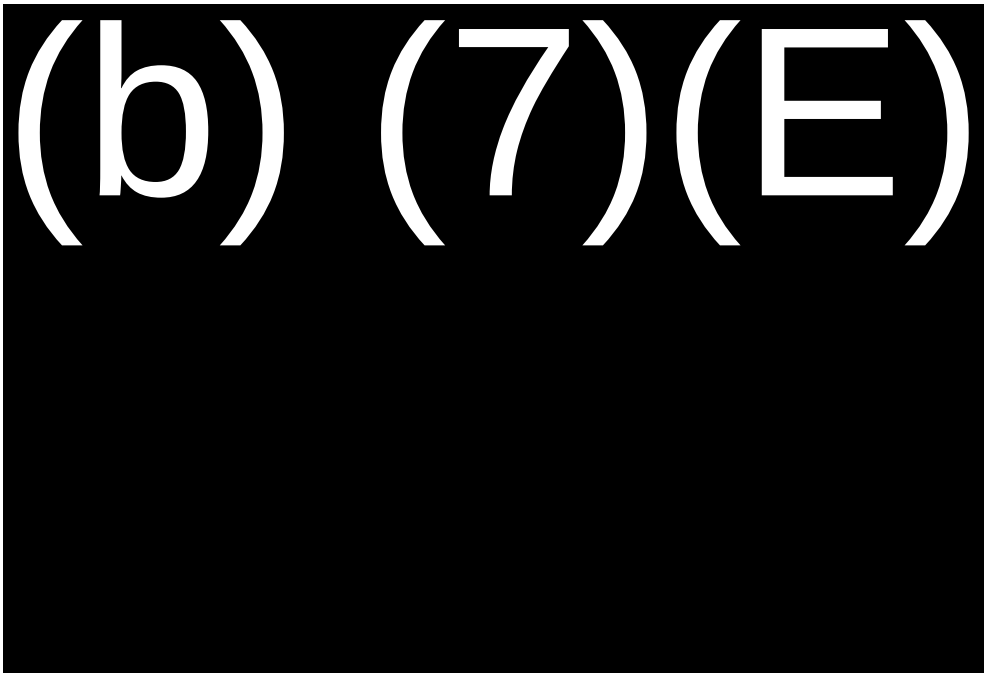


Figure 78: Breaching (b) (7)(E)

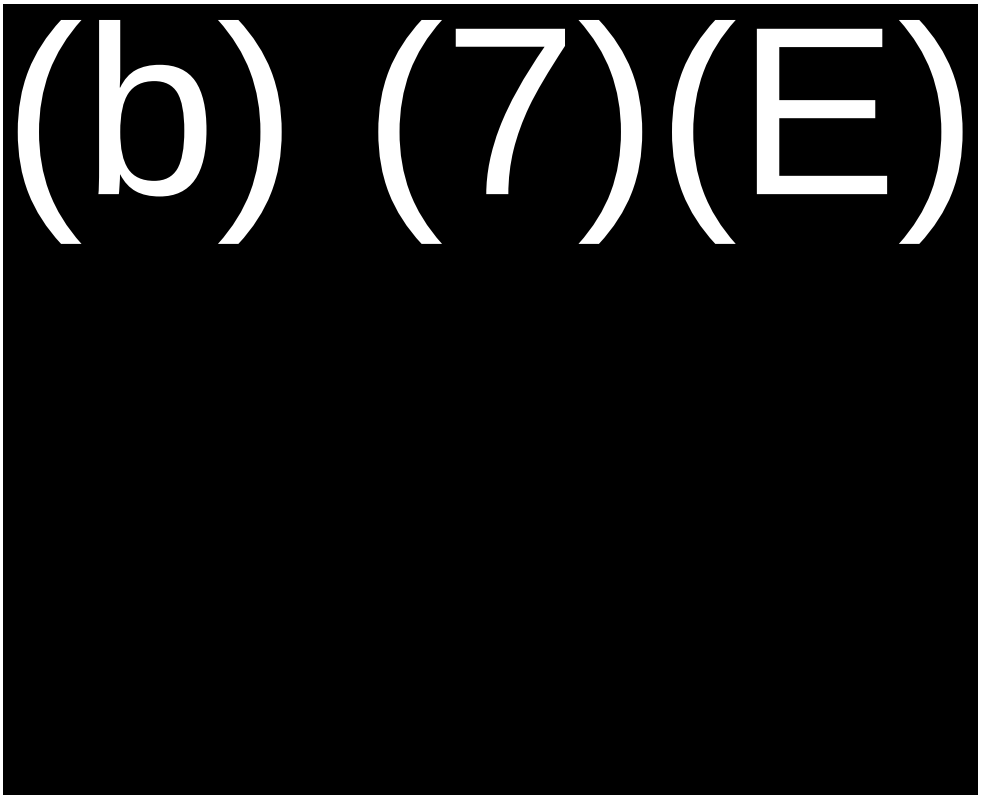


Figure 79: Breaching (b) (7)(E)

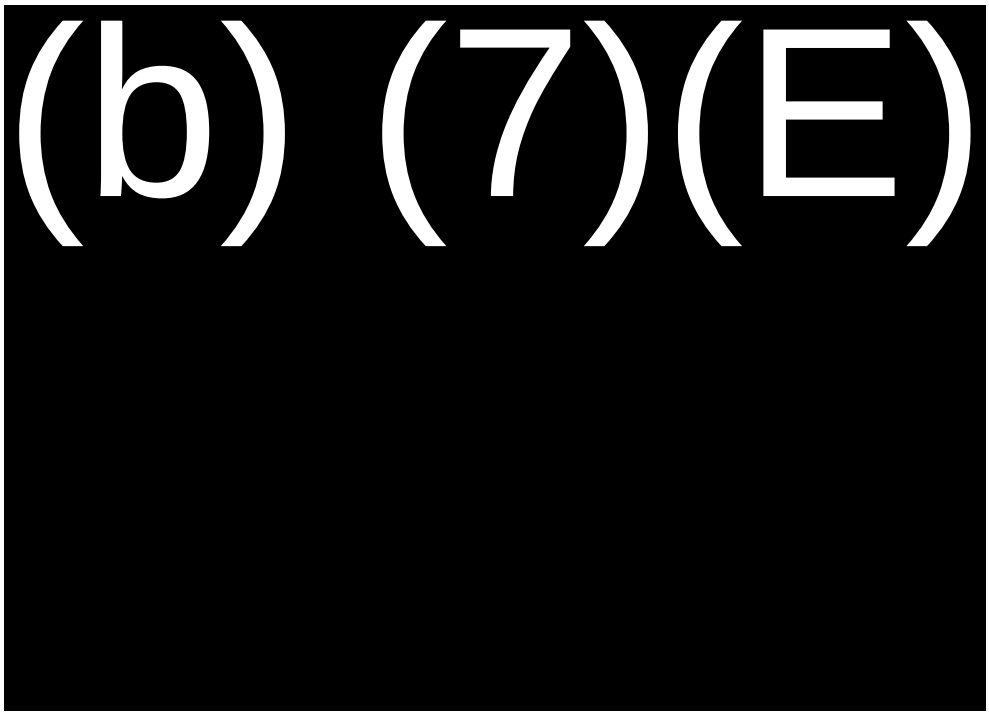


Figure 80: (b) (7)(E) ***Breach Measurement***

3.1.4.4.3 Breaching Technique BT-3 (b) (7)(E)

The (b) (7)(E) deterred the creation of a (b) (7)(E) breach by breaching technique BT-3, (b) (7)(E) The progress of the breaching is shown in Figure 81, Figure 82, Figure 83, and Figure 84.

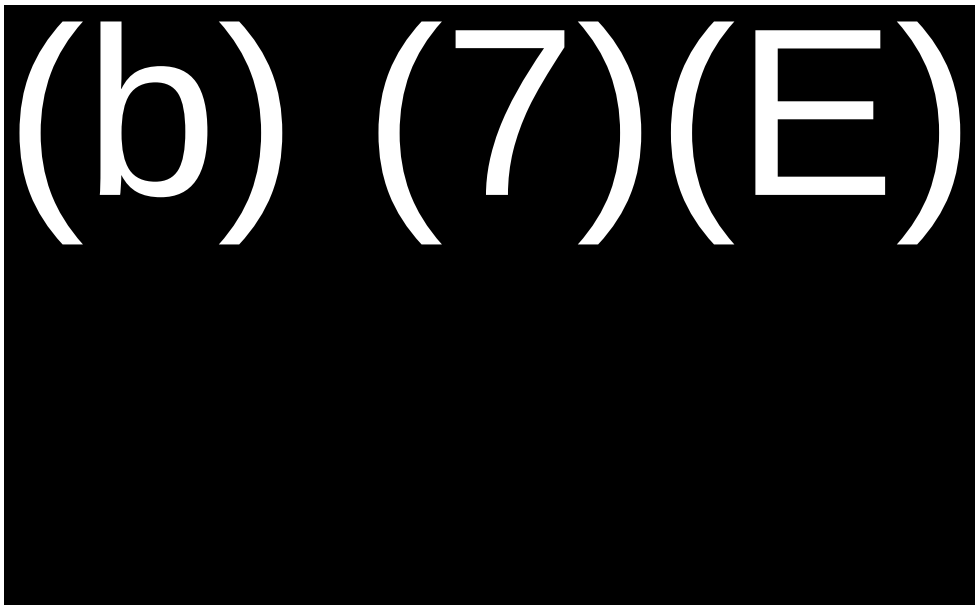


Figure 81: Breaching (b) (7)(E)

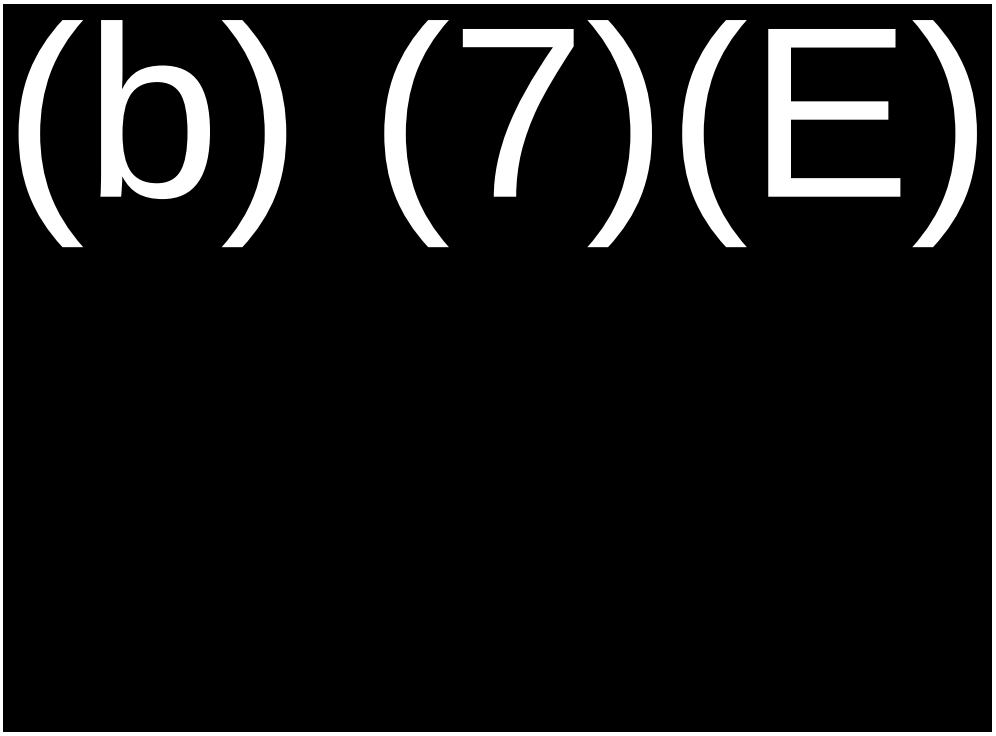


Figure 82: Breaching (b) (7)(E)

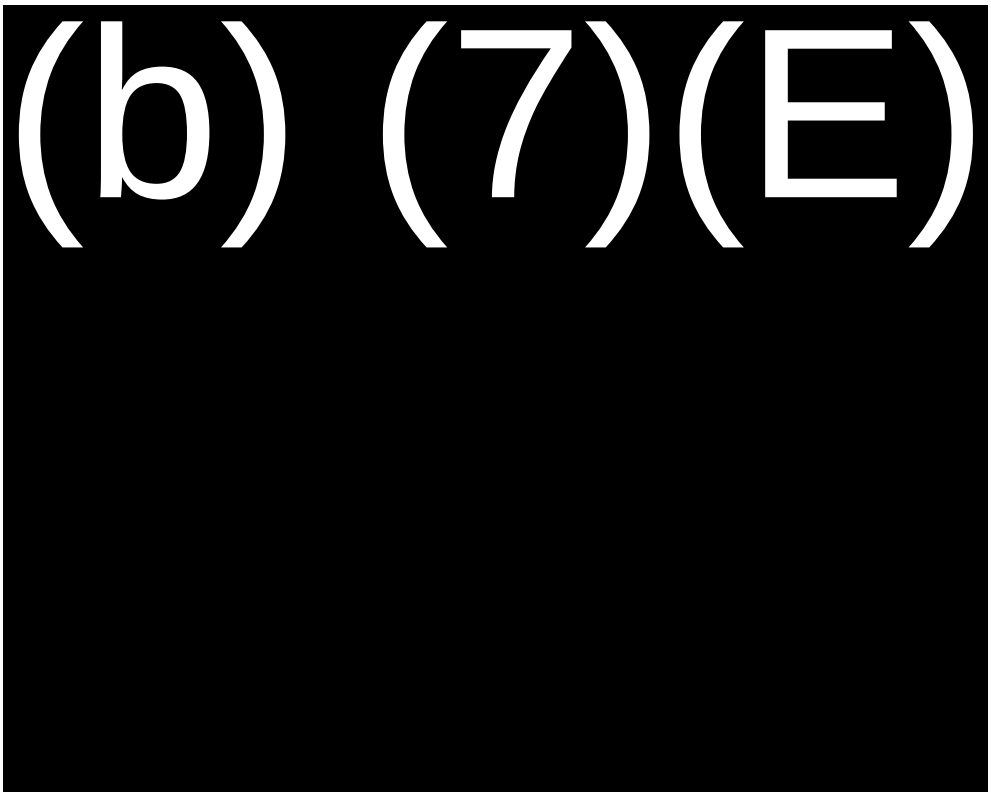


Figure 83: Breaching (b) (7)(E)

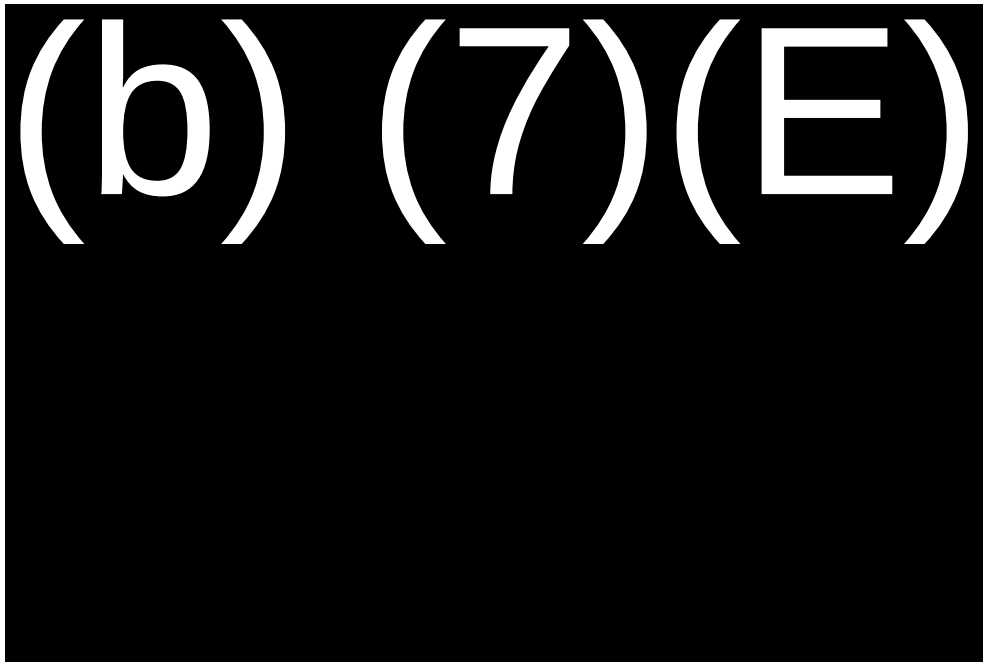


Figure 84: Breaching (b) (7)(E)

3.1.4.4.4 Breaching Technique BT-4 ((b) (7)(E)

The(b) (7)(E) deterred the creation of a(b) (7)(E) breach by breaching technique BT-4, (b) (7)(E) The progress of the breaching is shown in Figure 85, Figure 86, Figure 87, Figure 88 Figure 89, and Figure 90.

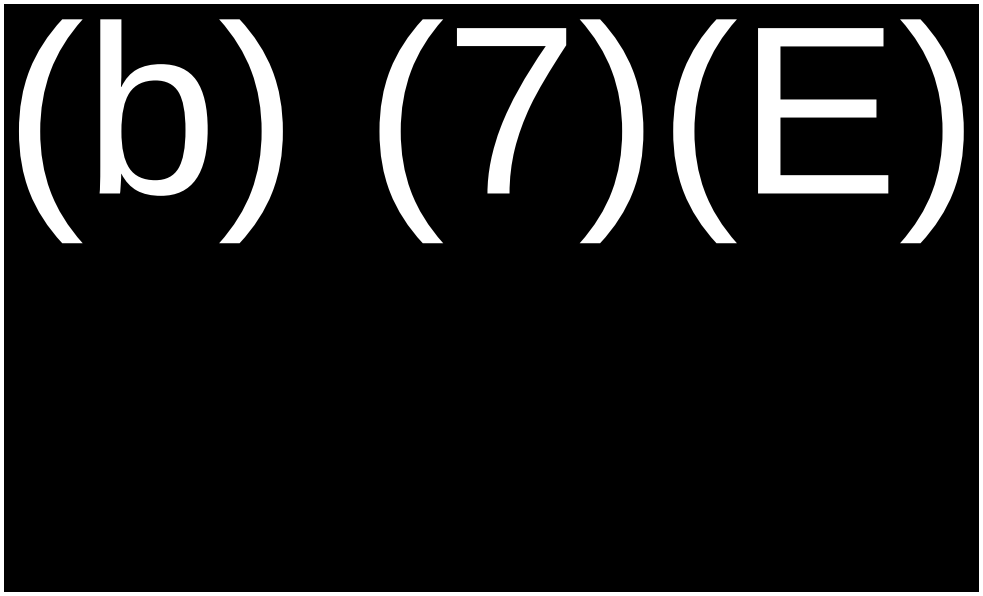


Figure 85: Breaching (b) (7)(E)

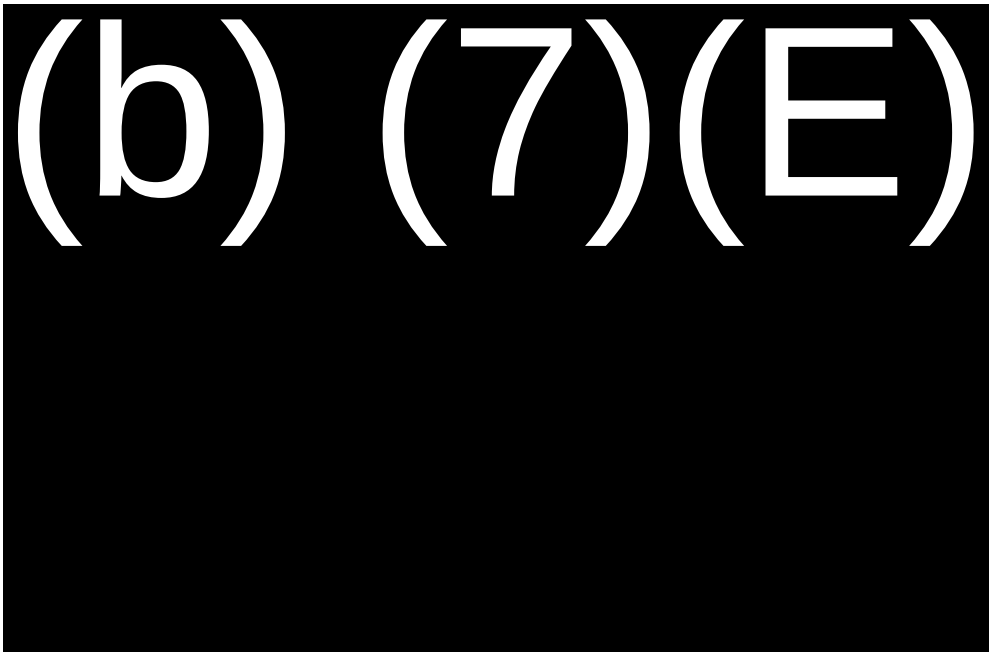


Figure 86: Breaching (b) (7)(E)

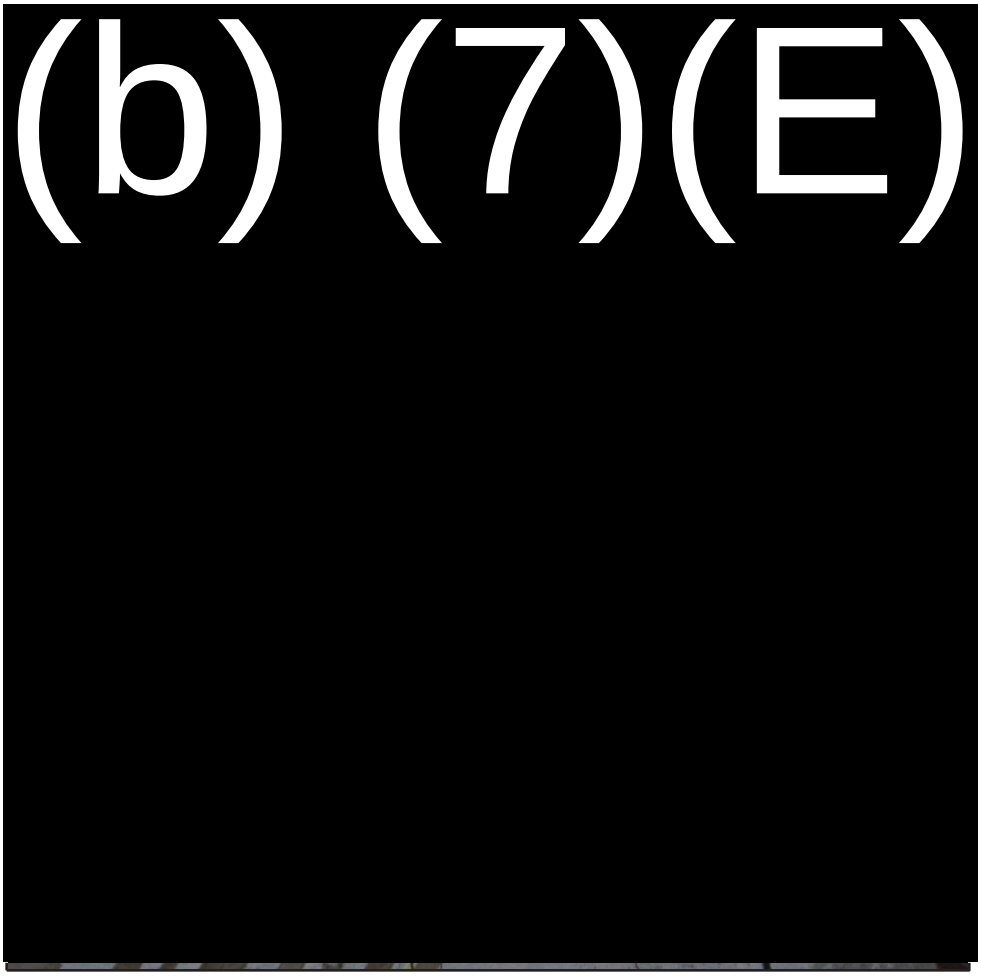


Figure 87: Breaching (b) (7)(E)

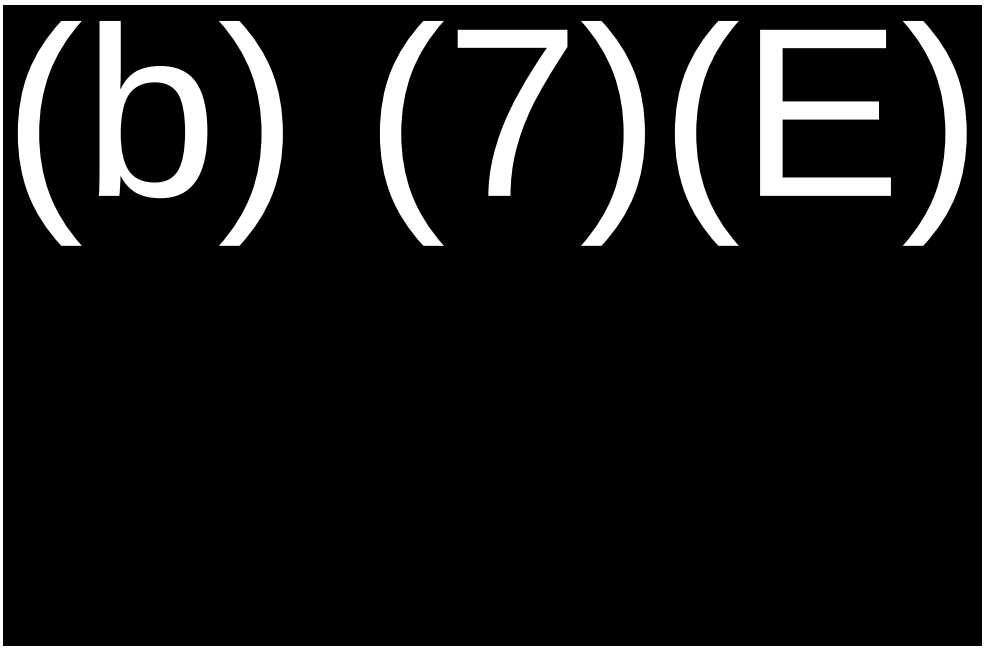


Figure 88: Breaching (b) (7)(E)

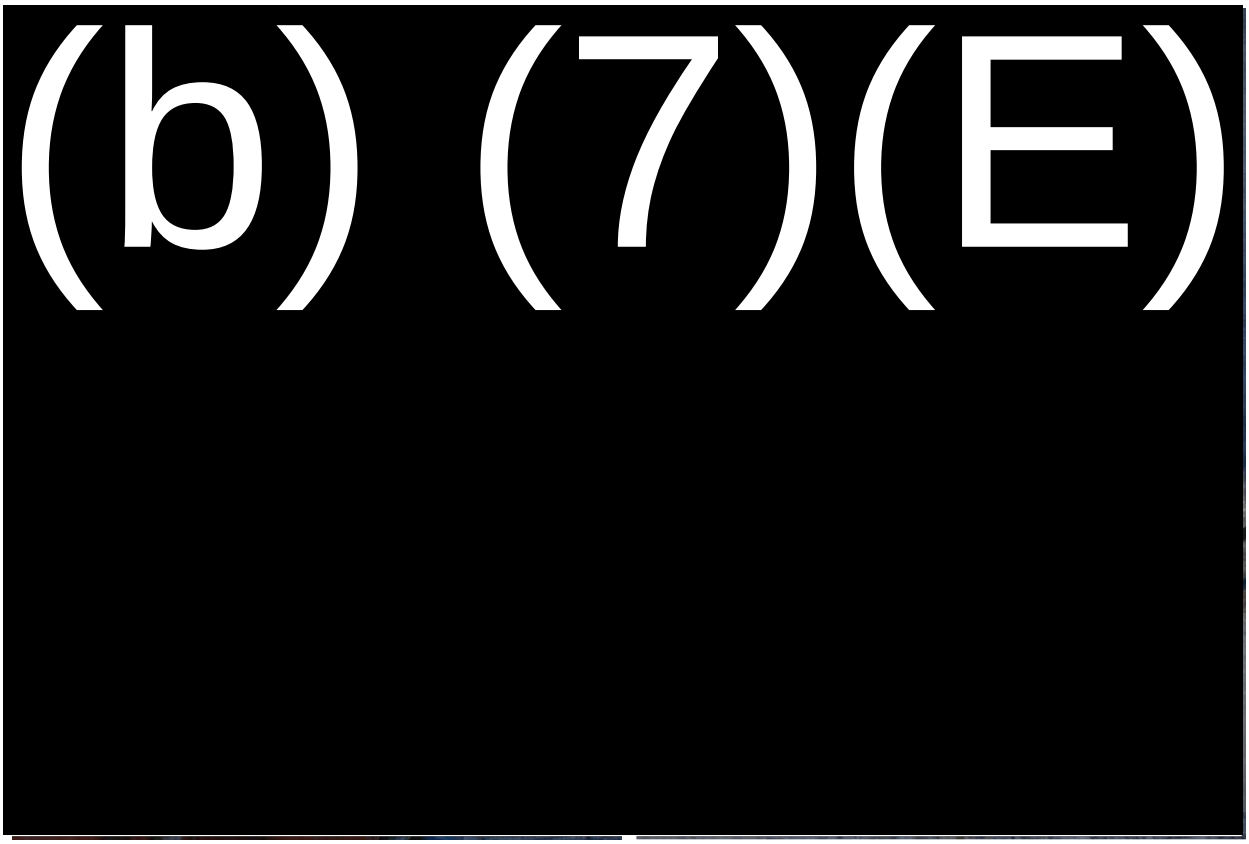


Figure 89: Breaching (b) (7)(E)

Figure 90: Breaching (b) (7)(E)

3.1.4.5 Mock-up (b) (7)(E)

The (b) (7)(E) represents the (b) (7)(E) Mock-up (b) (7)(E) is shown in Figure 91 and Figure 92.

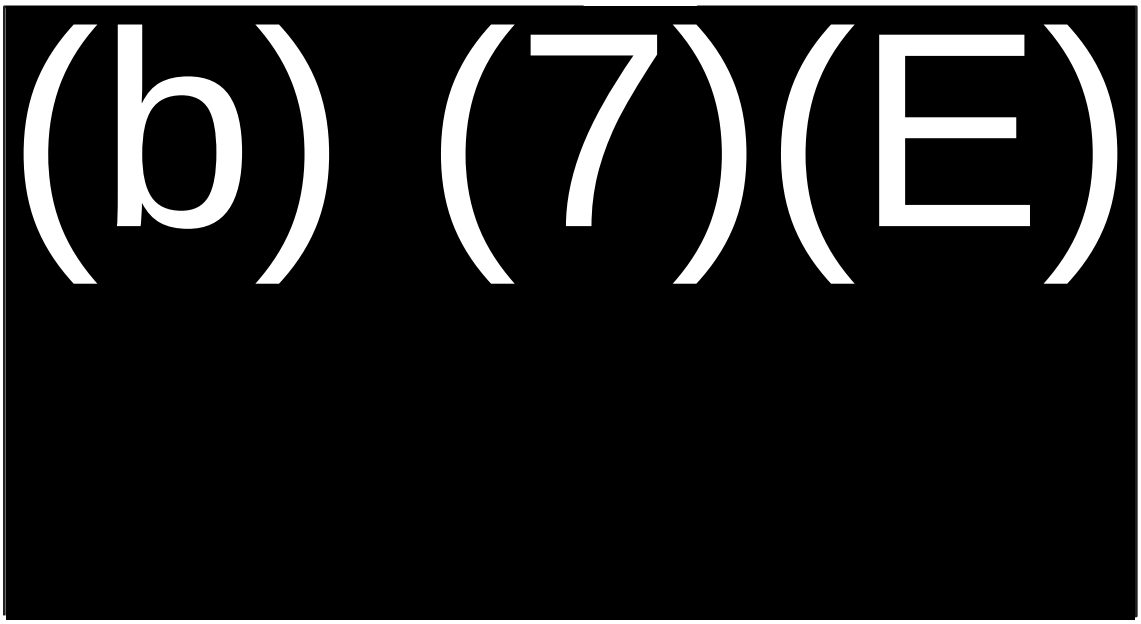


Figure 91: Mock-up (b) (7)(E)

Figure 92: Mock-up (b) (7)(E) ***Side View***

Table 11 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 11: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	The mock-up of the submitted solution deterred the creation of a (b) (7)(E) breach by: (b) (7)(E) .

3.1.4.5.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

Stakeholder and subject matter expert feedback was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observations is document in TORs 102 and 107, Appendix B.

Breaching experts observed:

- :
- (b) (7)(E)
-

- (b) (7)(E)

3.1.4.5.2 Breaching Technique BT-5 (b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-5, (b) (7)(E) The progress of the breaching is shown in Figure 93, Figure 94, and Figure 95.

(b) (7)(E)

Figure 93: Breaching (b) (7)(E)

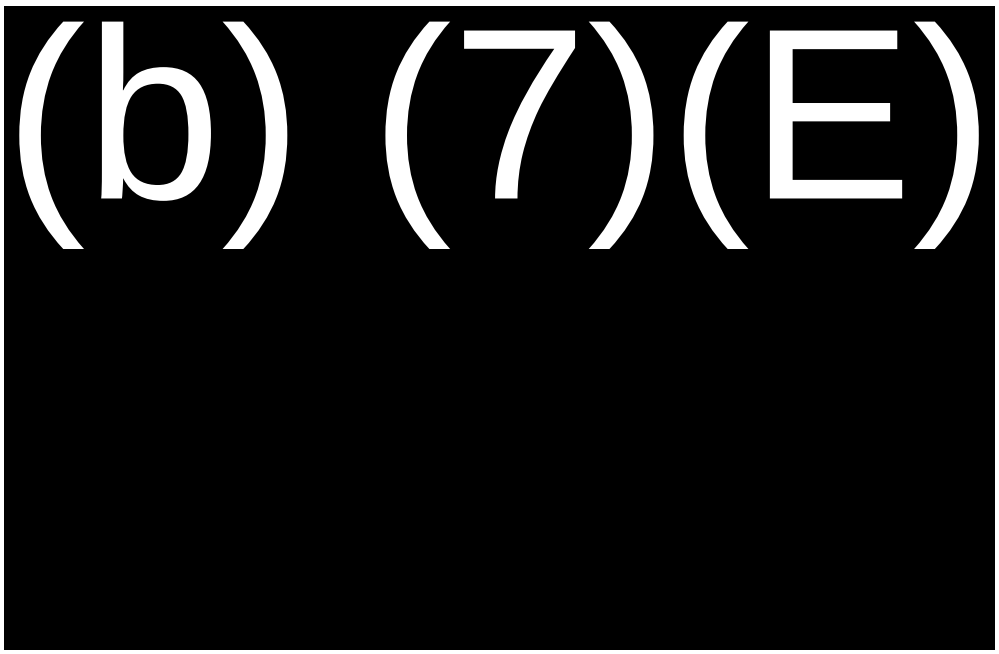


Figure 94: Breaching (b) (7)(E)

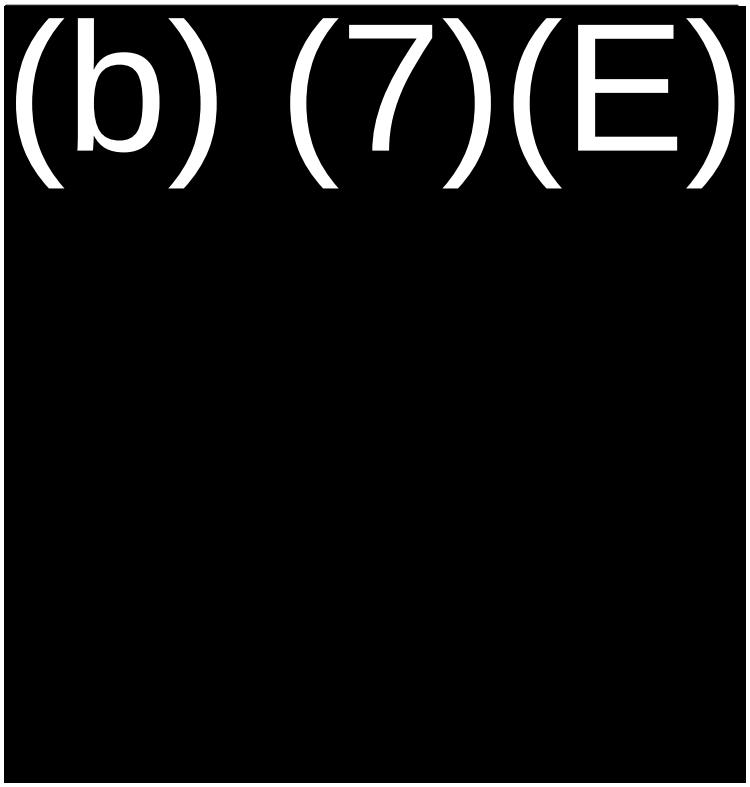


Figure 95: (b) (7)(E) ***Breach Measurement***

3.1.4.5.3 Breaching Technique BT-6 (Plasma Cutter)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-5, (b) (7)(E) The progress of the breaching is shown in Figure 96, Figure 97, and Figure 98.

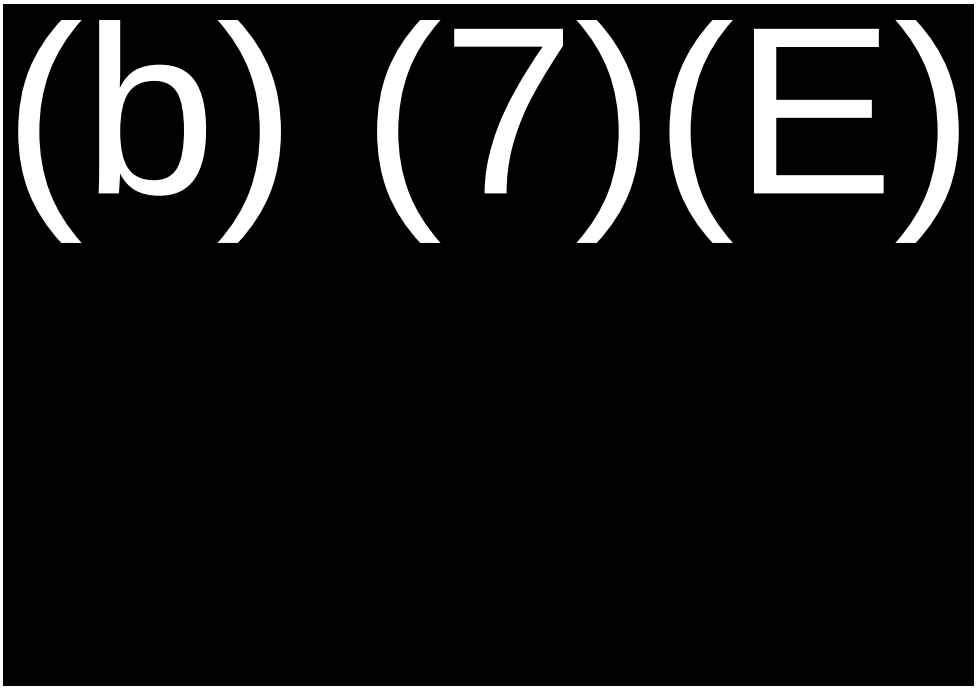


Figure 96: Breaching (b) (7)(E)

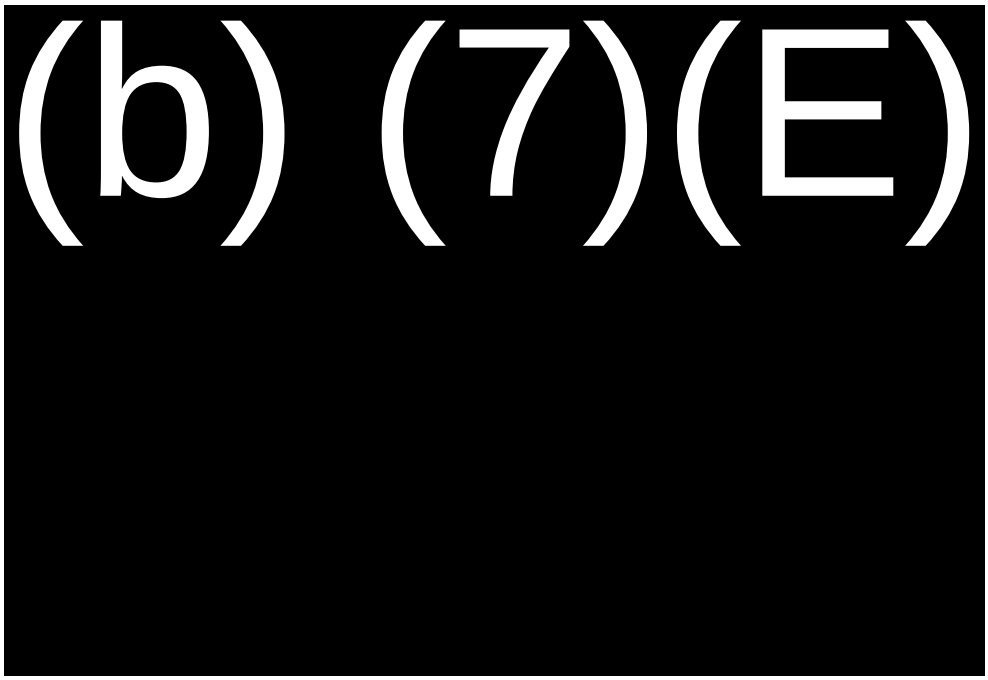


Figure 97: Breaching (b) (7)(E)

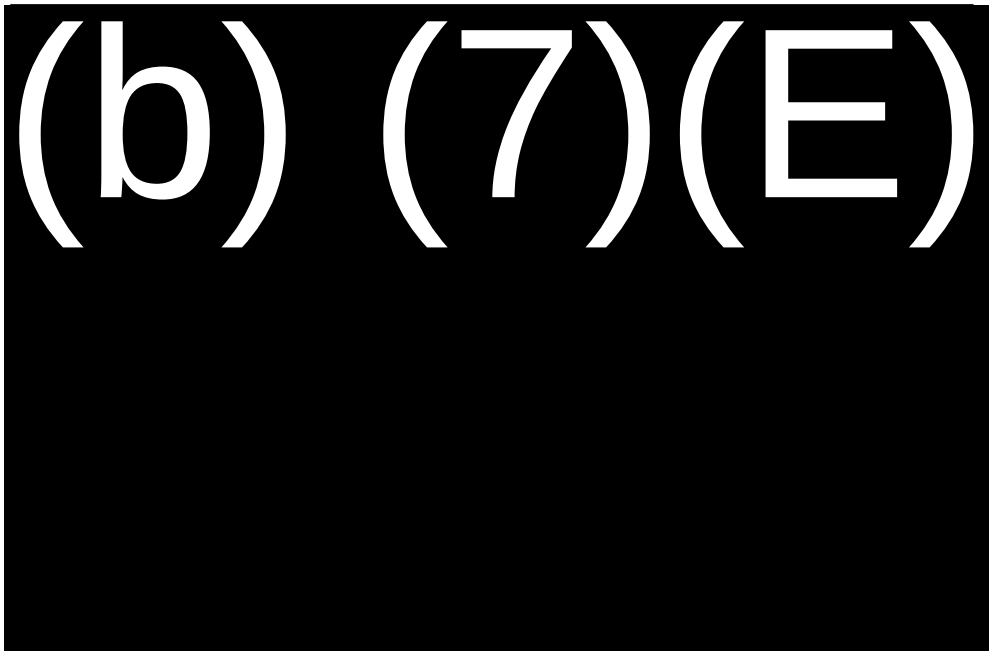


Figure 98: (b) (7)(E) ***Breach Measurement***

3.1.4.5.4 Breaching Technique BT-7 ((b) (7)(E) *)*

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-7, (b) (7)(E) . The progress of the breaching is shown in Figure 99, Figure 100, Figure 101, and Figure 102.

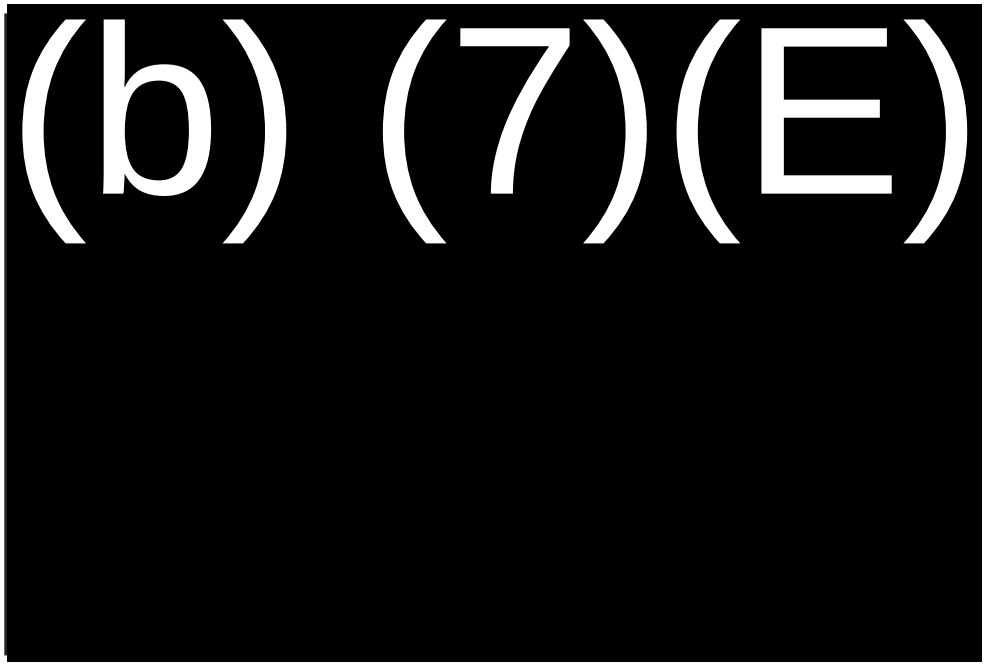


Figure 99: Breaching (b) (7)(E)

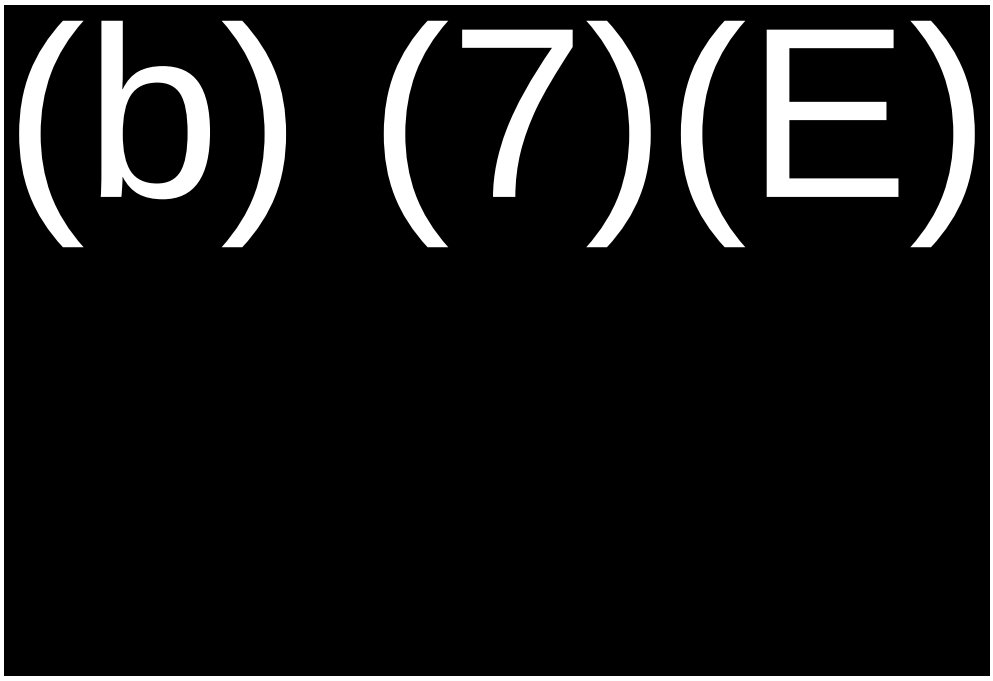


Figure 100: Breaching (b) (7)(E)

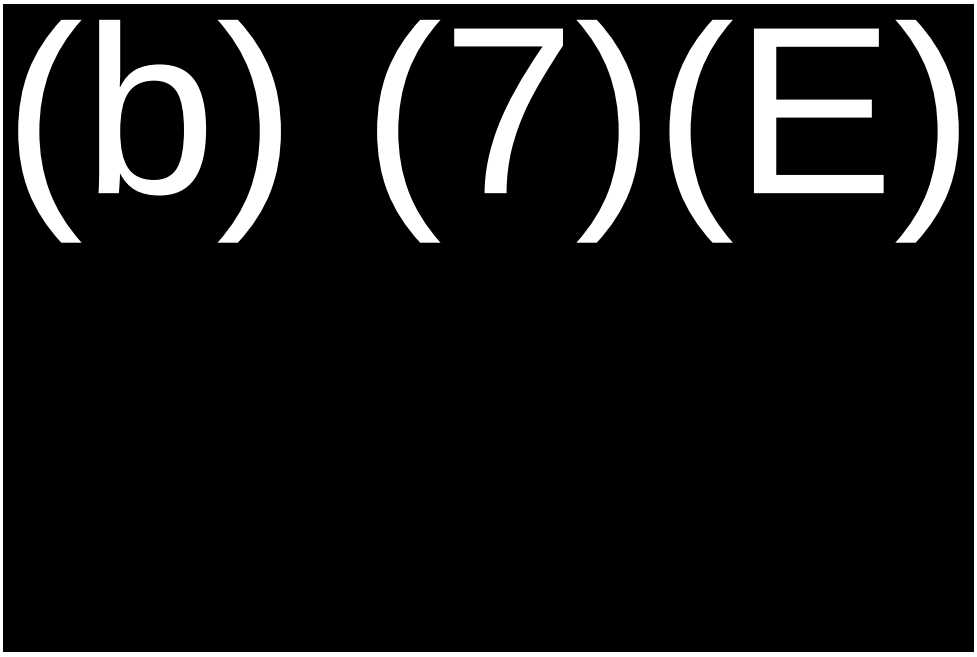


Figure 101: Breaching (b) (7)(E)

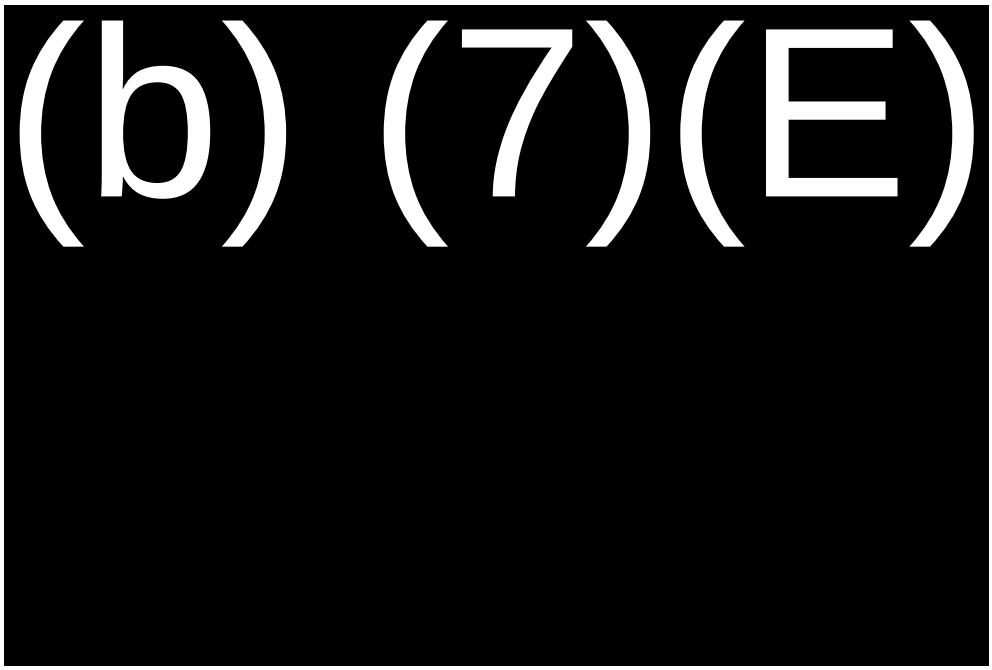


Figure 102: (b) (7)(E) ***Breach Measurement***

3.1.4.5.5 Breaching Technique BT-8 (Quick Saw)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-8. (b) (7)(E) The progress of the breaching is shown in Figure 103 and Figure 104.

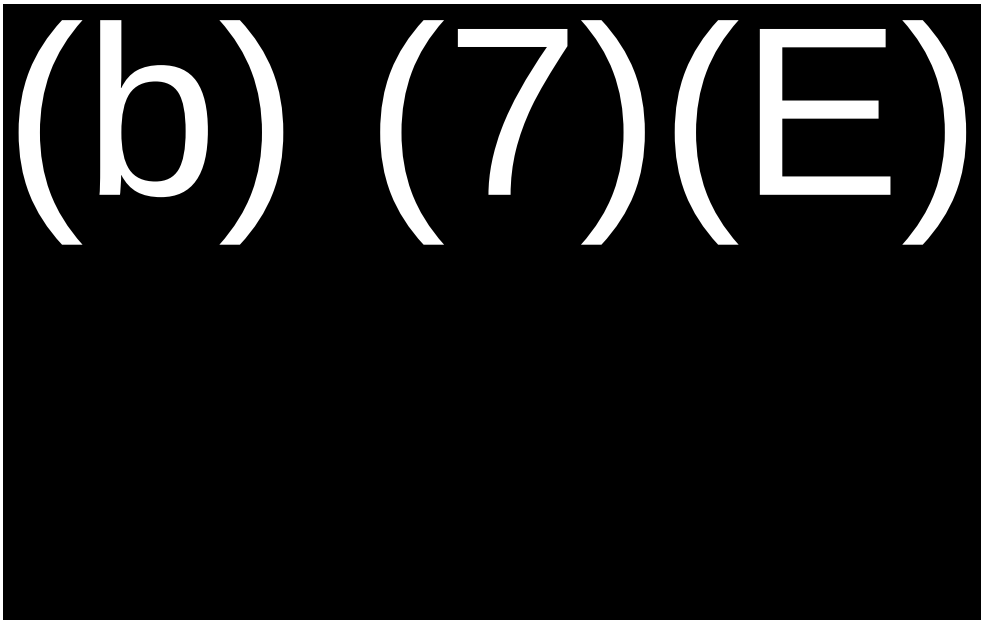


Figure 103: Breaching (b) (7)(E)

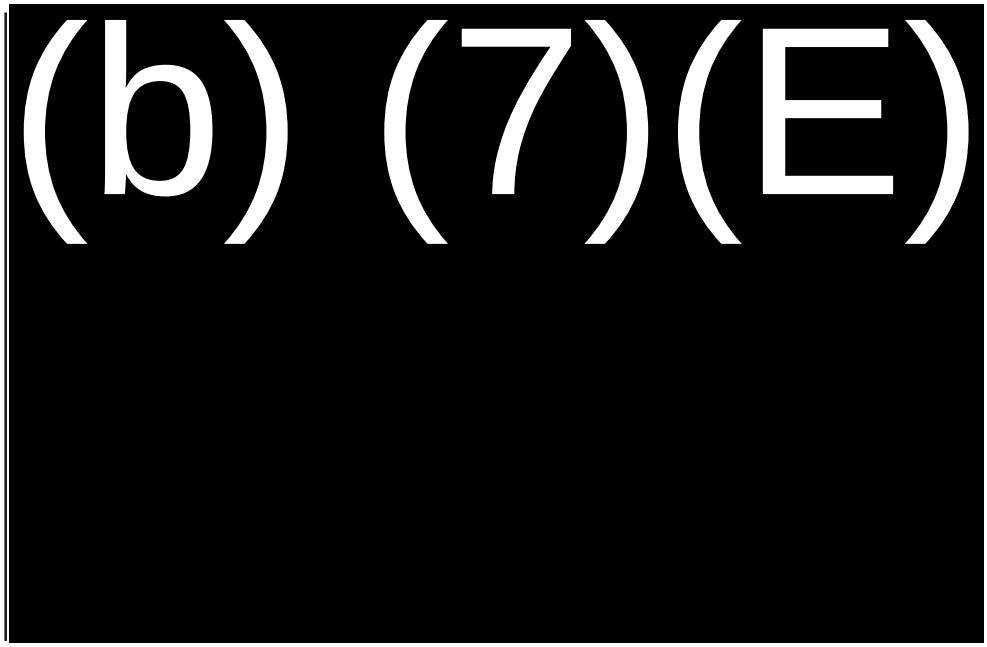


Figure 104: Breached (b) (7)(E)

3.1.4.6 Mock-up (b) (7)(E)

The (b) (7)(E) represents the (b) (7)(E) Mock-up (b) (7)(E) is shown in Figure 105 and Figure 106.

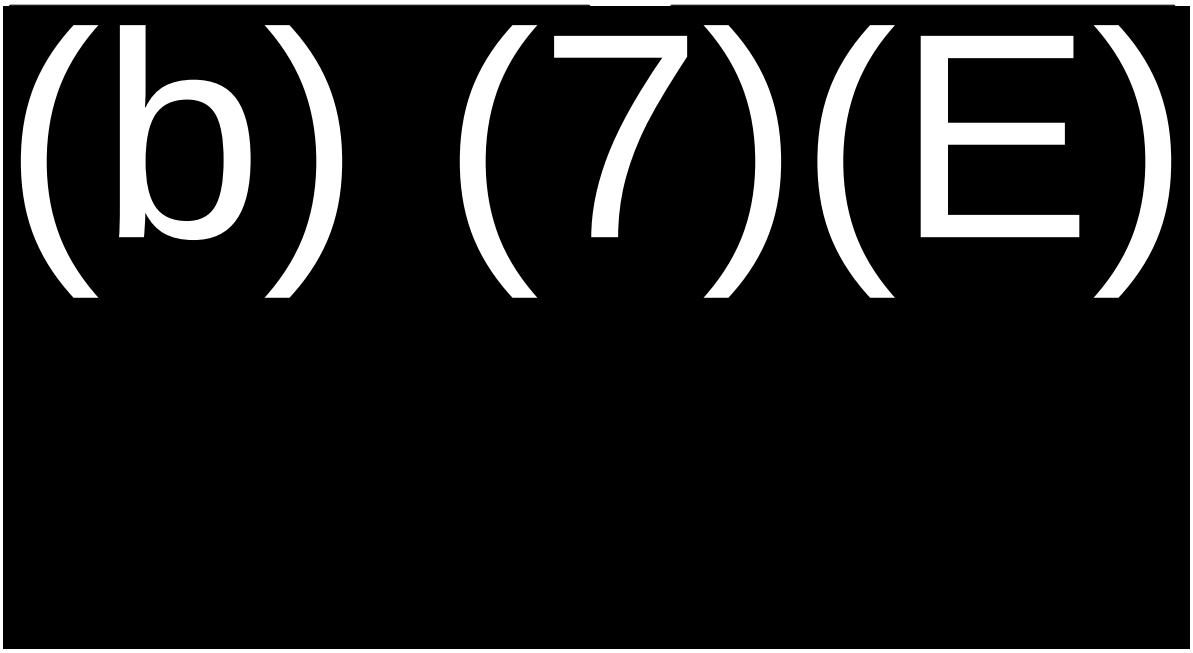


Figure 105: Mock-up (b) (7)(E)

Figure 106: Mock-up (b) (7)(E) ***Side View***

Table 12 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 12: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	The mock-up of the submitted solution deterred the creation of (b) (7)(E) breach by: (b) (7)(E)

3.1.4.6.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

Stakeholder and subject matter expert was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observations is documented in TORs 24 and 101, Appendix B.

Breaching experts observed:

- (b) (7)(E)

- (b) (7)(E)

3.1.4.6.2 Breaching Technique BT-2 ((b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-2, (b) (7)(E) . The progress of the breaching is shown in Figure 107, Figure 108, Figure 109, and Figure 110.

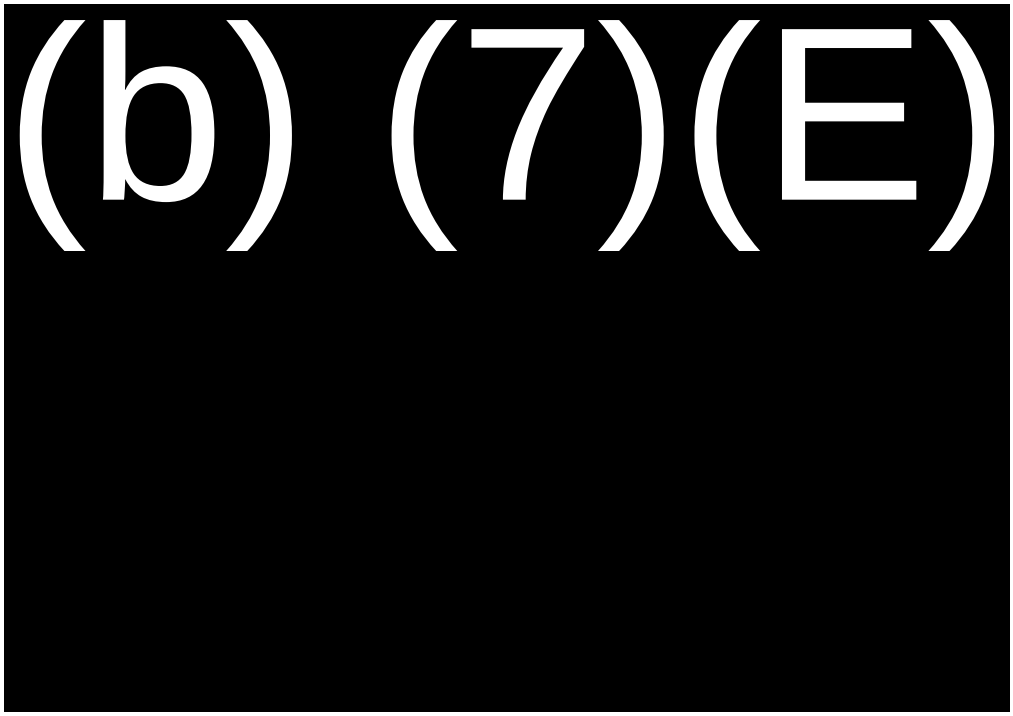


Figure 107: Breaching (b) (7)(E)

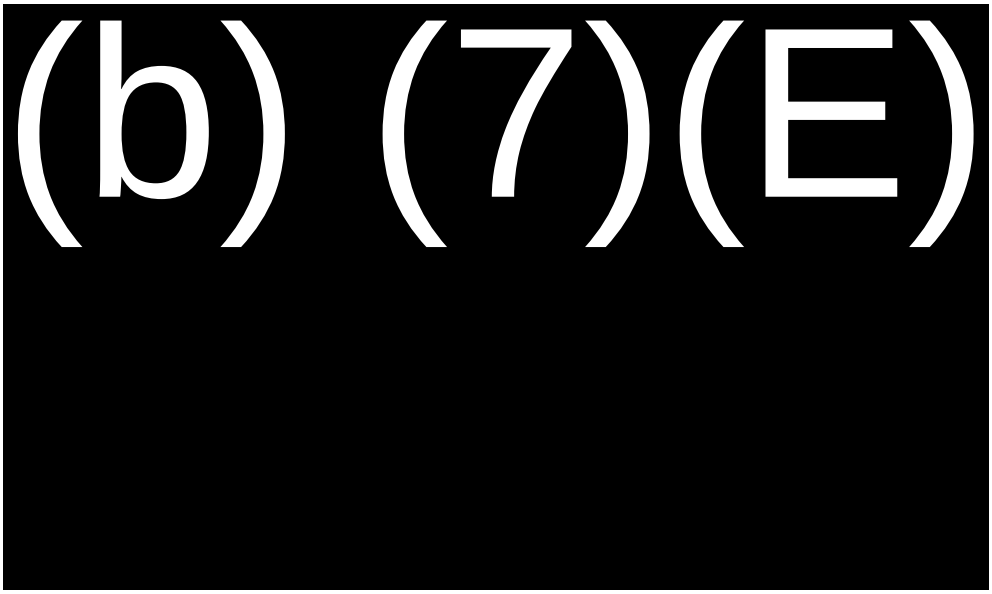


Figure 108: Breaching (b) (7)(E)

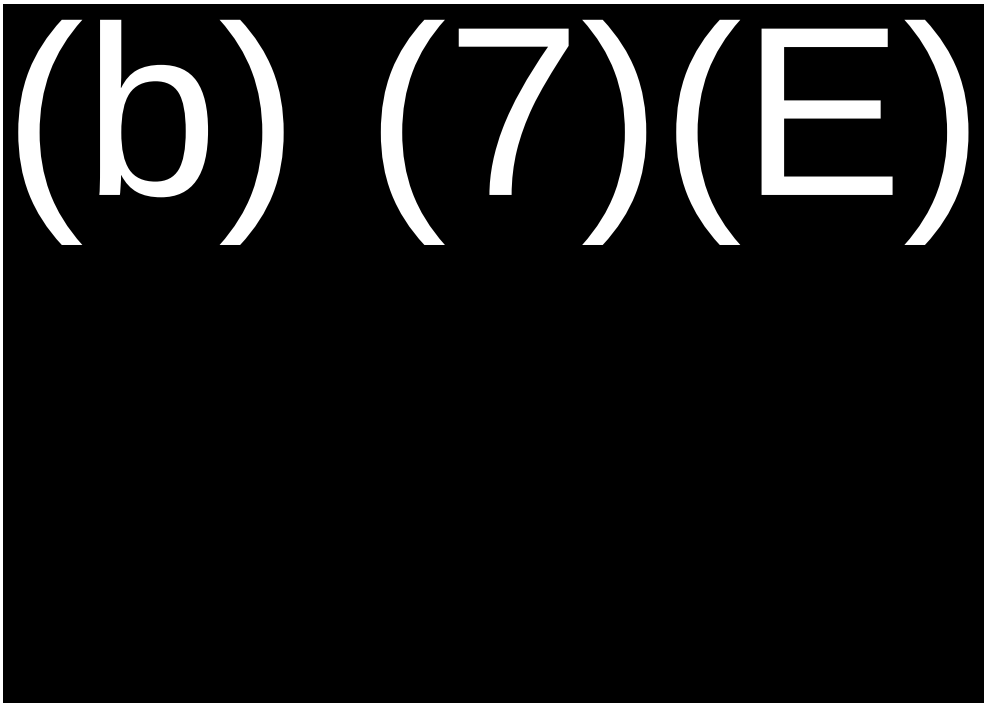


Figure 109: Breaching (b) (7)(E)

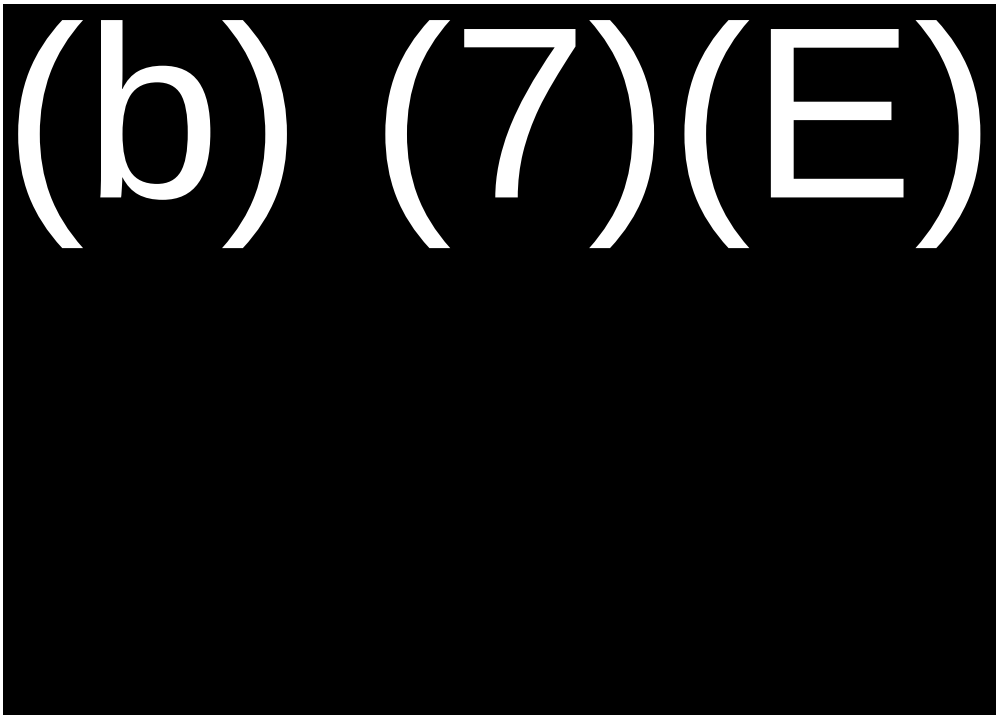


Figure 110: Breaching (b) (7)(E) Breach Measurement

3.1.4.6.3 Breaching Technique BT-3 (b) (7)(E))

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-3, (b) (7)(E) The progress of the breaching is shown in Figure 111, Figure 112, Figure 113, and Figure 114.

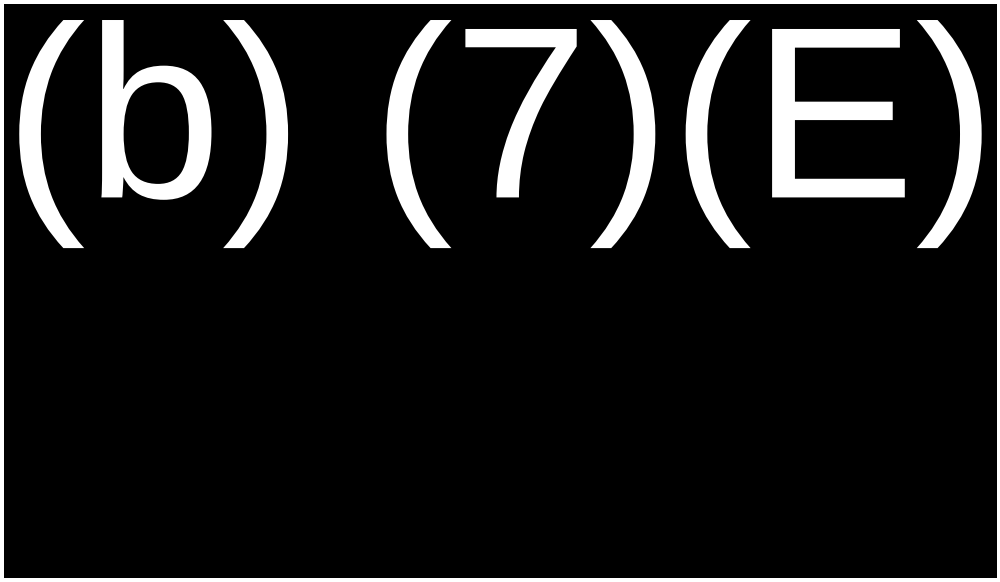


Figure 111: Breaching (b) (7)(E)

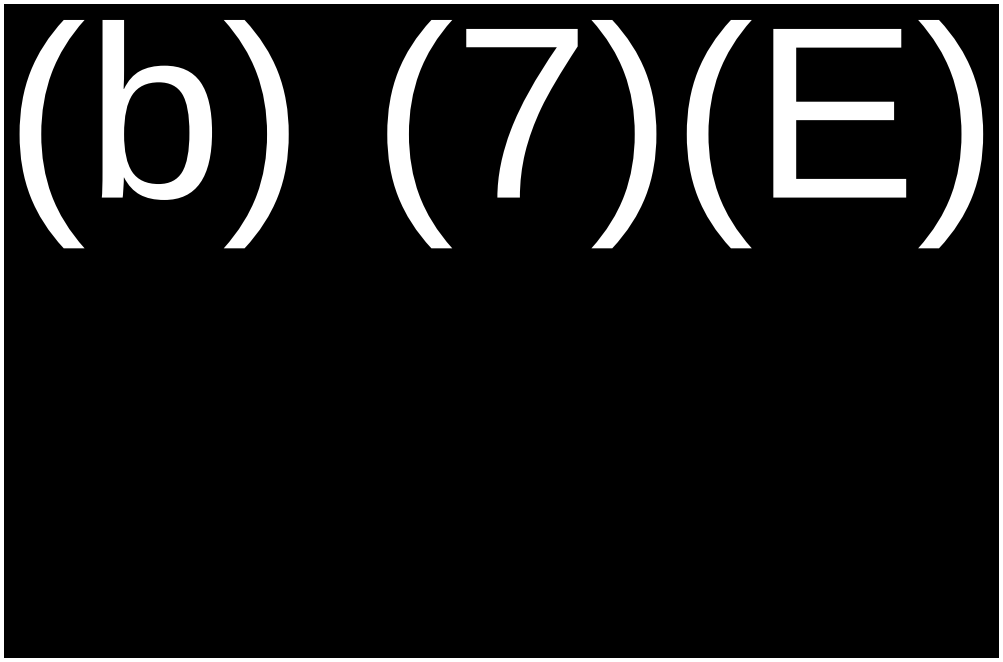


Figure 112: Breaching (b) (7)(E)

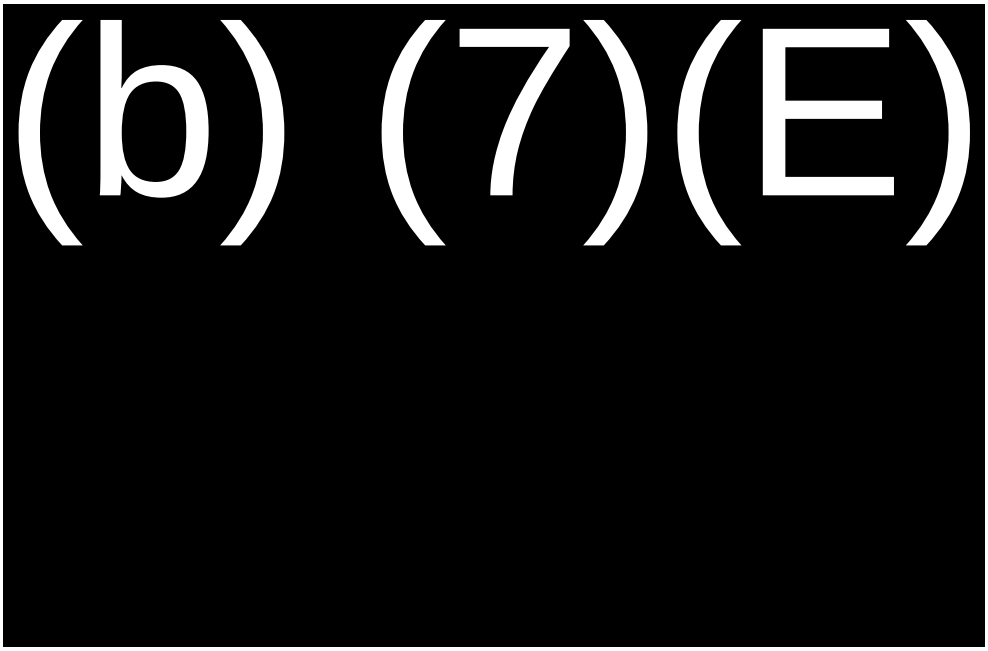


Figure 113: Breaching (b) (7)(E)

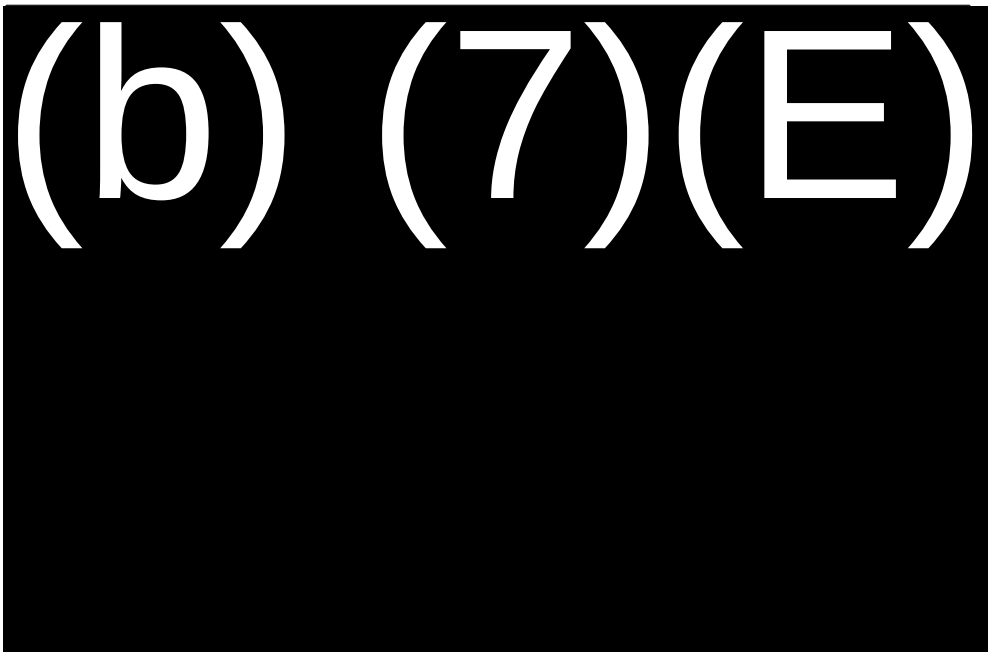


Figure 114: (b) (7)(E) ***Breach Measurement***

3.1.4.6.4 Breaching Technique BT-4 ((b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-4, the (b) (7)(E)

The progress of the breaching is shown in Figure 115, Figure 116, Figure 117, and Figure 118.

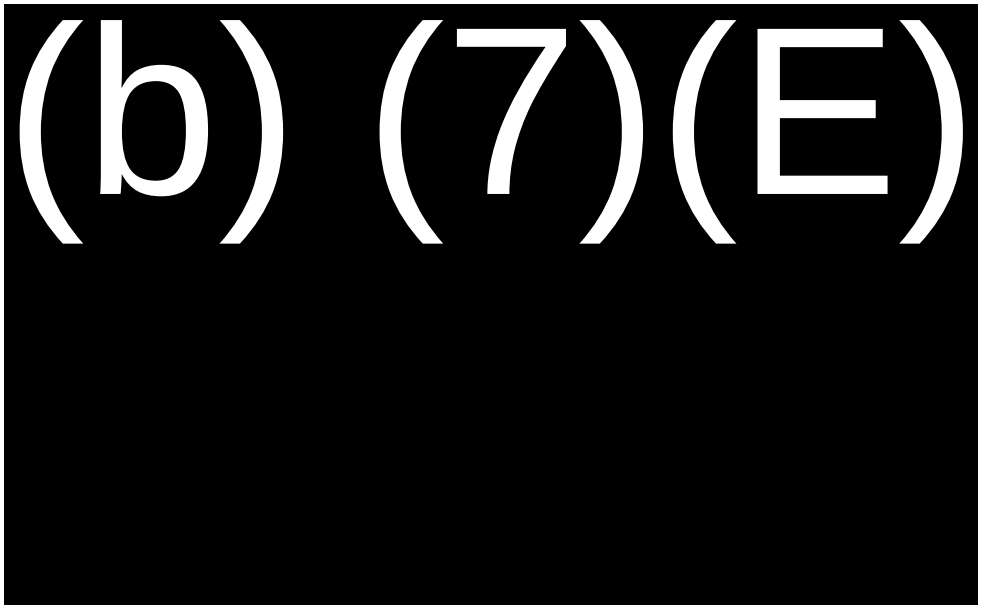


Figure 115: Breaching (b) (7)(E)

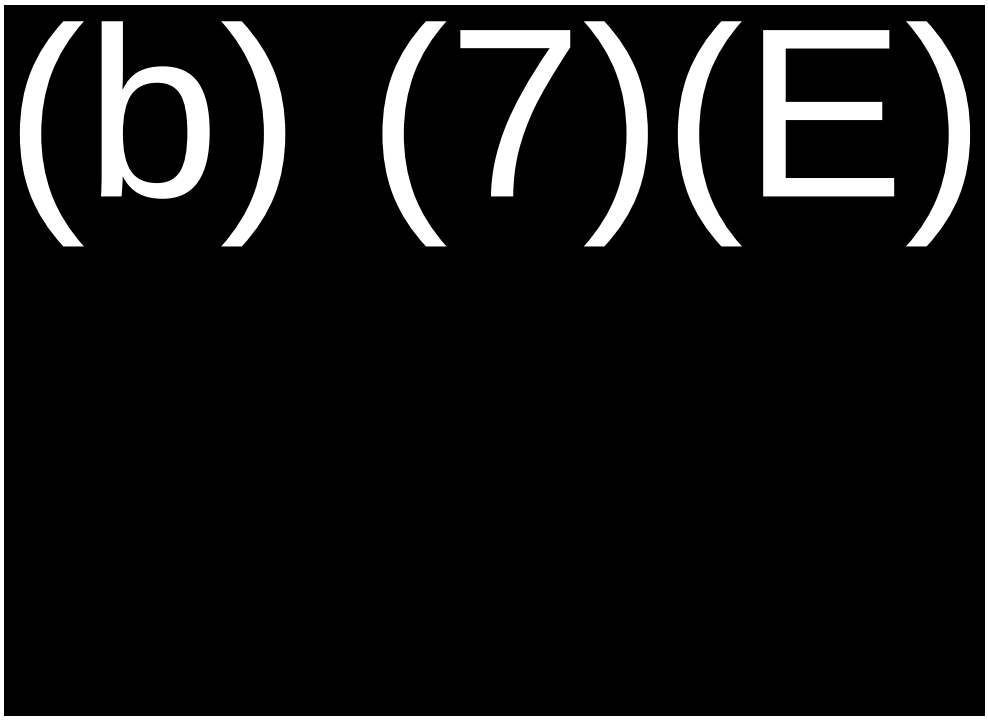


Figure 116: Breaching (b) (7)(E)

Figure 117: Breaching (b) (7)(E)

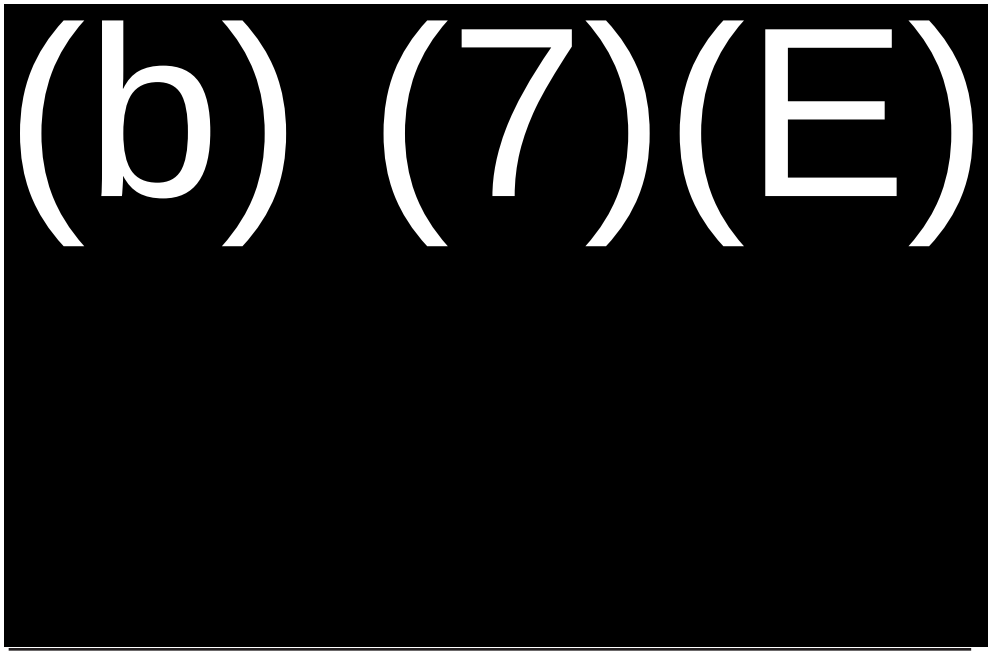


Figure 118: Breaching (b) (7)(E)

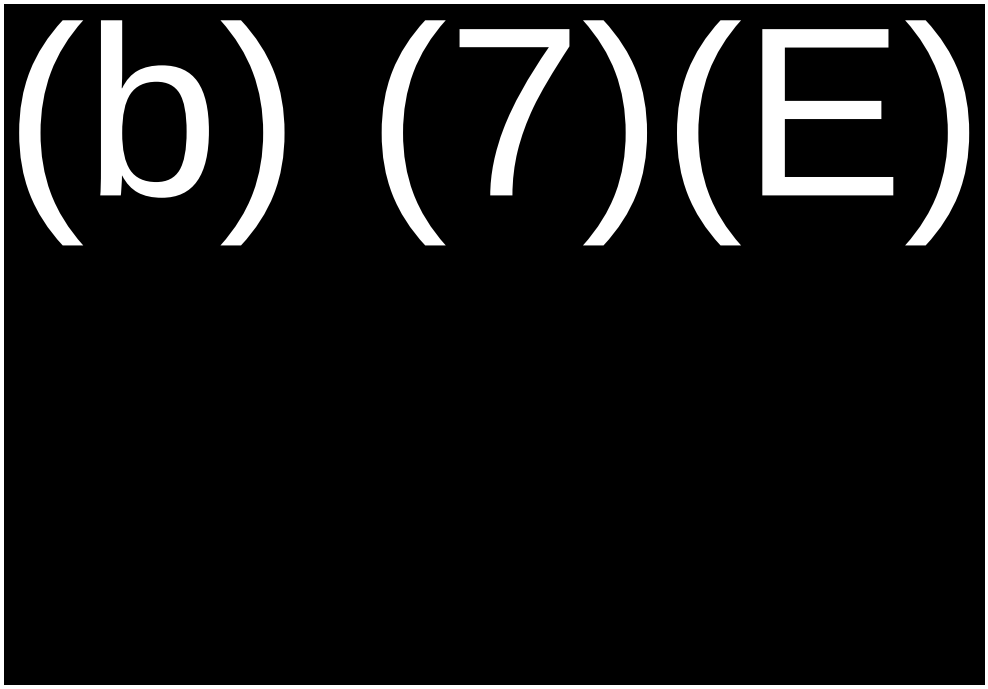


Figure 119: Breaching (b) (7)(E)

3.1.4.7 Mock-up (b) (7)(E)

The (b) (7)(E) represents the (b) (7)(E) Mock-up (b) (7)(E) is shown in Figure 120 and Figure 121.

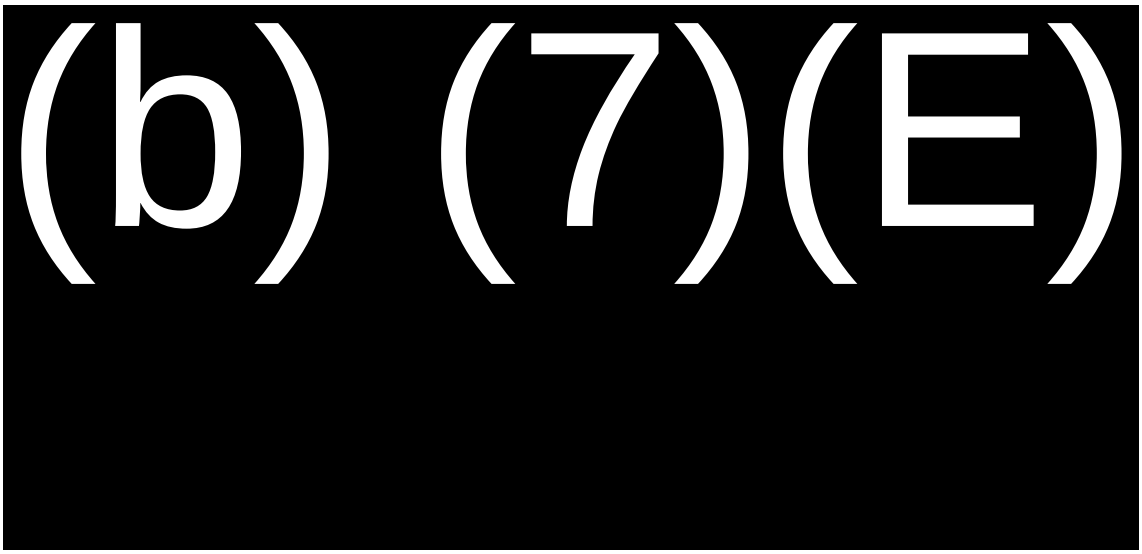


Figure 120: Mock-up (b) (7)(E)

Figure 121: Mock-up (b) (7)(E) ***Side View***

The (b) (7)(E) design, shown in Figure 122, consisted of (b) (7)(E) e, depicted in Figure 123 (b) (7)(E) depicted in Figure 124, (b) (7)(E) as depicted in Figure 124, (b) (7)(E) .

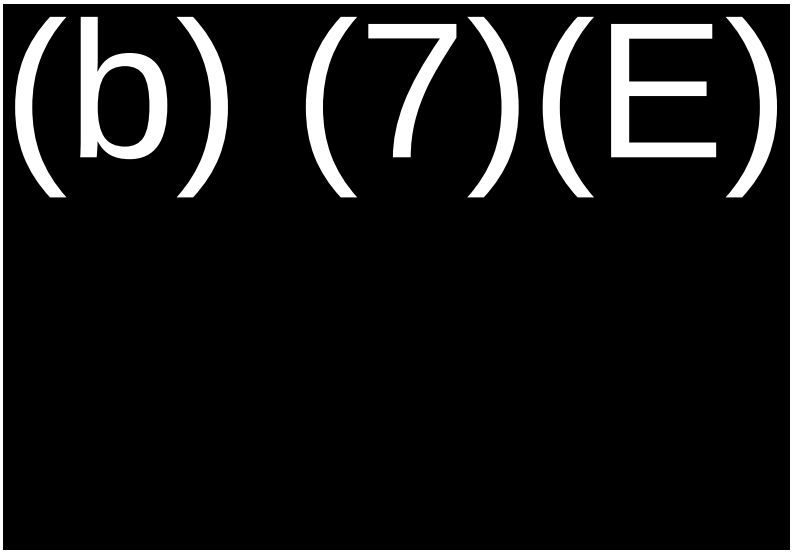


Figure 122: (b) (7)(E) ***Top-Down View***

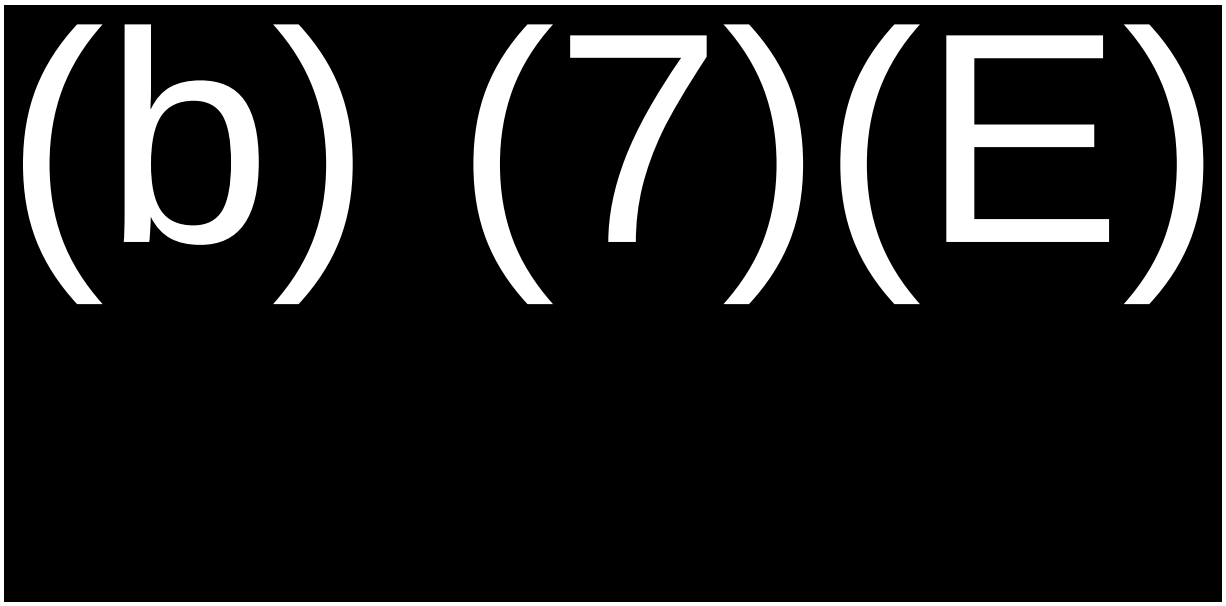


Figure 123: (b) (7)(E) ***Cut Away Isometric View*** ***Figure*** (b) (7)(E) ***Isometric View***

Table 13 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 13: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	The mock-up of the submitted solution deterred the creation of a (b) (7)(E) breach by: (b) (7)(E)

3.1.4.7.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

Stakeholder and subject matter expert was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observation is documented in TOR 15, Appendix B.

Breaching experts observed:

- (b) (7)(E)

3.1.4.7.2 Breaching Technique BT-5 (b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-5, the (b) (7)(E) The progress of the breaching is shown in Figure 125, Figure 126, and Figure 127.

(b) (7)(E)

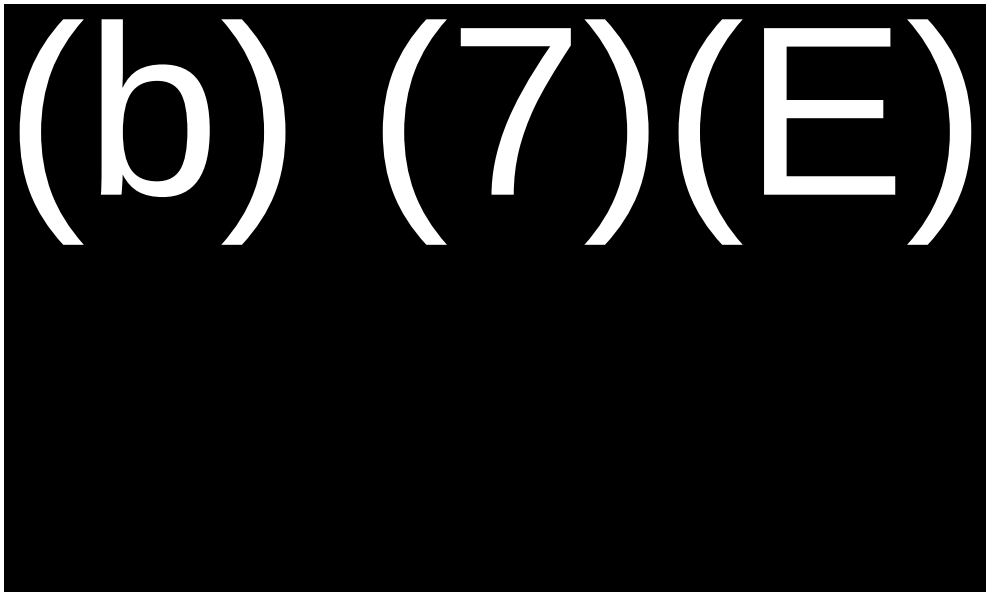


Figure 125: Breaching (b) (7)(E)

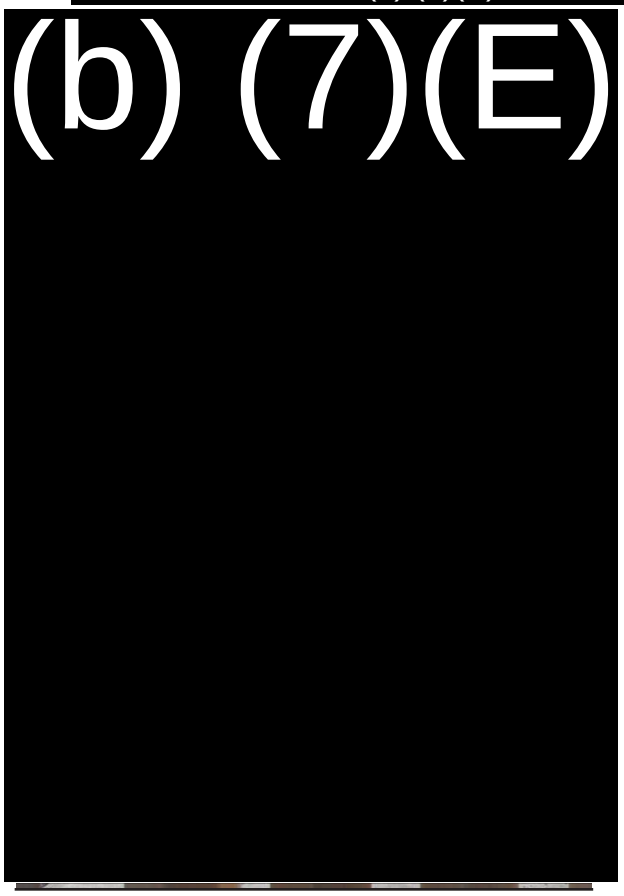


Figure 126: Breached (b) (7)(E)

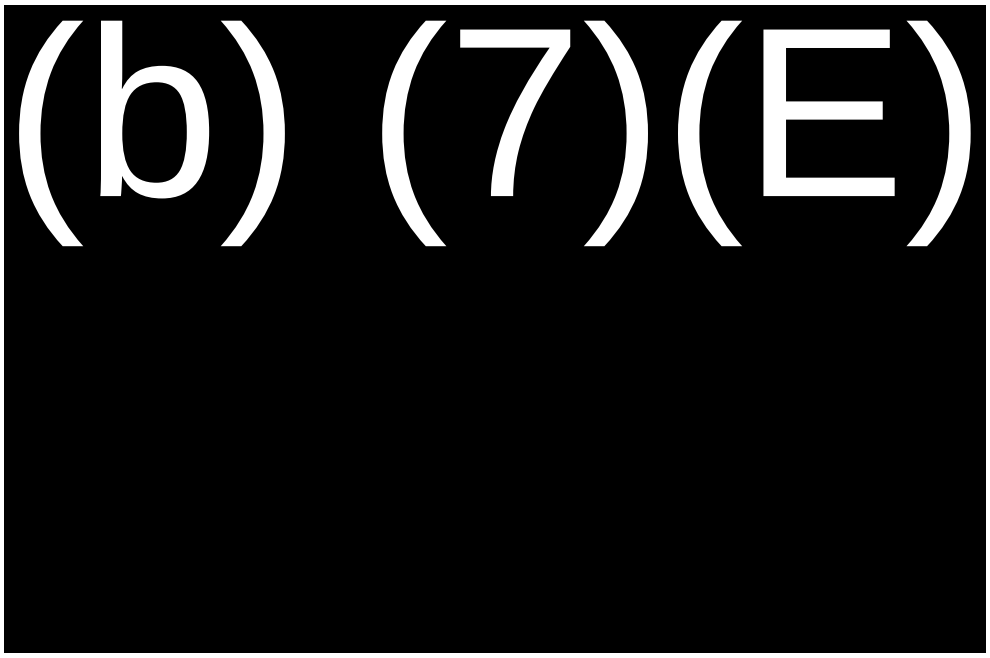


Figure 127: (b) (7)(E) ***Breach Measurement***

3.1.4.7.3 Breaching Technique BT-6 (b) (7)(E)

The(b) (7)(E) deterred the creation of(b) (7)(E) breach by breaching technique BT-6,(b) (7)(E) The breach is shown in Figure 128 and Figure 129.

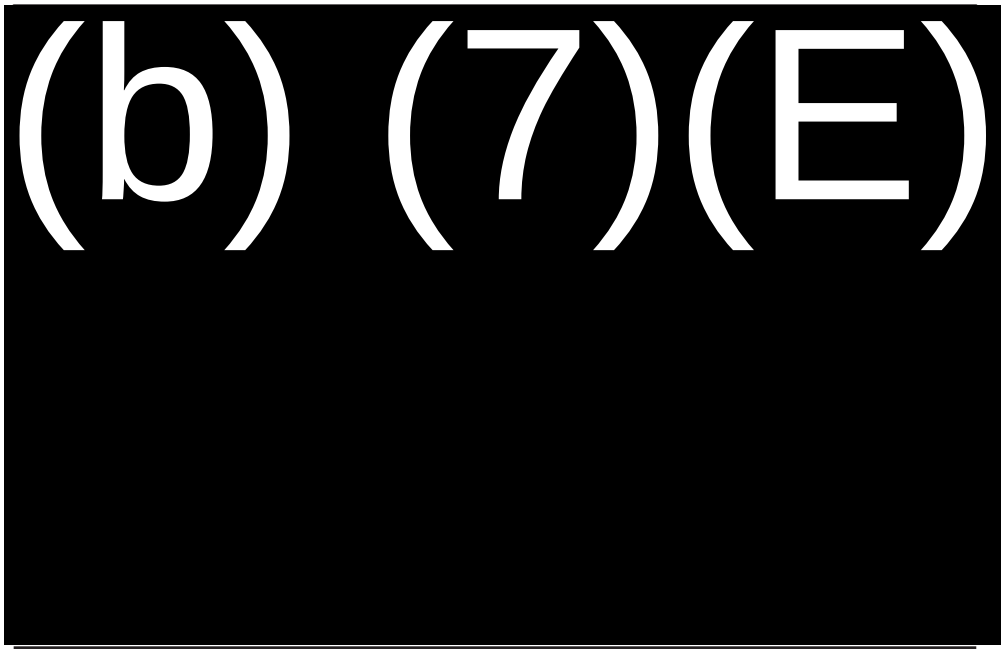


Figure 128: Breaching (b) (7)(E)

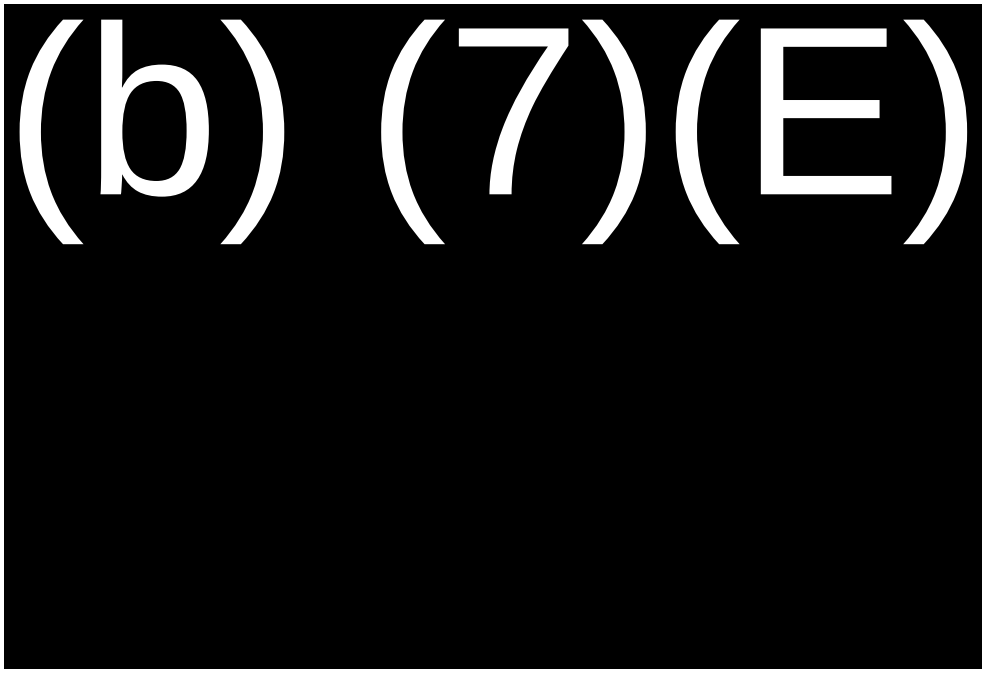


Figure 129: Breaching (b) (7)(E) Breach Measurement

3.1.4.7.4 Breaching Technique BT-7 (b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-7, (b) (7)(E) The progress of the breaching is shown in Figure 130, Figure 131, Figure 132, and Figure 133.

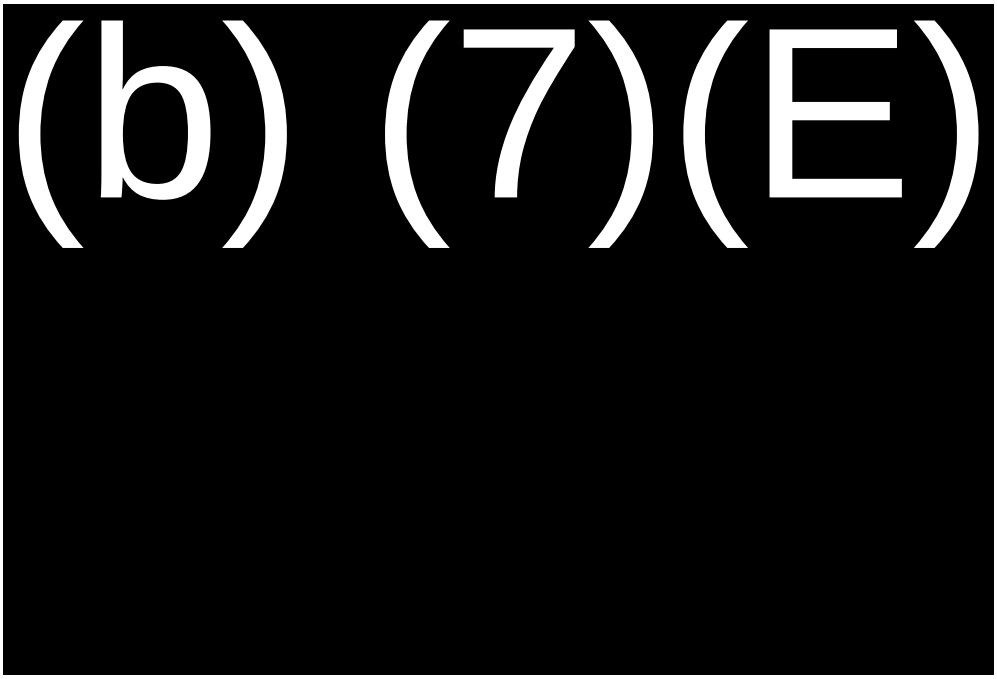


Figure 130: Breaching (b) (7)(E)

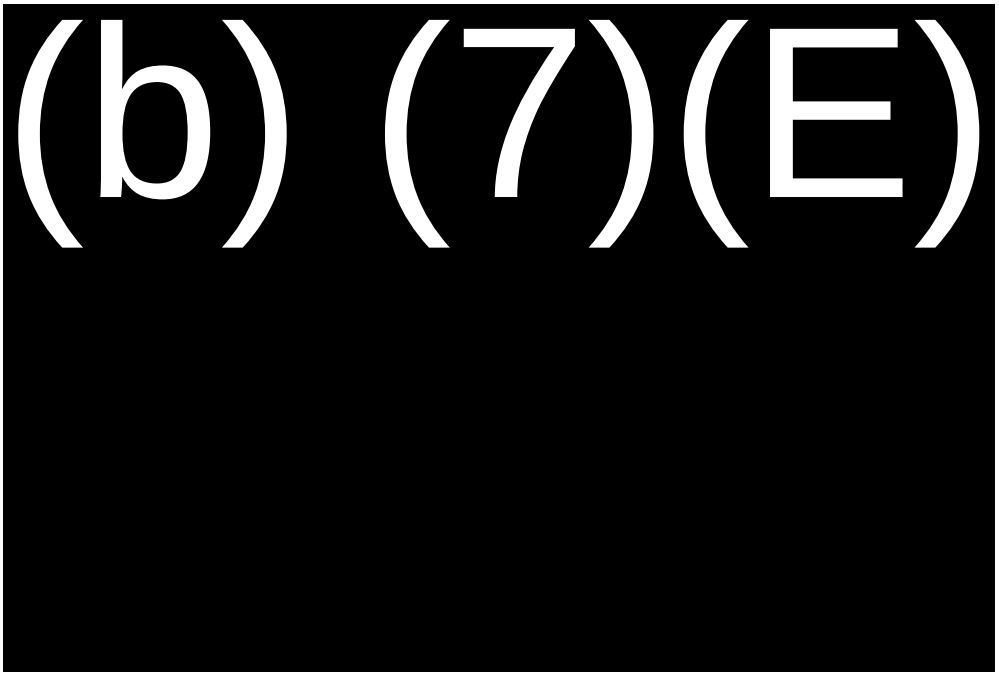


Figure 131: Breaching (b) (7)(E)

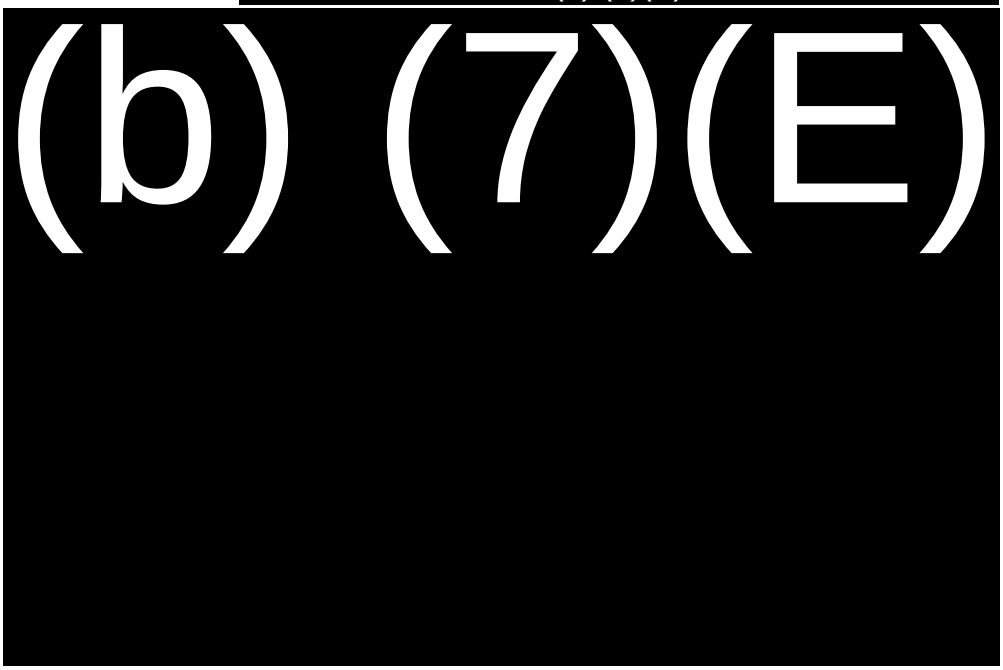


Figure 132: Breaching (b) (7)(E)

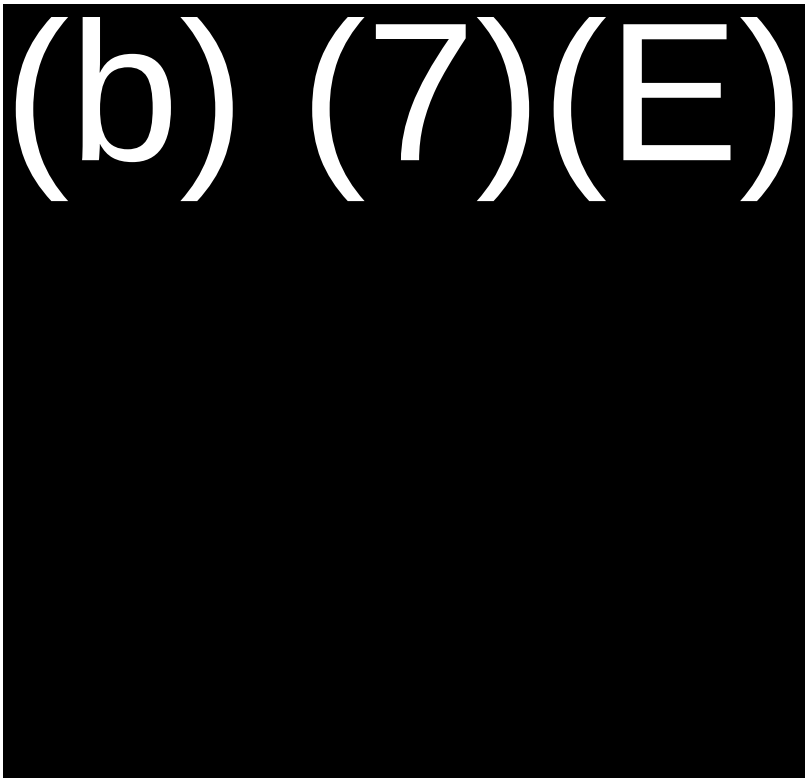
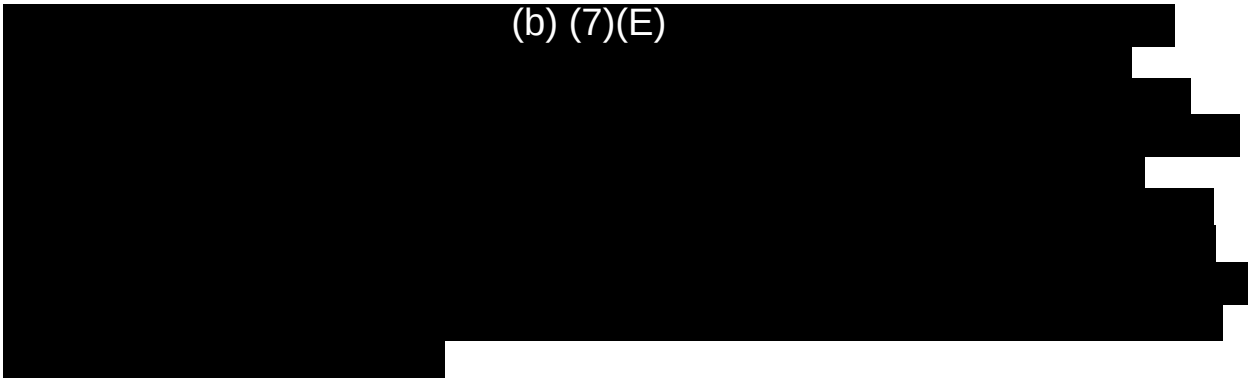


Figure 133: Breaching (b) (7)(E) Breach Measurement

3.1.4.7.5 Breaching Technique BT-8 (b) (7)(E)

The (b) (7)(E) deterred the creation of (b) (7)(E) breach by breaching technique BT-8, (b) (7)(E) The progress of the breaching is shown in Figure 134, Figure 135, and Figure 136.



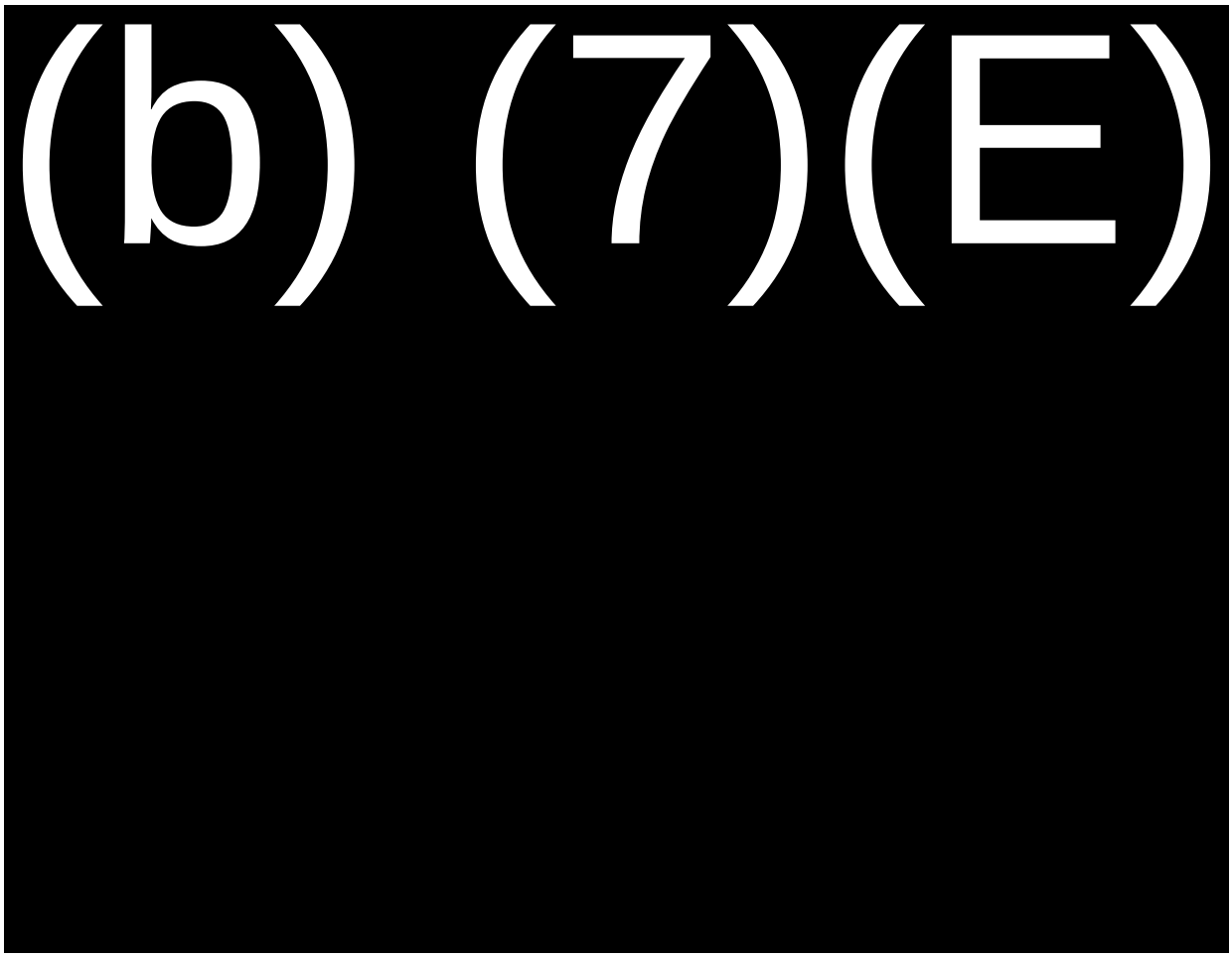


Figure 134:Breached (b) (7)(E)

Figure 135: Breached (b) (7)(E)

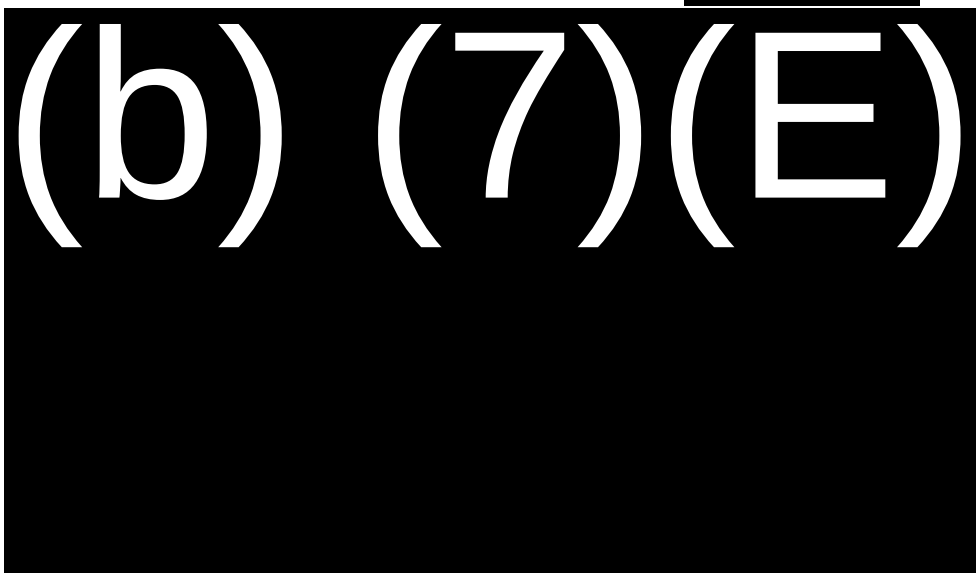


Figure 136: Breaching (b) (7)(E) ***Breach Measurement***

3.1.4.8 Mock-up (b) (7)(E)

The (b) (7)(E) represents the (b) (7)(E) Mock-up (b) (7)(E) shown in Figure 137 and Figure 138.

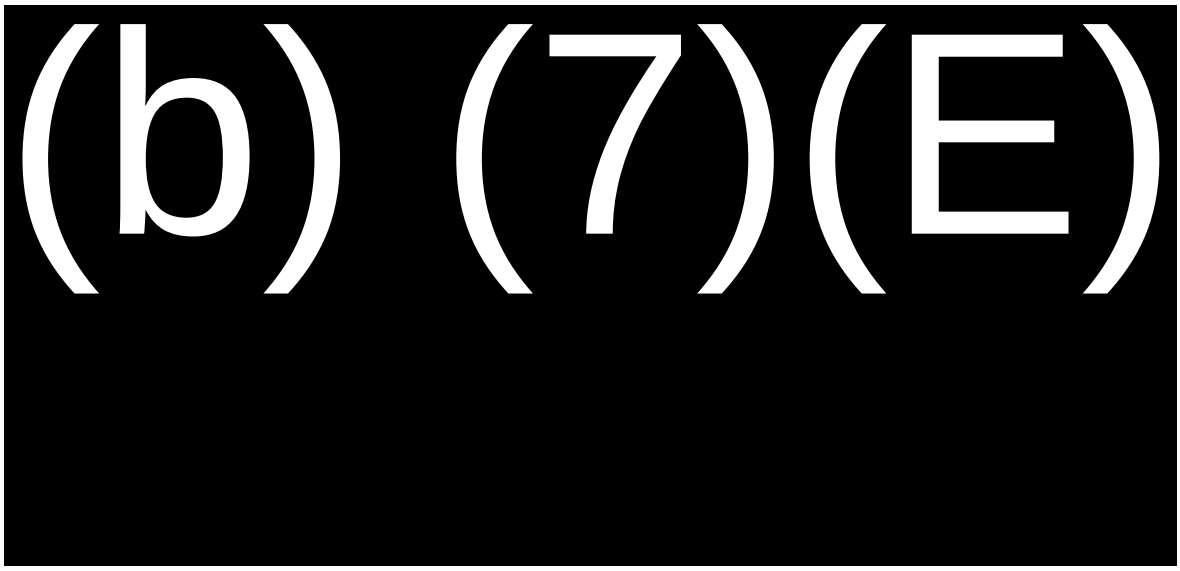


Figure 137: Mock-up (b) (7)(E)

Figure 138: Mock-up (b) (7)(E) ***Side View***

Table 14 lists the Breaching Test Case performance characterization statement for the submitted solution (b) (7)(E)

Table 14: (b) (7)(E) ***Breaching Review Performance Characterization Statement***

Requirement	Performance Characterization Statement
(b) (7)(E)	(b) (7)(E)

The (b) (7)(E) was unique from the other mock-ups in that the (b) (7)(E) . Of the (b) (7)(E) that made up the (b) (7)(E) there were (b) (7)(E)

1. (b) (7)(E)
2. (b) (7)(E)
3. (b) (7)(E)

4. (b) (7)(E)

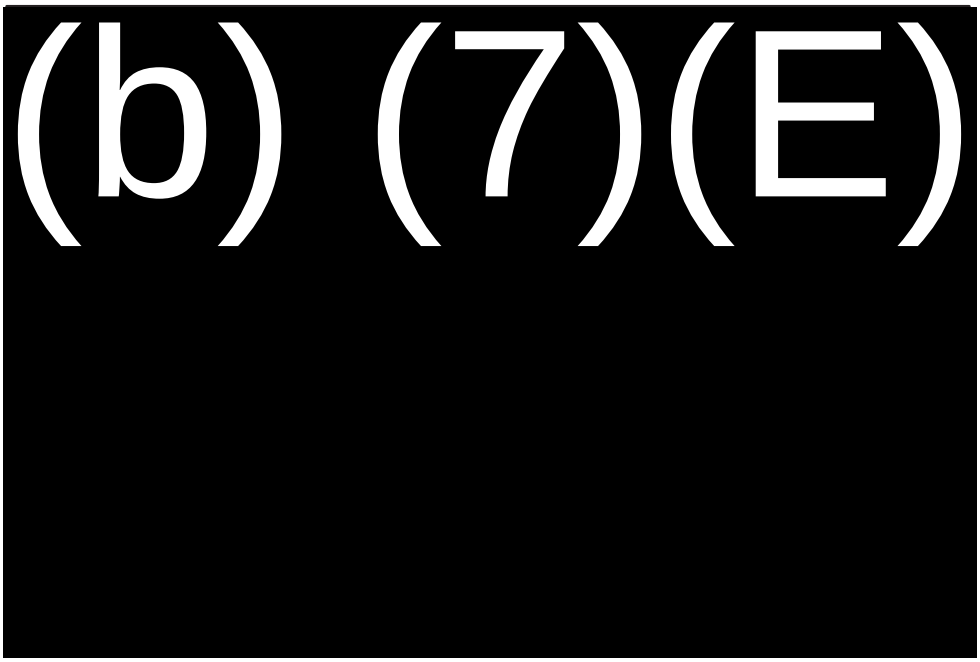


Figure 139: (b) (7)(E)

(b) (7)(E)

.

(b) (7)(E)

. The (b) (7)(E) were breached (b) (7)(E) However, without additional data, (b) (7)(E)

3.1.4.8.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

Stakeholder and subject matter expert feedback was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite breaching experts during the breaching. Full text of the observations is documented in TORs 3, 20, 23, 103, and 104, Appendix B.

Breaching experts observed:

- (b) (7)(E)

- (b) (7)(E)
- The breaching experts suggested that (b) (7)(E)
- (b) (7)(E)

3.1.4.8.2 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) he breach is shown in Figure 140.

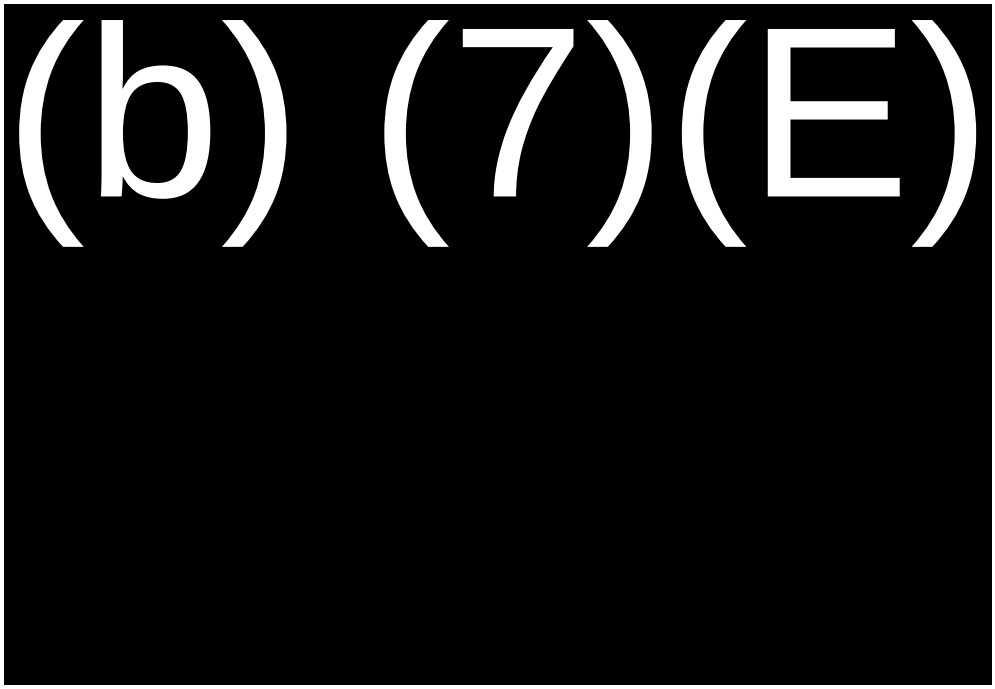


Figure 140: Breached (b) (7)(E)

3.1.4.8.3 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) The progress of the breaching is shown in Figure 141, Figure 142, Figure 143, and Figure 144.

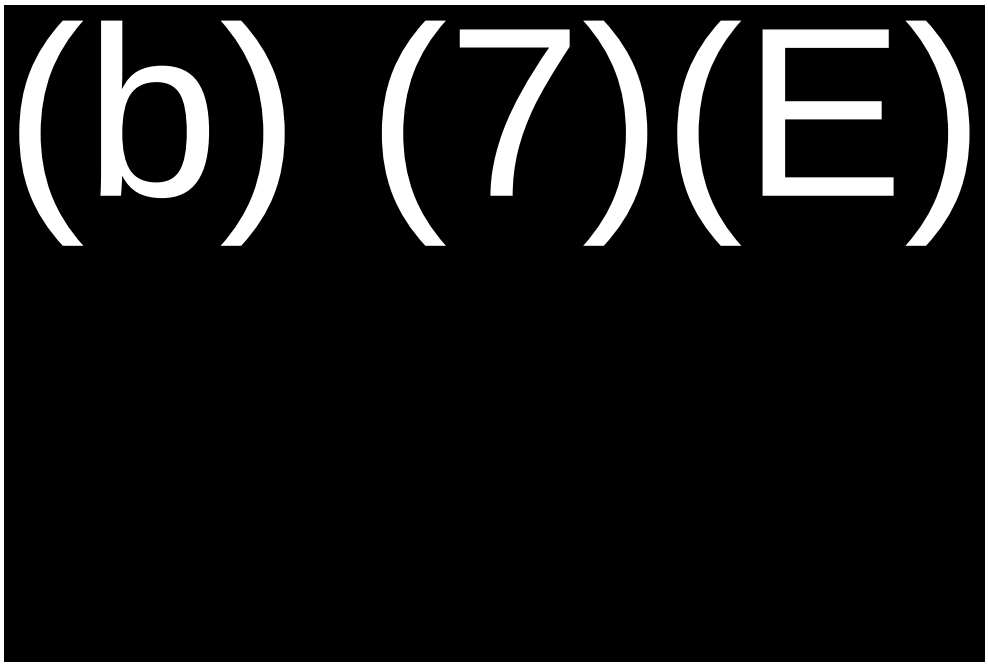


Figure 141: Breaching (b) (7)(E)

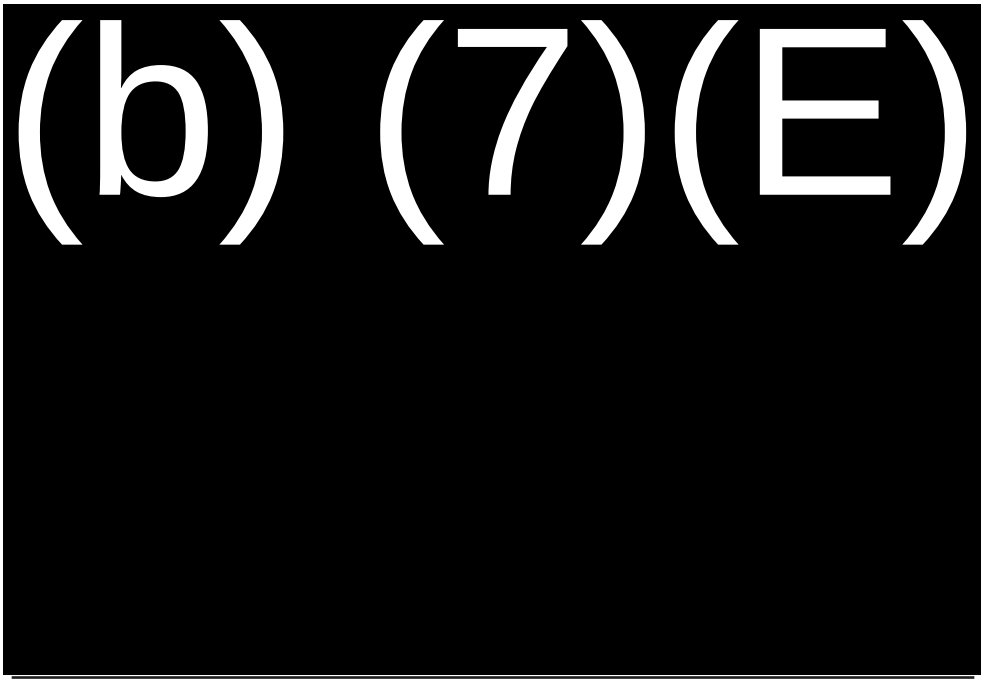


Figure 142: Breaching (b) (7)(E)

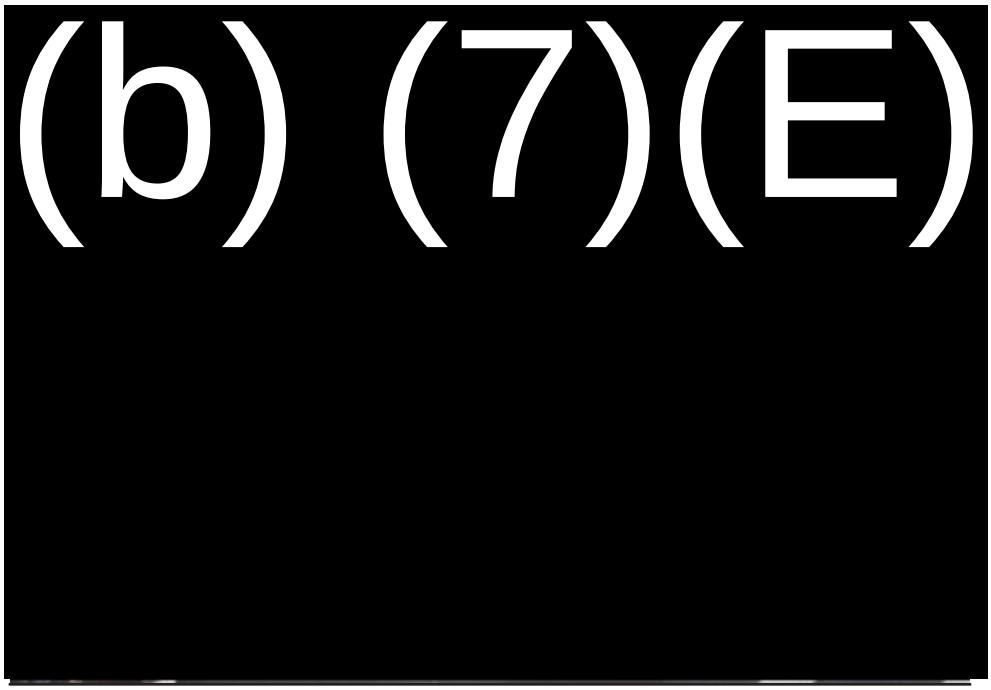


Figure 143: Breached (b) (7)(E)

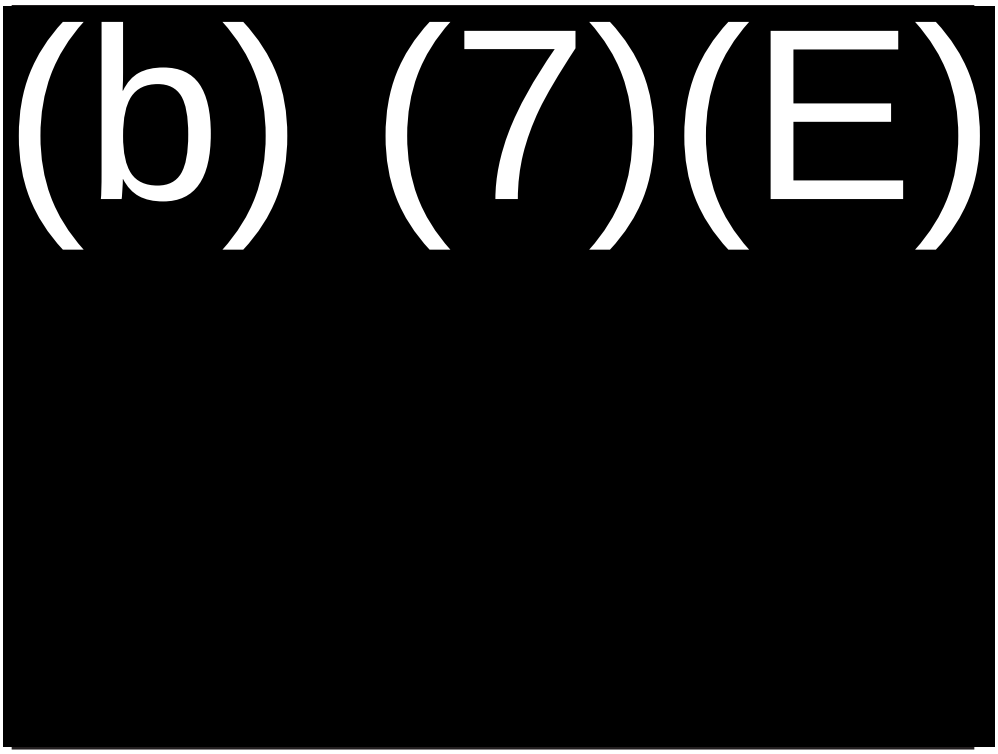


Figure 144: Breached (b) (7)(E) ***Breach Measurement***

3.1.4.8.4 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) he breach is shown in Figure 145.

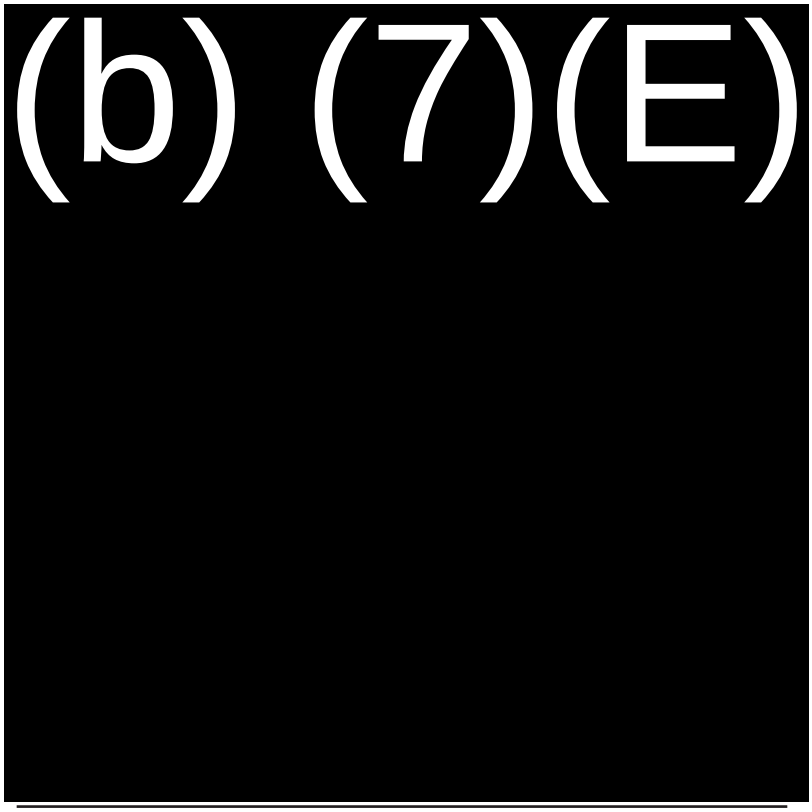


Figure 145: Breaching (b) (7)(E)

3.1.4.8.5 Breaching Technique (b) (7)(E)

The (b) (7)(E) wit (b) (7)(E) . The progress of the breaching is shown in Figure 146 and Figure 147.

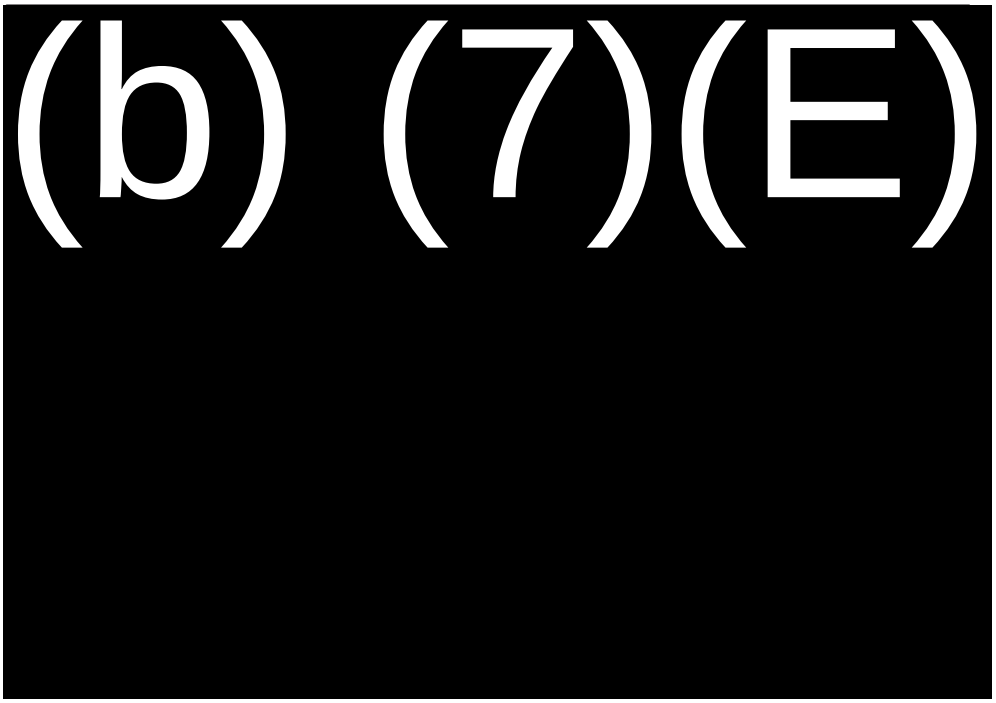


Figure 146: Breaching (b) (7)(E)

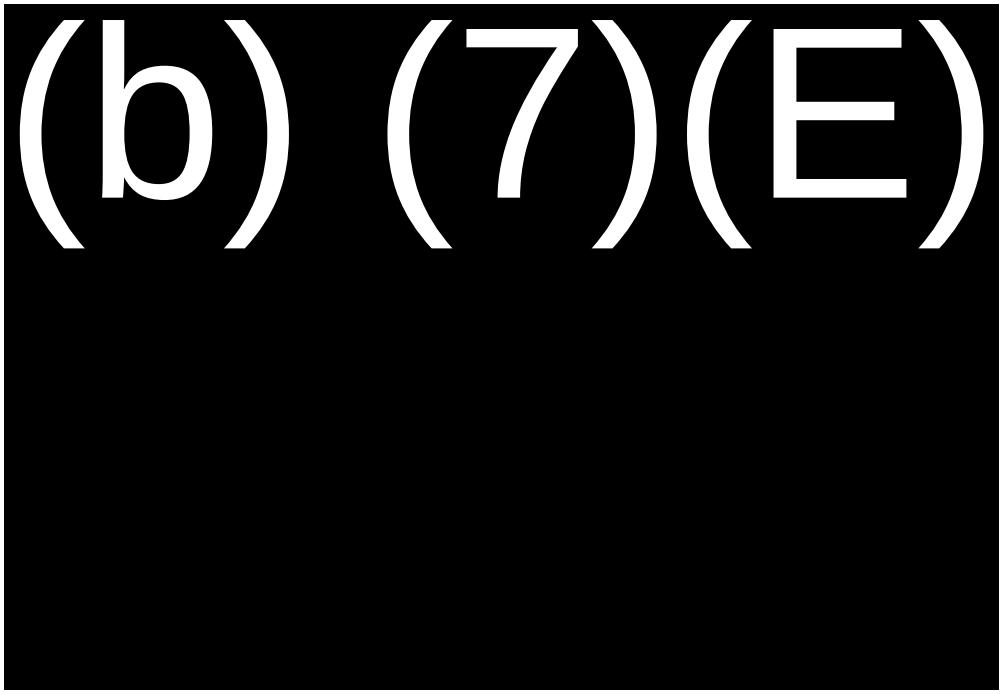


Figure 147: Breached (b) (7)(E)

3.1.4.8.6 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) The breach is shown in Figure 148.

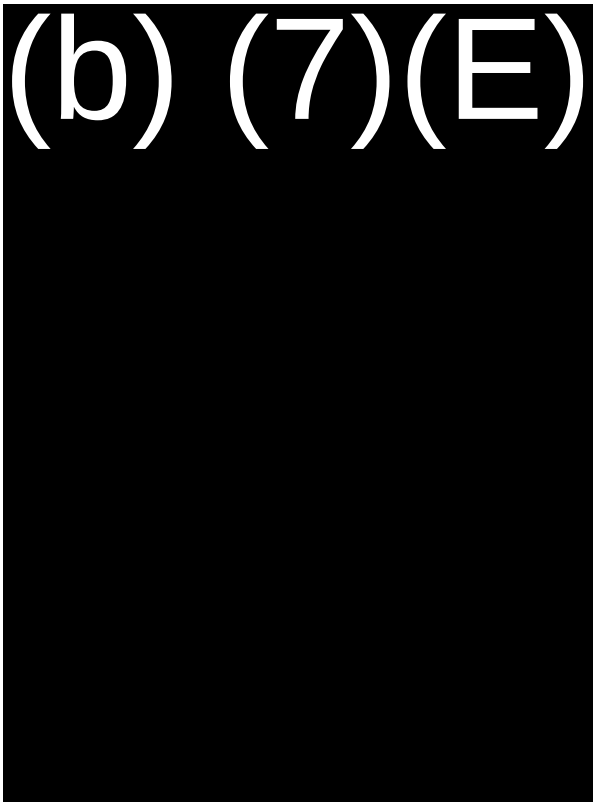


Figure 148: Breached (b) (7)(E)

3.1.4.8.7 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) The progress of the breaching is shown in Figure 149, Figure 150, and Figure 151.

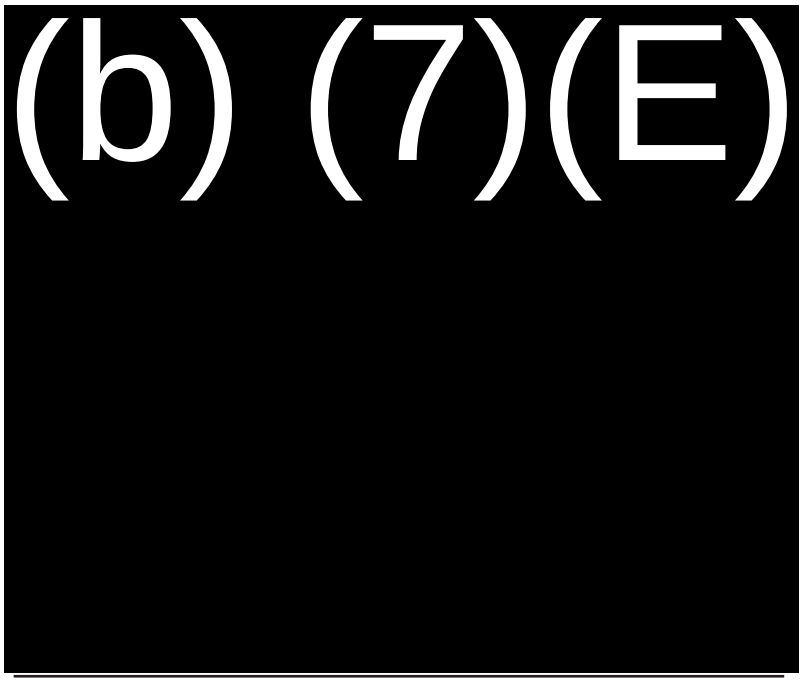


Figure 149: Breaching (b) (7)(E)

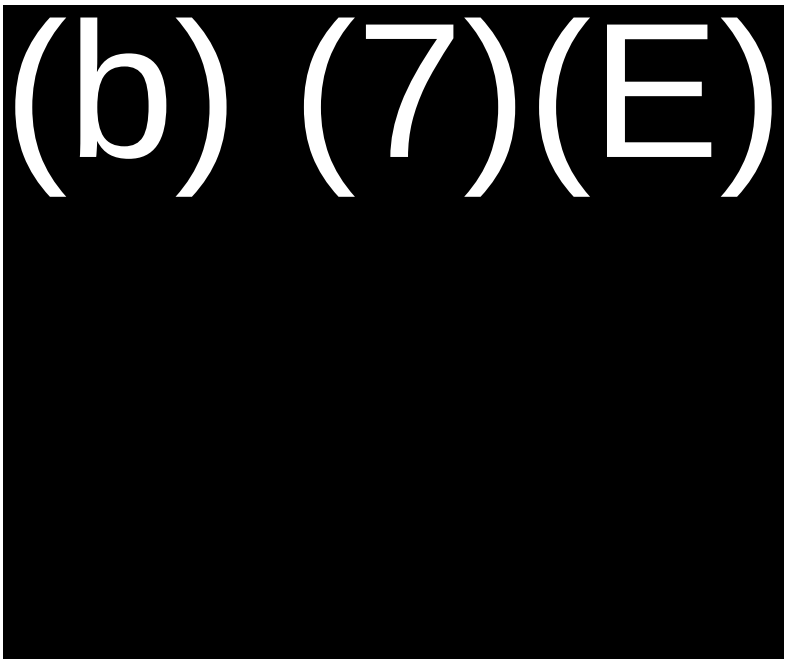


Figure 150: Breaching (b) (7)(E)

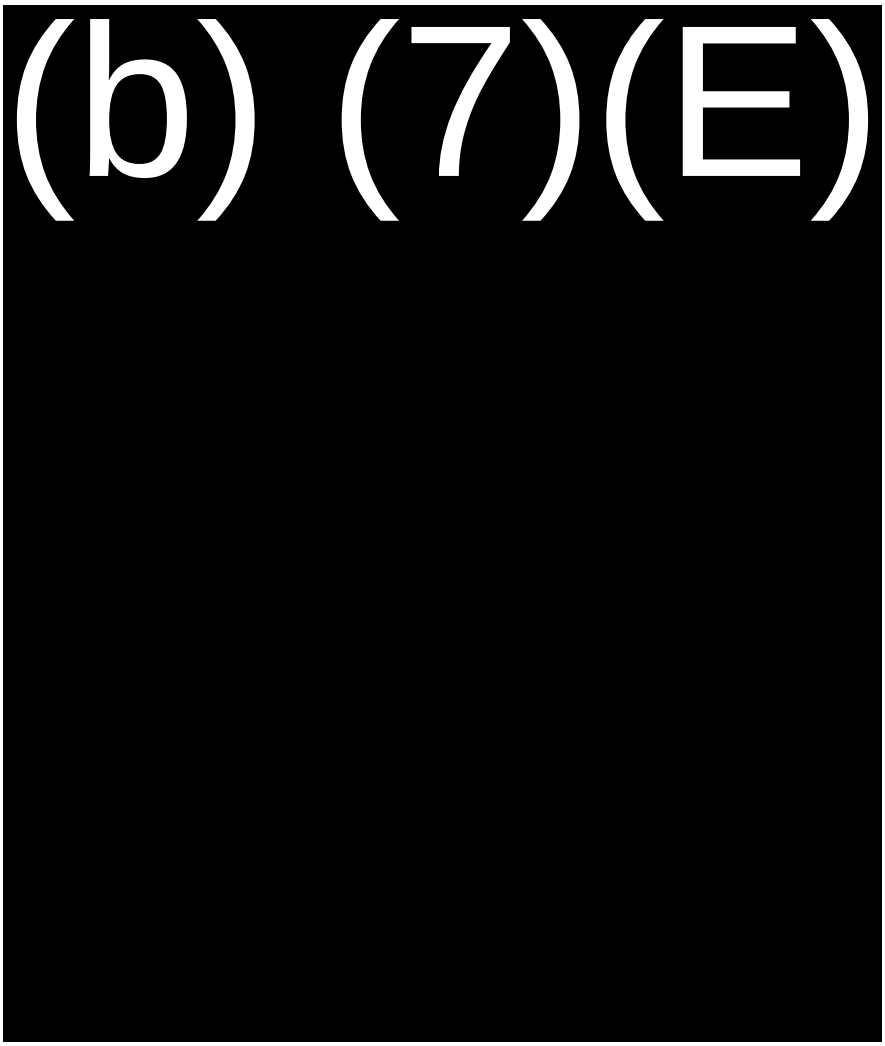


Figure 151: Breaching (b) (7)(E) ***Breach Measurement***

3.1.4.8.8 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) . The progress of the breaching is shown in Figure 152 and Figure 153.

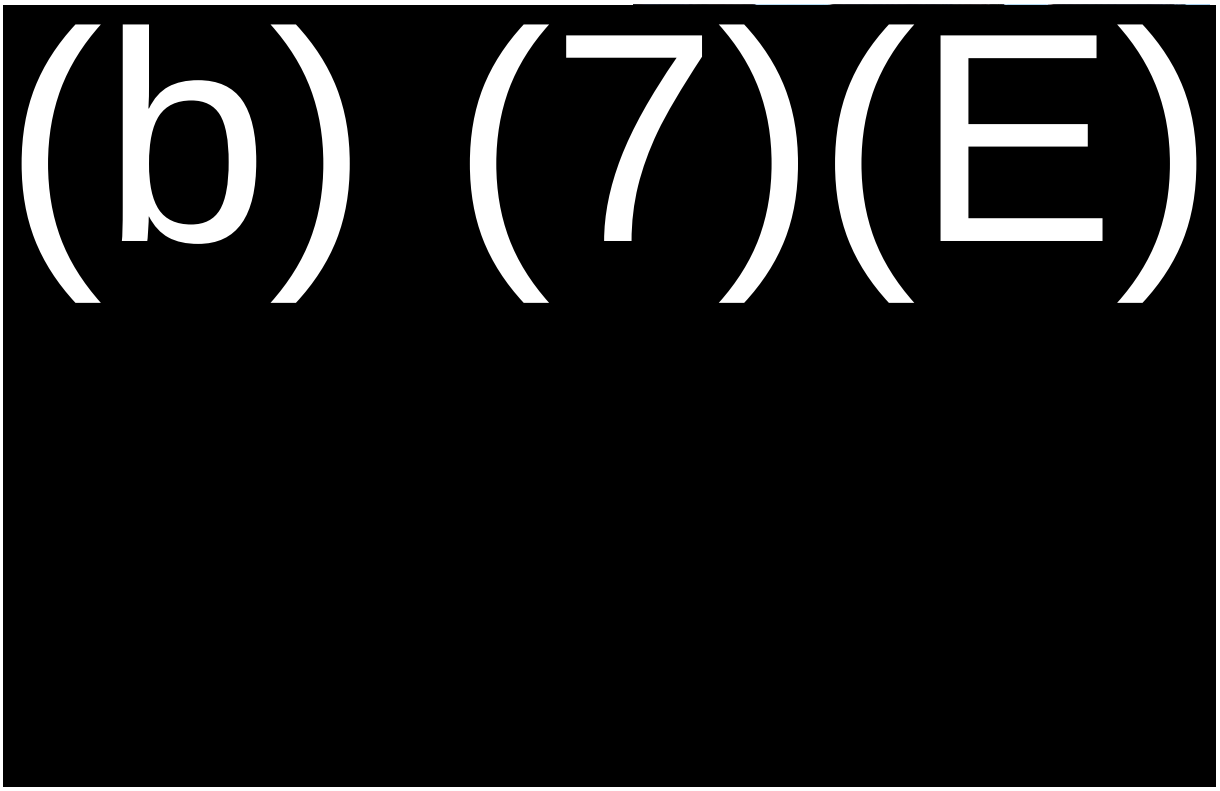


Figure 152: Breaching (b) (7)(E)

Figure 153: Breached (b) (7)(E)

3.1.4.8.9 Breaching Technique (b) (7)(E)

The (b) (7)(E) with (b) (7)(E) . The progress of the breaching is shown in Figure 154, Figure 155, and Figure 156.

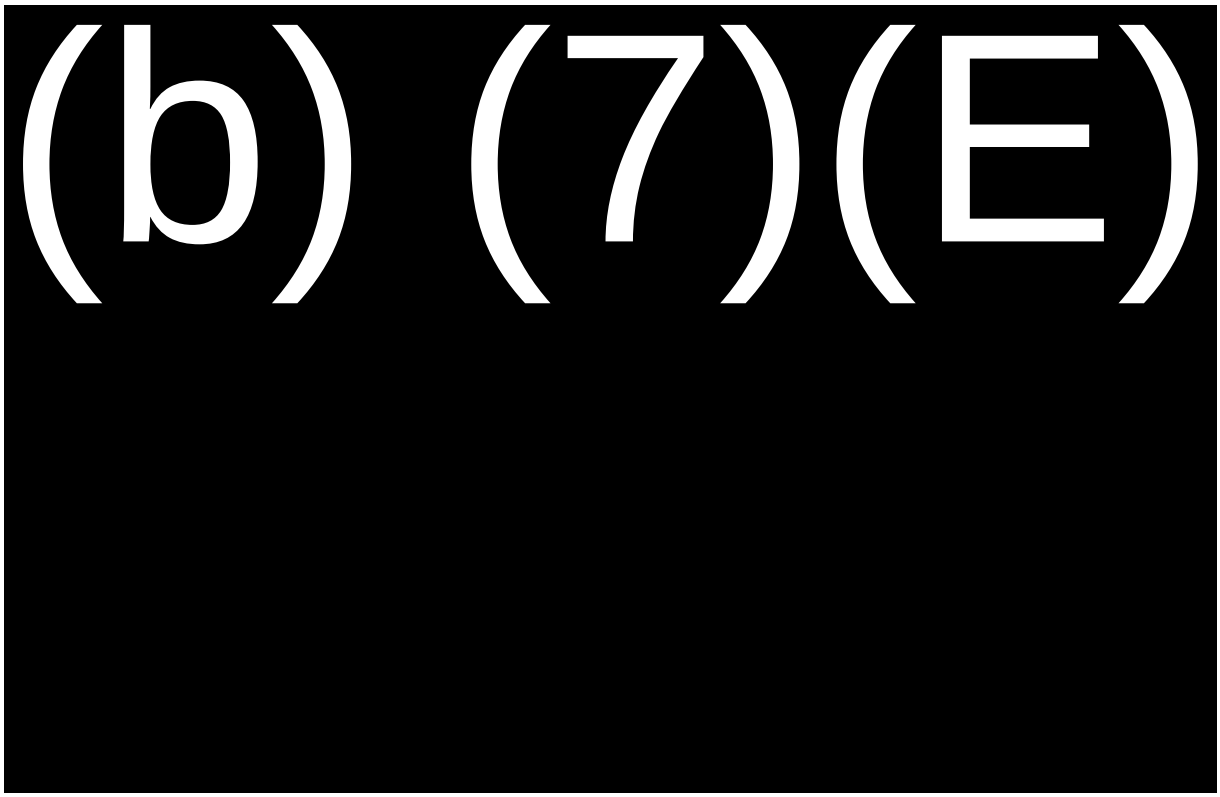


Figure 154: Breaching (b) (7)(E)

Figure 155: Breached (b) (7)(E)

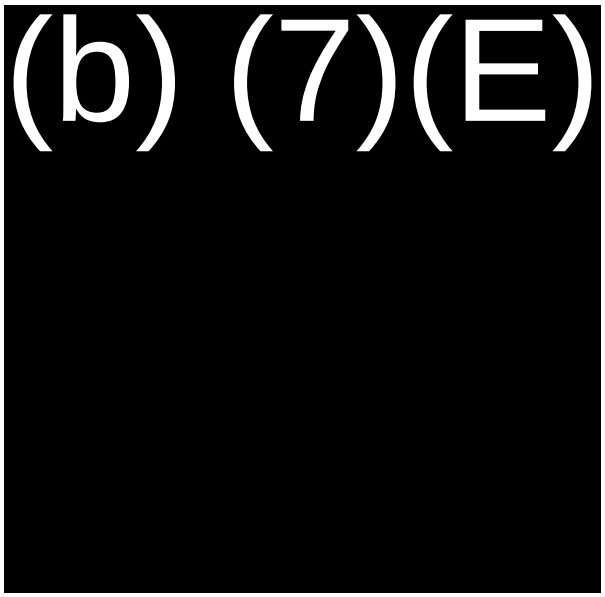


Figure 156: (b) (7)(E) ***Breach Measurement***

3.2 Scaling Test Case

The Scaling Test Case characterized the performance of the submitted solutions' capability to prevent climbing, also referred to as scaling, to the top of the border wall. Teams of scaling experts from BORTAC and SOCOM used scaling techniques (b) (7)(E) to attempt to reach the tops of the prototypes. Each prototype was attempted to be scaled with techniques appropriate for each design, as determined by the scaling experts. The Scaling Test Case was executed at the Border Prototype Site.

3.2.1 Requirements

Table 15 lists the scaling requirements for both the Solid Concrete and Other Border Wall submitted solutions.

Table 15: Scaling Requirements

Solid Concrete Wall Reference Name	Other Border Wall Reference Name	Requirement
(b) (7)(E)		(b) (7)(E)
(b) (7)(E)		The wall design shall include (b) (7)(E)

3.2.2 Test Case Execution

The Scaling Test Case consisted of two scaling scenarios, (b) (7)(E) The high-level execution included the following:

(b) (7)(E)

- (b) (7)(E)

(b) (7)(E)

- (b) (7)(E).

- (b) (7)(E)

For the purposes of the test case execution, (b) (7)(E)

3.2.2.1 Scaling Techniques

Scaling techniques were developed prior to the test, and after the scaling experts were able to practice on the prototypes, the scaling techniques were modified as appropriate and additional techniques were developed. Although (b) (7)(E) techniques were available to climb the prototypes, only those techniques that were appropriate for a prototype were attempted for that prototype.

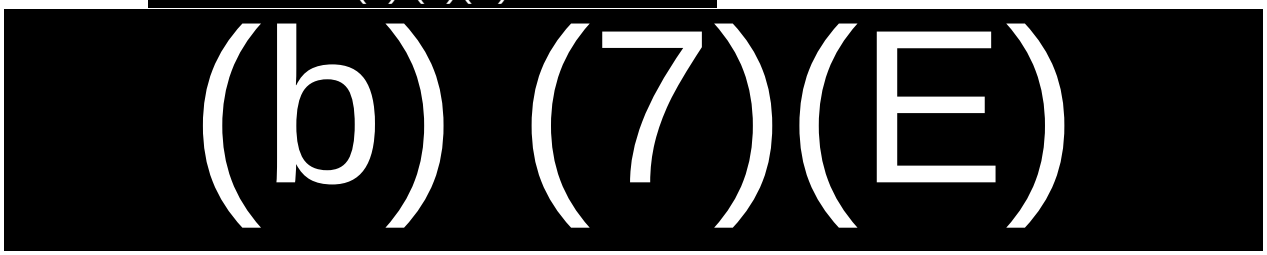
3.2.2.1.1 (b) (7)(E)

This technique describes (b) (7)(E) This technique was created to address the contract requirement (b) (7)(E)

3.2.2.1.2 (b) (7)(E)

This technique describes (b) (7)(E) This technique was created to address the contract requirements (b) (7)(E)

3.2.2.1.3 (b) (7)(E)



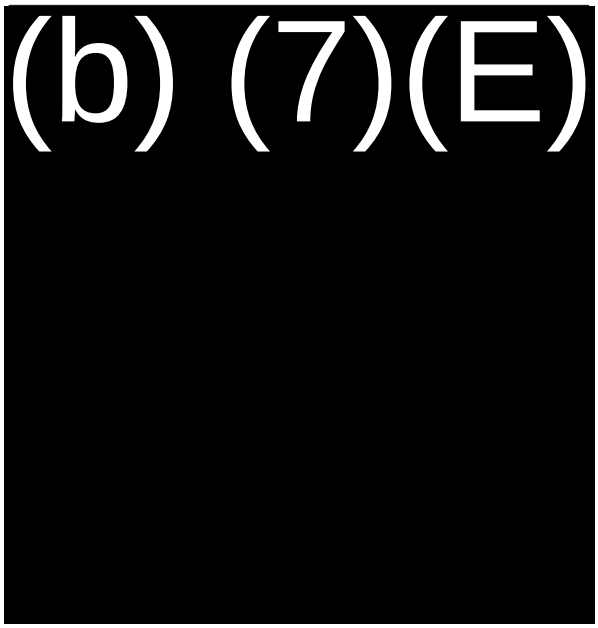


Figure 157: (b) (7)(E)

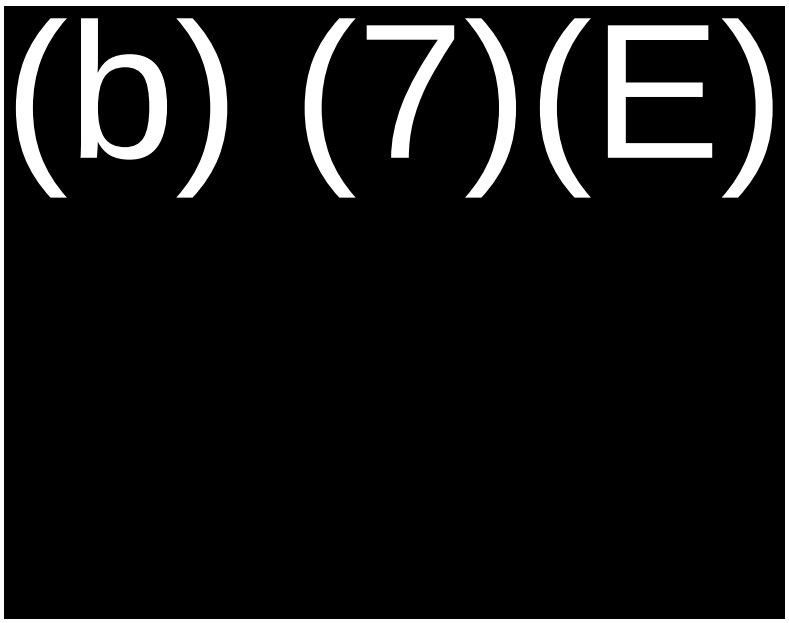


Figure 158: (b) (7)(E)

3.2.2.1.4 (b) (7)(E)

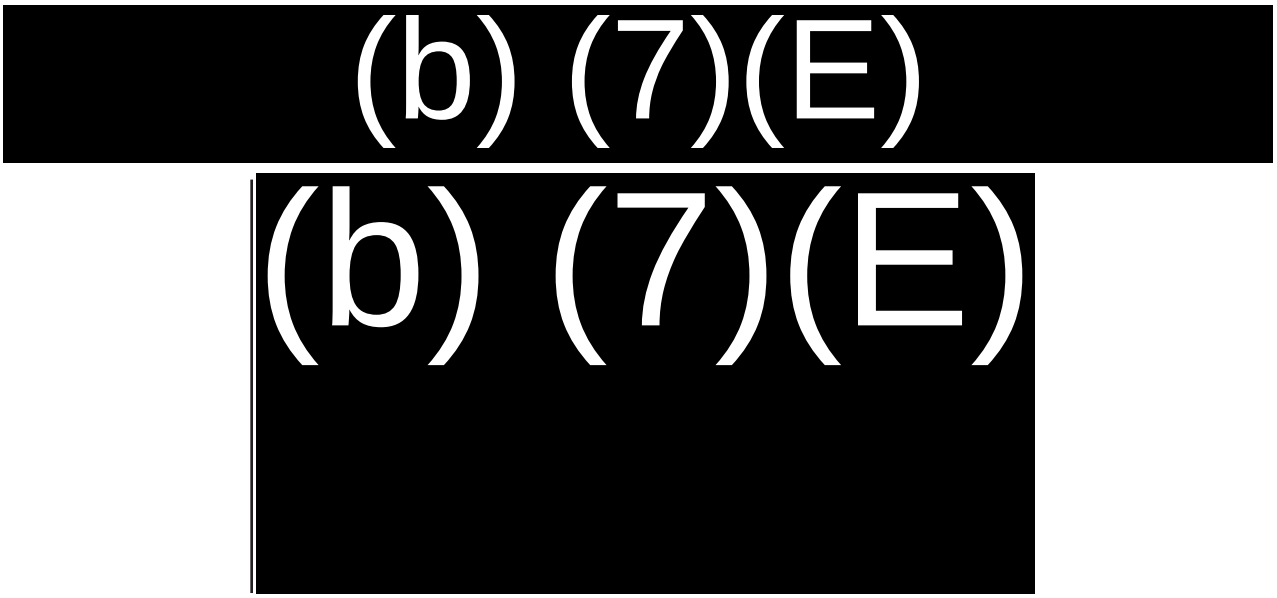


Figure 159: (b) (7)(E)

3.2.2.1.5 (b) (7)(E)

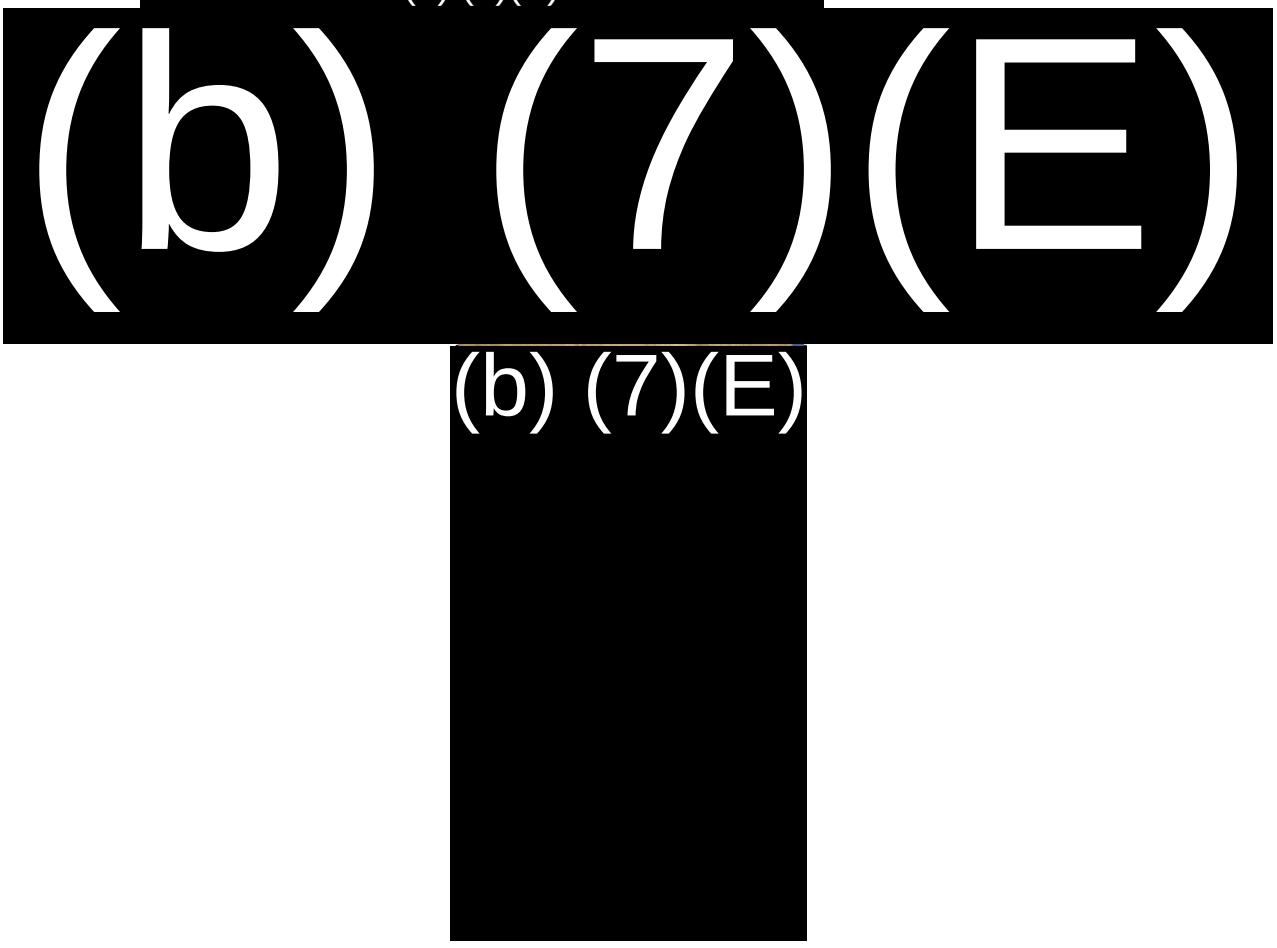


Figure 160: (b) (7)(E)

3.2.2.1.6 (b) (7)(E)

(b) (7)(E), examples are shown in Figure 161 and Figure 162, (b) (7)(E)

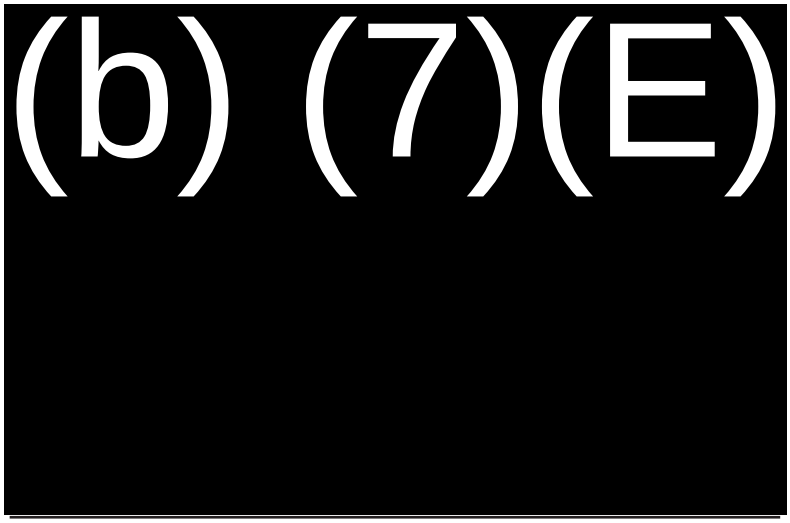


Figure 161: (b) (7)(E)

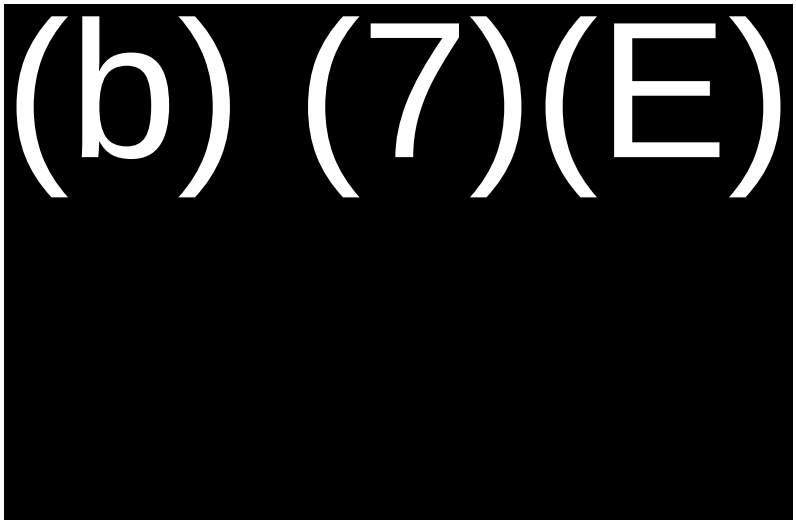


Figure 162: (b) (7)(E)

3.2.2.1.7 (b) (7)(E)

(b) (7)(E), an example is shown in Figure 163 (b) (7)(E)

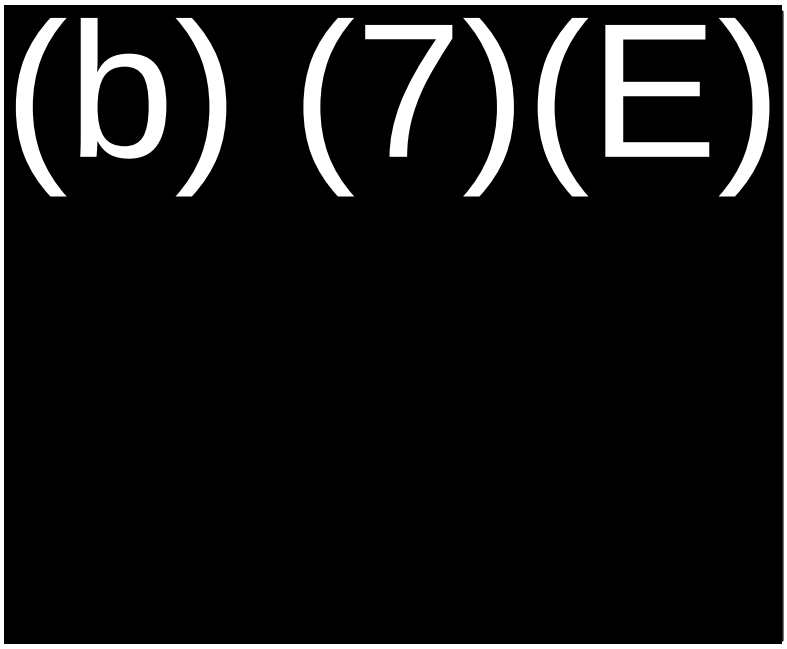


Figure 163: (b) (7)(E)

3.2.2.1.8 (b) (7)(E)

(b) (7)(E) an example is shown in Figure 164. (b) (7)(E) , an example is shown in Figure 165, (b) (7)(E)

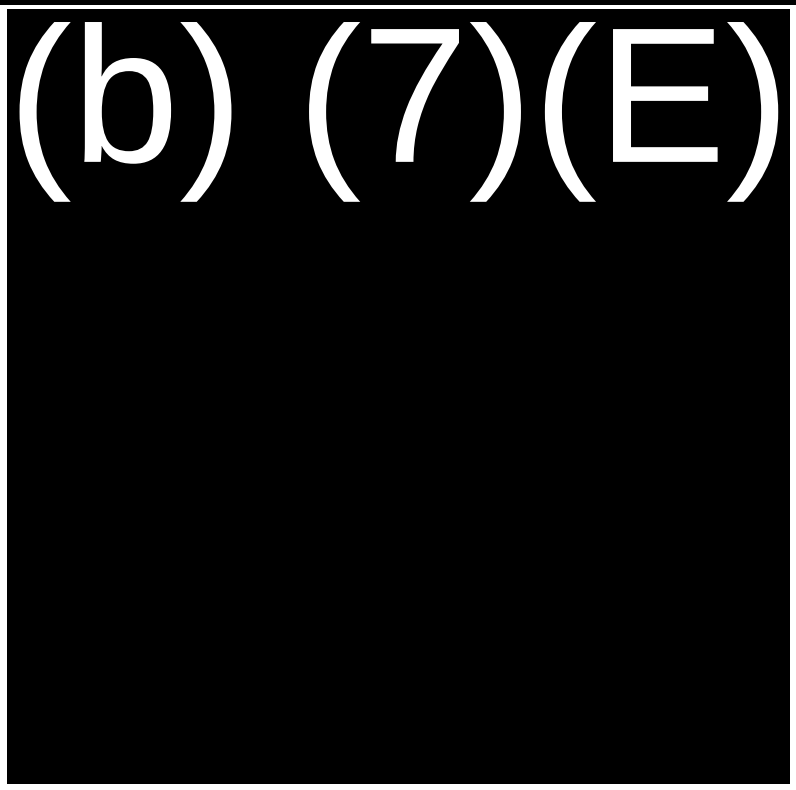


Figure 164: (b) (7)(E)

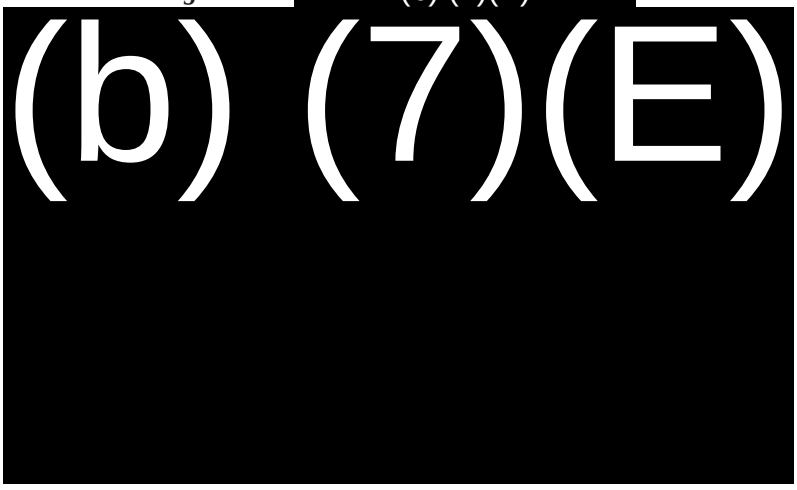


Figure 165: (b) (7)(E)

3.2.2.1.9 (b) (7)(E)

(b) (7)(E) examples are shown in Figure 161 and Figure 162, (b) (7)(E) an example is shown in Figure 164, (b) (7)(E)

.

3.2.2.1.10 (b) (7)(E)

(b) (7)(E) , shown in Figure 166, (b) (7)(E)

shown in Figure 158, (b) (7)(E)

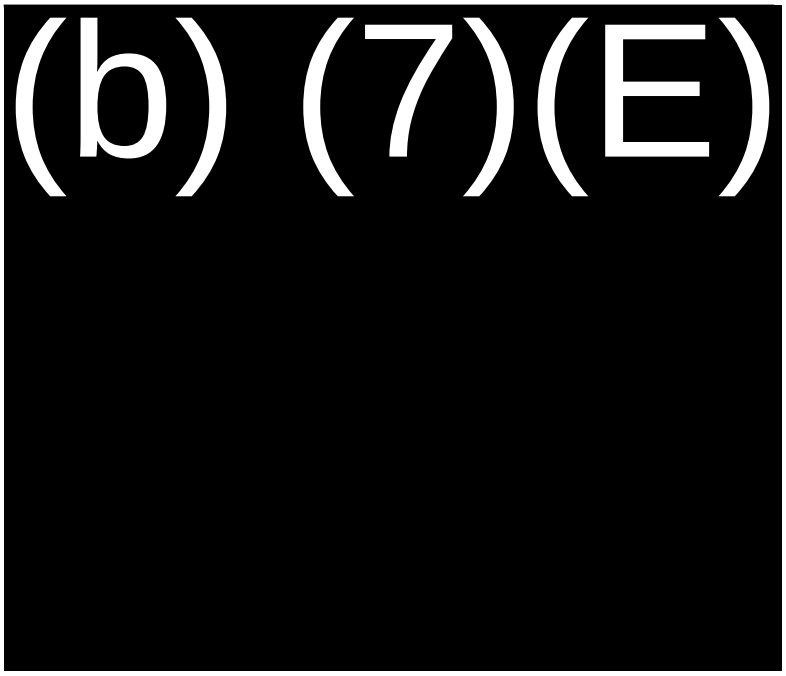


Figure 166: (b) (7)(E)

3.2.2.1.11 (b) (7)(E)

(b) (7)(E) , shown in Figure 167, (b) (7)(E)

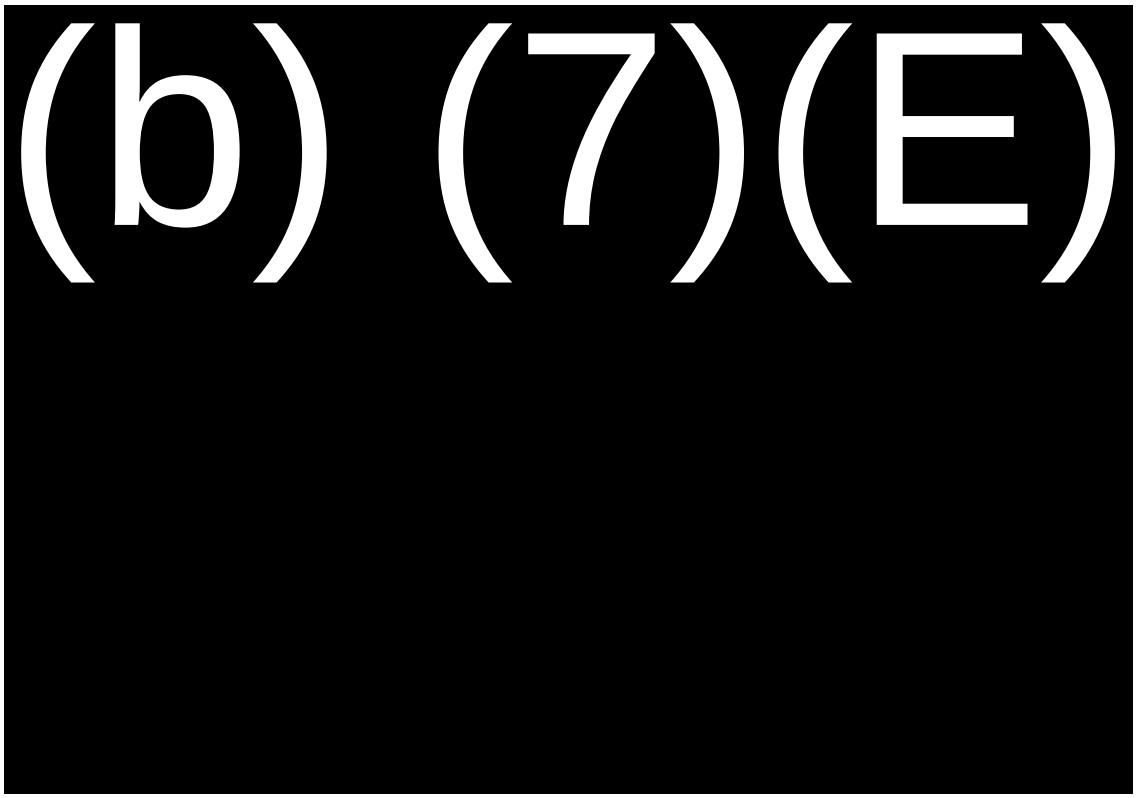


Figure 167: (b) (7)(E)

Figure 168: (b) (7)(E)

3.2.2.1.12 (b) (7)(E)

A two by four wooden board was tied to rope and thrown over the top of the prototype. The two (b) (7)(E) , shown in Figure 158, (b) (7)(E)

3.2.2.1.13 (b) (7)(E)

(b) (7)(E)

, shown in Figure 166 (b) (7)(E)

.

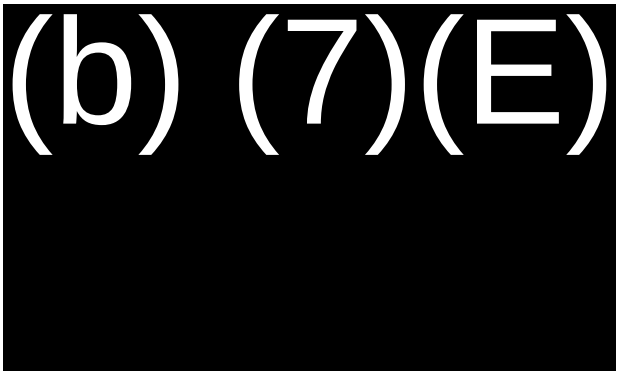


Figure 169: (b) (7)(E)

3.2.2.1.14 (b) (7)(E)

(b) (7)(E)

, shown in Figure 169, (b) (7)(E)

s, shown in Figure 158, (b) (7)(E)

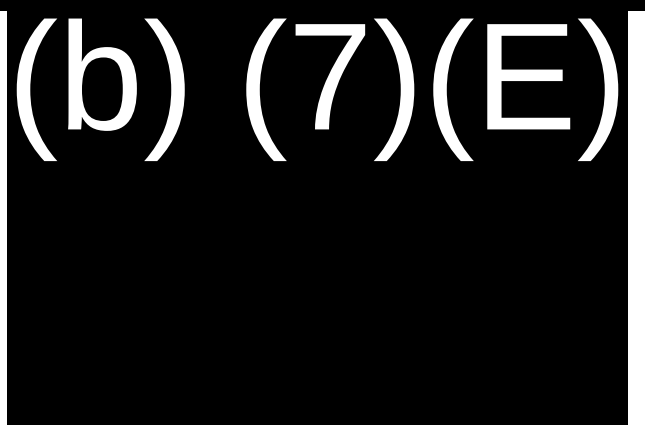


Figure 170: (b) (7)(E)

3.2.2.2 (b) (7)(E)

(b) (7)(E), an example shown in Figure 171, (b) (7)(E)

- (b) (7)(E)

(b) (7)(E)

Figure 171: Example of (b) (7)(E)

3.2.3 Analysis

The data collected was the start time of the scale attempt, the "scale time" when scaler reaches the top of the prototype or a note that the scaler could not reach the top, pictures of the scaling process, and video of the complete scaling attempt. Significant observations during the scaling attempt were recorded using a TOR.

(b) (7)(E)

.

(b) (7)(E)

If there was no similar prototype, no scale time was recorded.

3.2.4 Scaling Results

The scaling results, by scaling technique used on each prototype, are listed in Table 16. (b) (7)(E)

[redacted]

Table 16: Scaling Test Case Times to Breach

Prototype	Scaling Technique (b) (7)(E)
(b) (7)(E)	(b) (7)(E)
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	

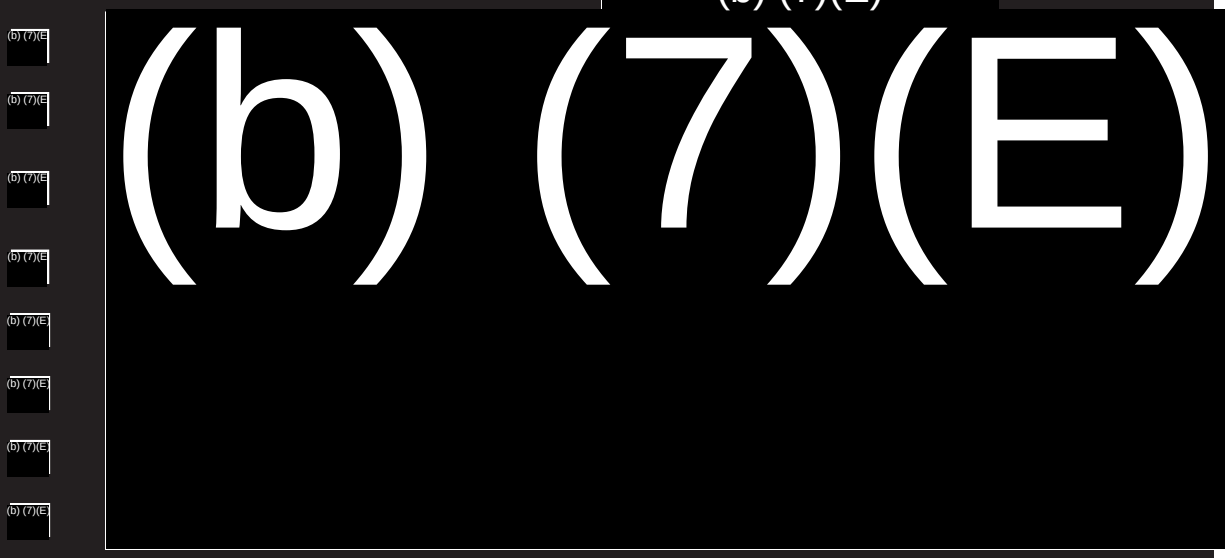
The performance characterization statements for the (b) (7)(E) scaling requirements are listed in Table 17 and Table 18.

Table 17 (b) (7)(E) Scaling Performance Characterization Statements

Prototype	Performance Characterization Statements ((b) (7)(E)
(b) (7)(E)	(b) (7)(E)
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	

(b) (7)(E)

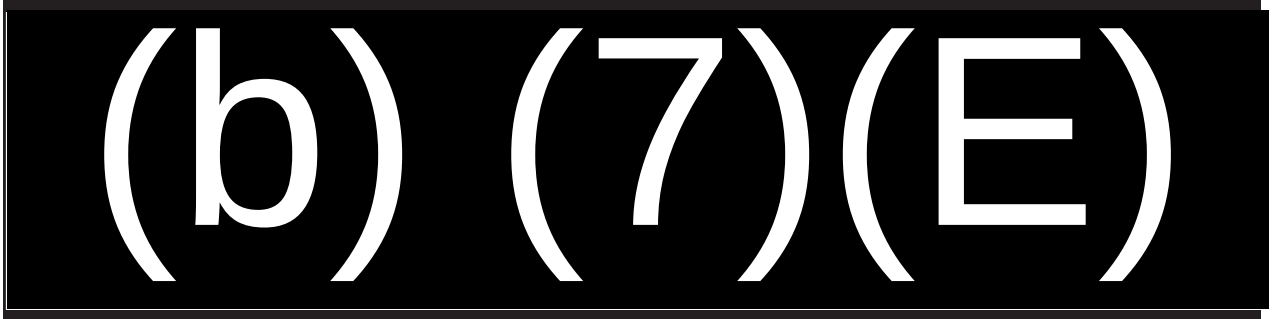
(b) (7)(E)



(b) (7)(E)

(b) (7)(E)

(b) (7)(E)



(b) (7)(E)

- (b) (7)(E)

3.2.4.1.2 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.1.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.1.4 Prototype (b) (7)(E)

The technique (b) (7)(E)

.

(b) (7)(E)

3.2.4.1.5 Prototype (b) (7)(E)

The technique (b) (7)(E)

.

(b) (7)(E)

(b) (7)(E)

3.2.4.1.6 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.1.7 Prototype (b) (7)(E)

The technique (b) (7)(E) , shown in Figure 172, (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

Figure 172: (b) (7)(E) ***Scaling Technique on*** (b) (7)(E)

3.2.4.1.8 Prototype (b) (7)(E)

The technique (b) (7)(E) an example is shown in Figure 146, (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

3.2.4.2 Prototype (b) (7)(E)

For the (b) (7)(E) prototype, the scaling techniques, outcome, scale time, and remarks are listed in Table 20. Scale outcomes and scale times notated with estimated have either an administrative technical climbing gear set or an estimated climb time.

Table 20: (b) (7)(E) ***Scaling Techniques and Scale Times***

Scaling Technique	Scale Outcome	Scale Time	Remarks
(b) (7)(E)			

3.2.4.2.1 (b) (7)(E) *Stakeholder and Subject Matter Expert Feedback*

Stakeholder and subject matter expert feedback was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite climbing experts during the climbing. Full text of the observations is documented in TORs 105 and 108, Appendix B.

Climbing Expert Observations:

- (b) (7)(E)

3.2.4.2.2 Prototype (b) (7)(E)

The technique (b) (7)(E) e.

(b) (7)(E)

(b) (7)(E)

3.2.4.2.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.2.4 Prototype (b) (7)(E)

The technique (b) (7)(E) , as shown in Figure 173 (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

Figure 173: (b) (7)(E)

3.2.4.2.5 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

- (b) (7)(E)

3.2.4.3.2 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.3.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

.

(b) (7)(E)

3.2.4.3.4 Prototype (b) (7)(E)

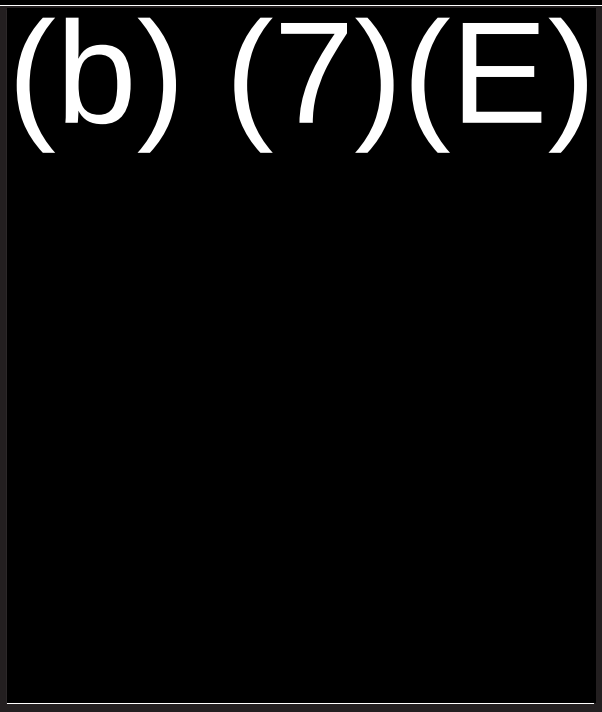
The technique (b) (7)(E)

, as shown in Figure 174.

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)



(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

3.2.4.4.1 (b) (7)(E) Stakeholder and Subject Matter Expert Feedback

Stakeholder and subject matter expert feedback was solicited and provided in the form of test observation reports. The primary source of feedback was from the onsite climbing experts during the scaling. Full text of the observations is documented in TORs 17, 18, 35, 42, 70, 71, 72, 73, 74, 75, and 76, Appendix B.

Climbing Expert Observations:

- (b) (7)(E)

3.2.4.4.2 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.4.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.4.4 Prototype (b) (7)(E)

The technique (b) (7)(E) shown in Figure 175, (b) (7)(E) as shown in Figure 176.

(b) (7)(E)

(b) (7)(E)

Figure 175: (b) (7)(E) ***Prototype***

Figure 176: (b) (7)(E)

3.2.4.4.5 Prototype (b) (7)(E)

(b) (7)(E)

Figure 177, (b) (7)(E) shown in Figure 178.

(b) (7)(E)

(b) (7)(E)

Figure 177: (b) (7)(E)

(b) (7)(E)

Figure 178: (b) (7)(E)

3.2.4.4.6 Prototype (b) (7)(E)

The technique (b) (7)(E) as shown Figure 179, (b) (7)(E) shown in Figure 180.

(b) (7)(E)

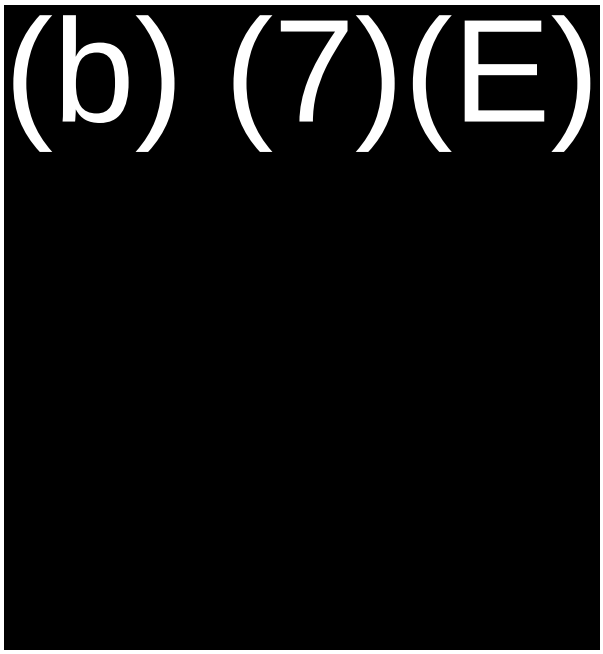


Figure 179: (b) (7)(E)

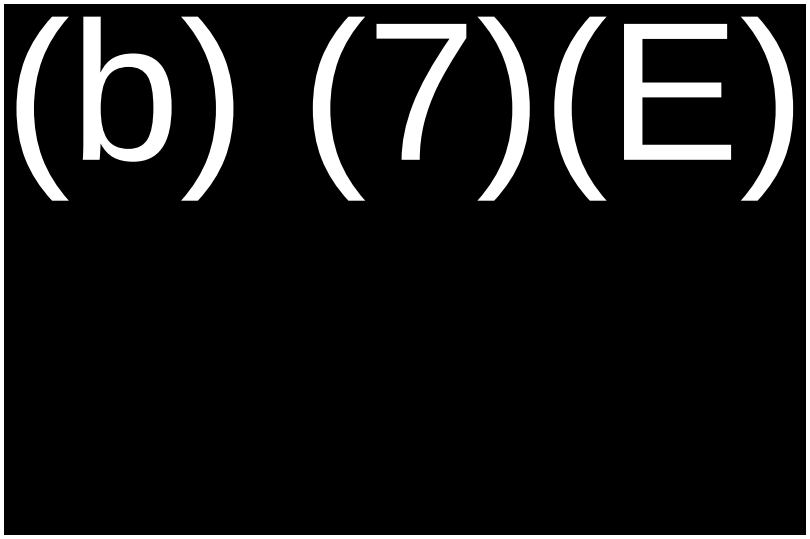


Figure 180: (b) (7)(E)

3.2.4.4.7 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

3.2.4.5.2 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.5.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

.

(b) (7)(E)

3.2.4.5.4 Prototype (b) (7)(E)

This technique (b) (7)(E) as shown in Figure 181. (b) (7)(E) as shown in Figure 182.

(b) (7)(E) as shown in Figure 181.

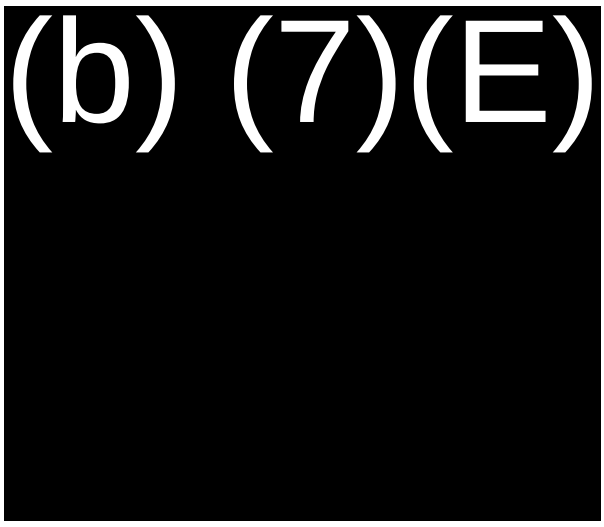


Figure 181: (b) (7)(E)

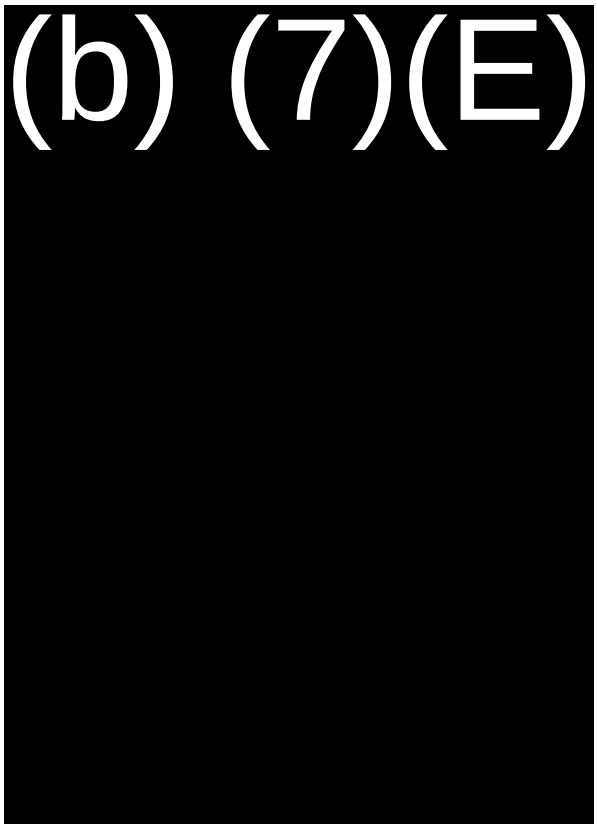
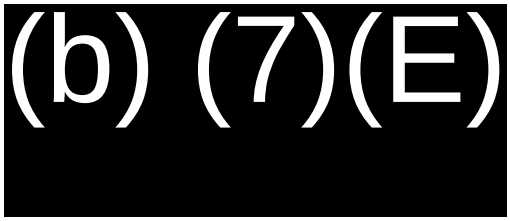


Figure 182: (b) (7)(E)

3.2.4.5.5 Prototype (b) (7)(E)

This technique (b) (7)(E)



3.2.4.5.6 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E)

3.2.4.5.7 Prototype (b) (7)(E)

This technique (b) (7)(E) shown in Figure 183, (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

Figure 183: (b) (7)(E)

3.2.4.5.8 Prototype (b) (7)(E)

This technique (b) (7)(E) shown in Figure 184, (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

Figure 184: Prototype (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

3.2.4.6.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.6.4 Prototype (b) (7)(E)

This technique (b) (7)(E)

as shown in Figure 185.

(b) (7)(E)

(b) (7)(E)

Figure 185: (b) (7)(E)

3.2.4.6.5 Prototype (b) (7)(E)

This technique (b) (7)(E) as shown in Figure 186. (b) (7)(E) .

(b) (7)(E)

(b) (7)(E)

Figure 186: Prototype (b) (7)(E)

3.2.4.6.6 Prototype (b) (7)(E)

This technique (b) (7)(E) shown in Figure 177, (b) (7)(E) s.

(b) (7)(E)

(b) (7)(E)

Figure 187: Prototype (b) (7)(E)

3.2.4.6.7 Prototype (b) (7)(E)

This technique (b) (7)(E)

s shown in Figure 188.

(b) (7)(E)

(b) (7)(E)

Figure 188: Prototype (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

3.2.4.7.3 Prototype (b) (7)(E)

The technique (b) (7)(E)

(b) (7)(E)

3.2.4.7.4 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E)

3.2.4.7.5 Prototype (b) (7)(E)

This technique (b) (7)(E)

.

(b) (7)(E)

(b) (7)(E)

Figure 189: Prototype (b) (7)(E)

3.2.4.7.6 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E).

(b) (7)(E)

3.2.4.7.7 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E)

3.2.4.7.8 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E)

- (b) (7)(E)

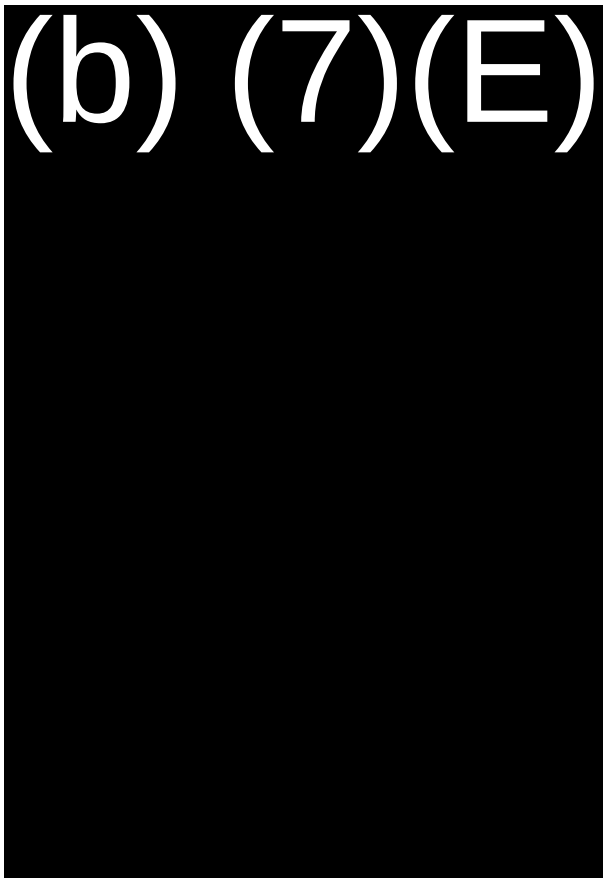


Figure 190: Prototype (b) (7)(E)

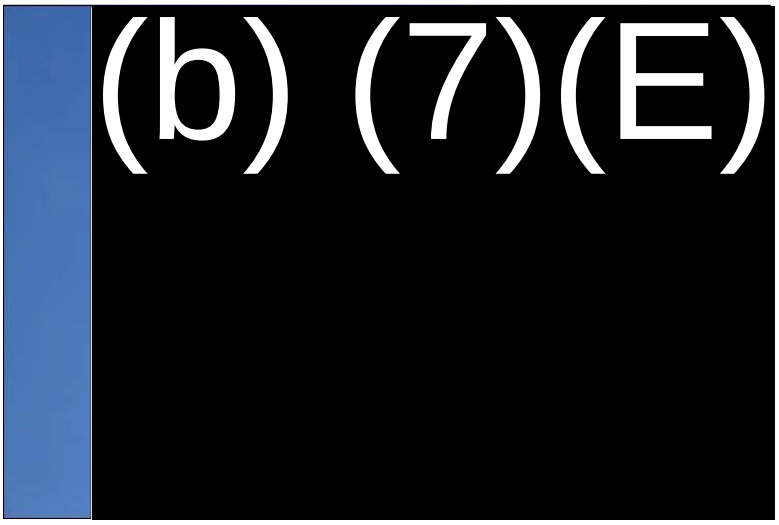


Figure 191: Prototype (b) (7)(E)

3.2.4.7.9 Prototype (b) (7)(E)

This technique, (b) (7)(E) . Figure 192 and Figure 193 (b) (7)(E) .

(b) (7)(E)

(b) (7)(E)

Figure 192: Prototype (b) (7)(E) ***Over***

(b) (7)(E)

Figure 193: Prototype (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

- (b) (7)(E)

3.2.4.8.2 Prototype (b) (7)(E)

The climber (b) (7)(E)

(b) (7)(E)

3.2.4.8.3 Prototype (b) (7)(E)

The climber (b) (7)(E)

.

(b) (7)(E)

3.2.4.8.4 Prototype (b) (7)(E)

The climber was (b) (7)(E)

(b) (7)(E)

3.2.4.8.5 Prototype (b) (7)(E)

The climber was (b) (7)(E)

(b) (7)(E)

3.2.4.8.6 Prototype (b) (7)(E)

(b) (7)(E)

(b) (7)(E)

3.2.4.8.7 Prototype (b) (7)(E)

This technique (b) (7)(E) shown in Figure 194, (b) (7)(E) , shown in Figure 195, (b) (7)(E) (b) (7)(E)

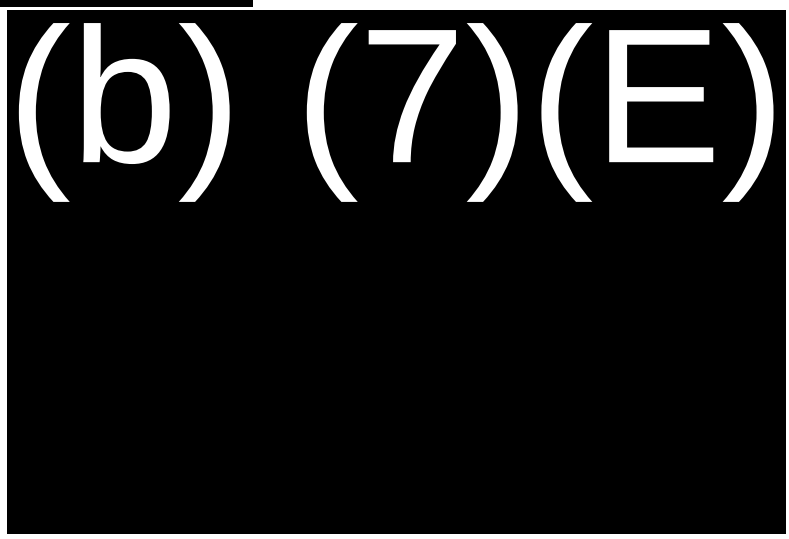


Figure 194: Prototype (b) (7)(E)

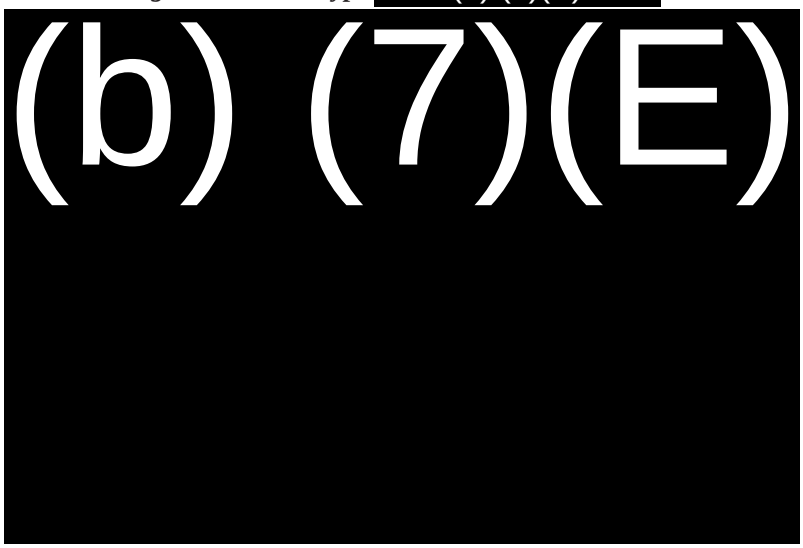


Figure 195: Prototype (b) (7)(E)

3.2.4.8.8 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E)

3.2.4.8.9 Prototype (b) (7)(E)

This technique (b) (7)(E)

(b) (7)(E)

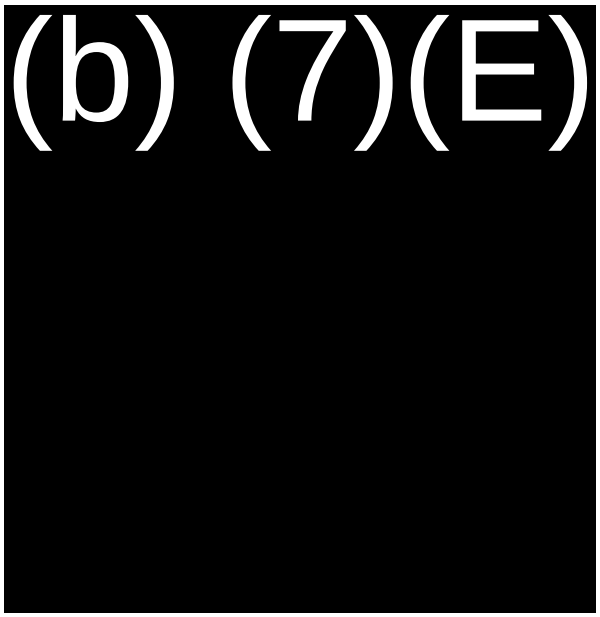


Figure 196: Prototype (b) (7)(E)

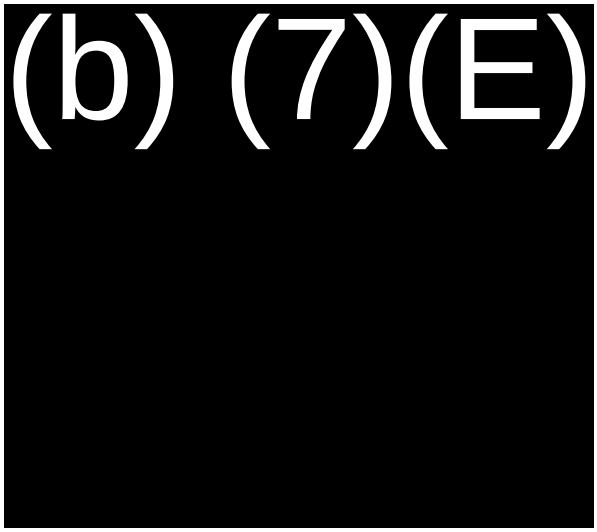


Figure 197: Prototype (b) (7)(E)

3.2.4.9 (b) (7)(E)

A consideration when evaluating the prototype (b) (7)(E) This assessment consisted of (b) (7)(E) (b) (7)(E) . The quantitative scoring ranges are shown in Table 27.

The results of the (b) (7)(E) assessment are listed in Table 28.

Table 27: (b) (7)(E) ***Scoring Definitions***

Score	(b) (7)(E)
(b) (7)(E)	

Table 28: Perch Test Results

Prototype	(b) (7)(E)
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	
(b) (7)(E)	

3.3 Aesthetics Paired Comparison Test Case

The Aesthetics Paired Comparison Test Case characterized the performance of the submitted solutions capability to be aesthetically pleasing. The test case characterized the prototype performance against the contract requirement for "aesthetically pleasing" by ranking two aesthetic concepts, attractiveness and appropriateness. The goal of the test case was to understand the relationship of the two aesthetic concepts, attractiveness and appropriateness, to wall attributes and the impact of these on variance in patterns of preference.

The Aesthetics Paired Comparison Test Case was executed with 76 participants. They were provided pictures of the prototypes and answered questions about the aesthetic concepts of each. The paired comparison test included an evaluation of wall attributes on the participant's preference of border wall.

Design aesthetics is the deliberate arrangement of factors, such as shape, color, and texture, in a way that appeals to the senses and/or emotions. Aesthetics involves attractiveness, which is visual appeal and essentially a preference. In addition, aesthetics involves the appropriateness of the item for a specific context, and not just that it is attractive. The effective use of aesthetic choices can make a design resonate with a target audience. An aesthetic evaluation focuses on how something is perceived and judged by a person that causes them to place a particular value judgment upon it.

The Aesthetics Paired Comparison Test Case ranked the prototypes by the attractiveness and appropriateness, which in context is the appearance of barrier effectiveness.

3.3.1 Requirement

Table 29 lists the aesthetic requirement for both the Solid Concrete and Other Border Wall submitted solutions.

The aesthetic evaluation was conducted to evaluate the first part of the aesthetic requirement, (b) (7)(E) shall be aesthetically pleasing in color,(b) (7)(E) etc., to be consistent with general surrounding environment." The second part of the requirement, the manufacturing/construction process should facilitate changes in color and texture pursuant to site-specific requirements, is characterized in Section 3.4.

Table 29: Aesthetics Paired Comparison Requirement

Solid Concrete Wall Reference Name	Other Border Wall Reference Name	Requirement
(b) (7)(E)		The (b) (7)(E)) shall be aesthetically pleasing in color, (b) (7)(E) , etc., to be consistent with general surrounding environment.

3.3.2 Test Case Execution

Paired comparison data was collected from both personnel from the Office of Acquisition, Arlington, VA and from personnel on-site at Pogo Row, including leadership, subject matter experts, and users. The aesthetics test case focused on how the border wall is perceived and judged by participants that causes them to place a value judgment upon it.

The aesthetics test examines two concepts, each with four factors. The first concept is attractiveness, with four factors:

- Color – hue, intensity, brightness, depth
- Texture – look/feel of the physical surface, smoothness, roughness, shape, configuration
- Pattern – large visual shape, arrangements, decorations
- Wall top style – appearance of top of the wall, top in relation to rest of wall

The second concept is appropriateness, which in the context of the prototypes is the appearance of border wall effectiveness. The four appropriateness factors are:

- Texture – look/feel of the physical surface, smoothness, roughness, shape, configuration
- Wall top style – appearance of top of the wall, top in relation to rest of wall
- Apparent difficulty to breach/scale – difficulty to get past the wall, impenetrability
- Provision of situation awareness – ability to understand activity near, around, by the wall

The participants came from readily available populations at the CBP Office of Acquisition in Arlington, VA, and the personnel involved in the mock-up and prototype testing in San Diego, CA. All participants were asked to indicate if their career specialty was law enforcement, engineer (civil or related discipline), government leadership, or other.

There was a total of 76 participants. Forty-two from the CBP Office of Acquisition in Arlington, VA and 34 from the San Diego, CA test location. Twenty-one self-identified as law enforcement, 30 as engineers, 9 as government leadership, and 16 as other.

Participants were asked to indicate if they had seen the wall prototypes in person, only in pictures, or never before completing the aesthetics test. Twenty-seven participants had seen the wall prototypes in person, 38 had seen the wall prototypes only in pictures, and 11 had not seen the wall prototypes at all.

For this test case, there were four sets of paired comparisons. Set 1 was the comparison of pictures of the wall prototypes based on attractiveness. Set 2 was the comparison of importance of the attractiveness factors. Set 3 was the comparison of pictures of the wall prototypes based on appearance of barrier effectiveness. Set 4 was the comparison of importance of the barrier effectiveness factors.

The paired comparison test was implemented in an Excel-based tool which displayed the pairs, collected input, stored the inputs, and provided initial analysis of the preferences. As can be seen in Figure 198 and Figure 199, participants indicated how much they preferred one option over the other, or if they had no preference. Since there are eight wall prototypes, the participants did 28 comparisons for each of the concepts (attractiveness and appearance of barrier effectiveness) and 6 comparisons for each set of four factors, for a total of 78 comparisons. The paired comparison took 10-15 minutes per participant.

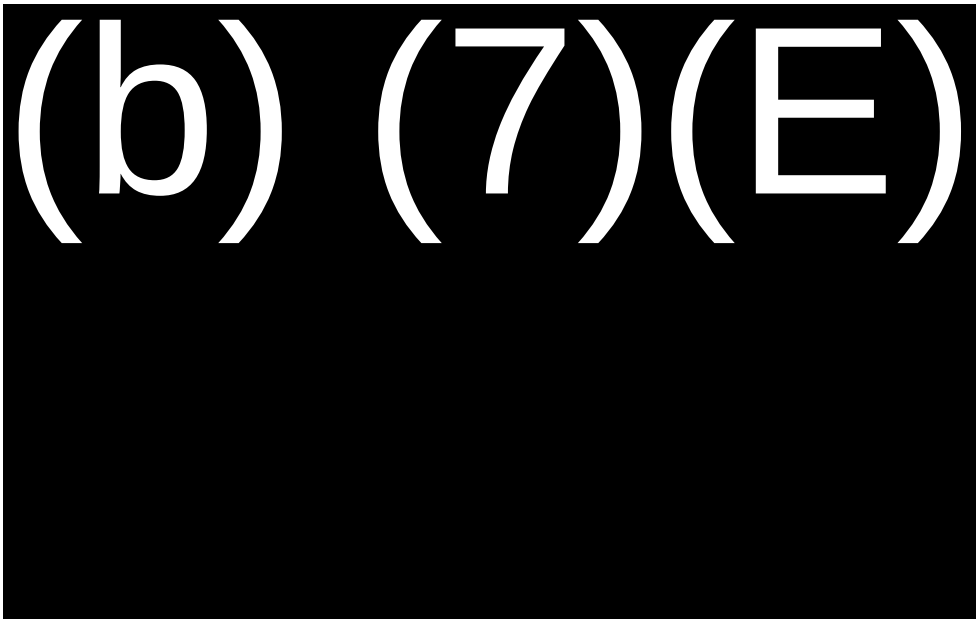


Figure 198: Example of picture comparison from Excel-based paired comparison tool

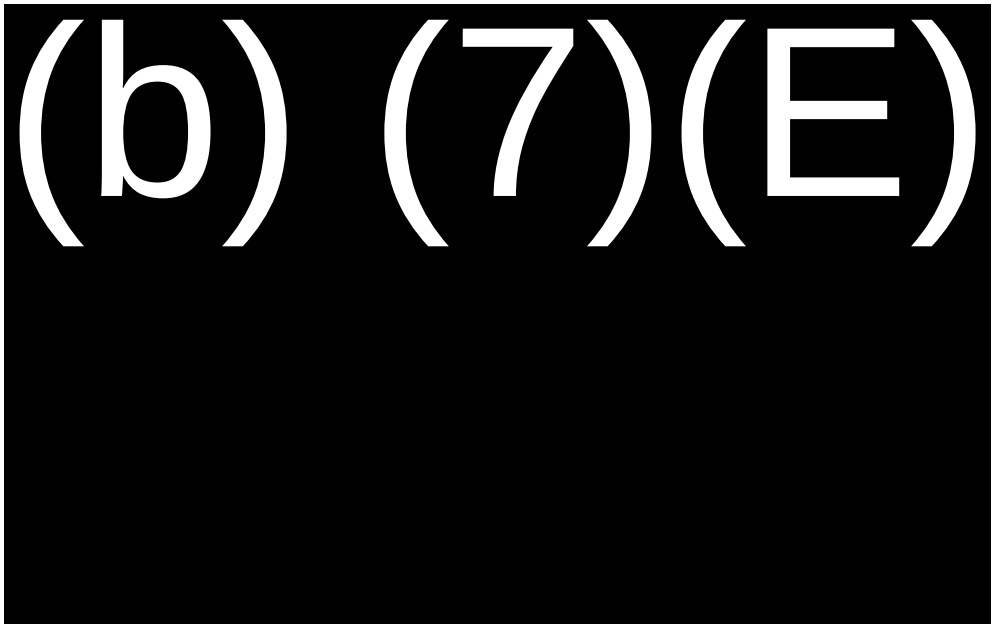


Figure 199: Example of factor comparison from Excel-based paired comparison tool

3.3.3 Analysis

The methodology used for the aesthetics test was a paired, or pairwise, comparison. The paired comparison has been used by psychologists since the 1920s to elicit ordered value judgements from participants. The strength of the paired comparison is its match to human cognition and using humans' strong ability to compare two objects to each other.

A separate analysis was completed for each set of comparisons. The analyses provide participants' ordered preference of the wall prototypes for attractiveness and separately for appearance of barrier effectiveness, as well as each set of factors ordered by importance for all participants. Additionally, order preferences were calculated and compared for career specialty and familiarity with the wall prototypes categories to examine any differences due to these factors.

The participants' preferences in each set of comparisons were converted to priority weights. The participants' priority weights were then combined for each option (wall prototype or factor) by calculating the geometric mean of the weights.

3.3.4 Aesthetics Paired Comparison Results

For attractiveness, the three prototypes ranked highest were (b) (7)(E) (b) (7)(E) and (b) (7)(E) For appearance of barrier effectiveness, the three prototypes ranked highest were (b) (7)(E) (b) (7)(E) and (b) (7)(E) Table 30 lists the Aesthetics Paired Comparison Test Case performance characterization statements for the eight submitted solutions.

Table 30: Aesthetics Performance Characterization Statements

Prototype	Performance Characterization Statements
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 3 for attractive appearance and ranked number 1 for effective appearance.
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 5 for attractive appearance and ranked number 5 for effective appearance
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 1 for attractive appearance and ranked number 3 for effective appearance
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 7 for attractive appearance and ranked number 4 for effective appearance
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 8 for attractive appearance and ranked number 8 for effective appearance
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 2 for attractive appearance and ranked number 3 for effective appearance
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 4 for attractive appearance and ranked number 7 for effective appearance
(b) (7)(E	In the paired comparison test of 8 prototype border walls, the submitted solution ranked number 6 for attractive appearance and ranked number 6 for effective appearance

As shown in Table 31 and Table 33, prototypes (b) (7)(E) (b) (7)(E) and (b) (7)(E) are highly ranked in both the attractiveness and appearance of barrier effectiveness categories. For attractiveness (see Table 32), the texture factor is ranked the highest, followed by the pattern and wall top style and finally color with the lowest weight. For appearance of barrier effectiveness (see Table 34), the highest ranked factor is appearance of breaching difficulty then situational awareness, followed by texture and wall top style. Despite the high weight for the situational awareness factor, the top three ranked walls are solid, which precludes viewing the situation on the other side of the wall.

Table 31: Attractiveness wall prototype rankings from all participants

Prototype	Combined Priority Weights	Rank
(b) (7)(E)	0.1093	**3**
(b) (7)(E)	0.0872	5
(b) (7)(E)	0.1674	**1**
(b) (7)(E)	0.0794	7
(b) (7)(E)	0.0633	8
(b) (7)(E)	0.1233	**2**
(b) (7)(E)	0.0977	4
(b) (7)(E)	0.0839	6

Table 32: Attractiveness factor rankings for all participants

Factor	Combined Priority Weights	Rank
Color	0.1776	4
Pattern	0.2043	2
Texture	0.2514	1
Wall top	0.2015	3

Table 33: Appearance of barrier effectiveness rankings for all participants

Prototype	Combined Priority Weights	Rank
(b) (7)(E)	(b) (7)(E)	**1**
(b) (7)(E)		5
(b) (7)(E)		**2**
(b) (7)(E)		4
(b) (7)(E)		8
(b) (7)(E)		**3**
(b) (7)(E)		7
(b) (7)(E)		6

Table 34: Appearance of barrier effectiveness factor rankings for all participants

Factor	Combined Priority Weights	Rank
(b) (7)(E)		

In addition to calculating the combined weights for all the participants, weights were also calculated for participants based on their self-identified career position: law enforcement, engineer, government leadership, or other. For wall type attractiveness ranking (see Table 35), all four career positions ranked [redacted] first. All but government leadership ranked [redacted] second with government leadership ranking [redacted] second. For the attractiveness factors (see Table 36), there is not a clear number one rank across the career positions, and the weightings are all very similar, meaning there wasn't much difference to the participants. For appearance of barrier effectiveness (see Table 37), law enforcement and engineers ranked (b) (7)(E) [redacted] dditionally, there is a larger preference (weight) for breaching difficulty and a somewhat larger preference for situational awareness compared to either wall top style or texture.

Table 35: Attractiveness wall prototype rankings by participant position

	Law Enforcement		Engineer		Government Leadership		Other	
Wall	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**
[redacted]	(b) (7)(E)							

Table 36: Attractiveness factor rankings by participant position

	Law Enforcement		Engineer		Government Leadership		Other	
Factor	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**
Color	0.1469	4	0.1802	4	0.1195	4	0.2329	2
Pattern	0.2376	1	0.1824	3	0.1835	3	0.2701	1
Texture	0.2369	2	0.2450	1	0.2960	1	0.2176	3
Wall top	0.2073	3	0.2250	2	0.2273	2	0.1361	4

Table 37: Appearance of barrier effectiveness rankings by participant position

	Law Enforcement		Engineer		Government Leadership		Other	
Wall	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**
[redacted]	(b) (7)(E)							

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

(b) (7)(E)

	In Person		Only in Pictures		Never	
Wall	Weight	Rank	Weight	Rank	Weight	Rank
(b) (7)(E						
(b) (7)(E						
(b) (7)(E						
(b) (7)(E						
(b) (7)(E						
(b) (7)(E						
(b) (7)(E						
(b) (7)(E						

	In Person		Only in Pictures		Never	
Factor	Weight	Rank	Weight	Rank	Weight	Rank

Table 41: Appearance of barrier effectiveness rankings by participant prototype familiarity

	In Person		Only in Pictures		Never	
Wall	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**
(b) (7)(E)						
(b) (7)(E)						
(b) (7)(E)						
(b) (7)(E)						
(b) (7)(E)						
(b) (7)(E)						
(b) (7)(E)						
(b) (7)(E)						

Table 42: Appearance of barrier effectiveness factor rankings by participant prototype familiarity

	In Person		Only in Pictures		Never	
Factor	**Weight**	**Rank**	**Weight**	**Rank**	**Weight**	**Rank**
(b) (7)(E)						

There are minor differences between the participants based on either position or prior wall familiarity. In addition, participants had similar responses for both the attractiveness and appearance of barrier effectiveness, with the same three wall prototypes coming in first, second, and third preferences.

3.4 Constructability Test Case

The Constructability Test Case characterized the performance of the submitted solutions' incorporation of specific constructability design elements. The Constructability Test Case was executed using OFAM engineer observations from the prototype wall construction. The OFAM engineers observed the prototype construction at the Border Prototype Site.

3.4.1 Requirements

Table 43 lists the constructability requirements for both the Solid Concrete and Other Border Wall submitted solutions.

Table 43: Constructability Requirements

Solid Concrete Wall Reference Name	Other Border Wall Reference Name	Requirement
(b) (7)(E)		The wall design shall be (b) (7)(E)
		The wall design shall be physically imposing in height. The Government's nominal concept is for a (b) (7)(E) wall. Offerors (b) (7)(E) uld consider this height, but designs with heights of at least (b) (7)(E) may be acceptable. Designs with heights of less than (b) (7)(E) re not acceptable.
		The wall shall (b) (7)(E)
		The manufacturing/construction process should facilitate changes in color and texture pursuant to site specific requirements.
		The wal (b) (7)(E) .
		(b) (7)(E)

3.4.2 Test Case Execution

The constructability requirements were assessed by inspection during and immediately following mock-up and prototype construction. OFAM engineers, who directly observed the prototype construction, provided a performance characterization for each submitted solution based on the inspection of the prototypes and their construction.

3.4.3 Analysis

No analysis was conducted for this Test Case.

3.4.4 Constructability Results

Constructability results for each submitted solution are listed by prototype in the corresponding section.

3.4.4.1 Prototype (b) (7)(E)

Table 44 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 44: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution consists of (b) (7)(E)
	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E)
	The (b) (7)(E) manufacturing process facilitates changes in color and textures pursuant to site specific requirements. (b) (7)(E)
	(b) (7)(E)

The (b) (7)(E) design (b) (7)(E)
The design uses a (b) (7)(E)

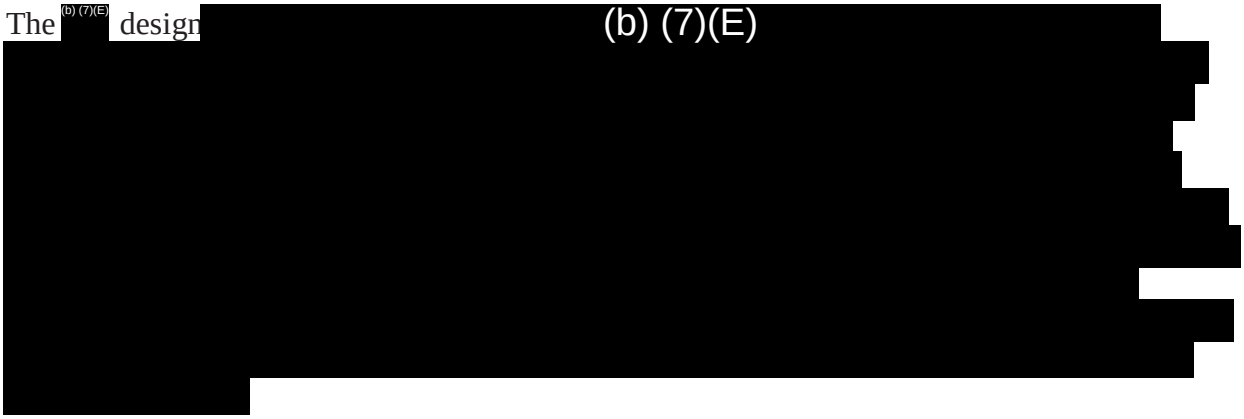
3.4.4.2 Prototype (b) (7)(E)

Table 45 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 45: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution consists of (b) (7)(E)
	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E)
	The (b) (7)(E) manufacturing process facilitates changes in color and textures pursuant to site specific requirements. (b) (7)(E)
	(b) (7)(E) .

The (b) (7)(E) design (b) (7)(E)



3.4.4.3 Prototype (b) (7)(E)

Table 46 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 46: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution consists of (b) (7)(E)
	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E).
	The (b) (7)(E) manufacturing process facilitates changes in color and textures pursuant to site specific requirements. (b) (7)(E) (b) (7)(E).

The (b) (7)(E) design (b) (7)(E)

3.4.4.4 Prototype (b) (7)(E)

Table 47 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 47: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution consists of (b) (7)(E)
	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E).
	The (b) (7)(E) does facilitate changes in color and textures pursuant to site specific requirements; however, changes in textures introduce added construction process complexity. (b) (7)(E).
	(b) (7)(E).

The (b) (7)(E) design (b) (7)(E).

3.4.4.5 Prototype (b) (7)(E)

Table 48 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 48: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E)
	The (b) (7)(E) surface does facilitate changes in color pursuant to site specific requirements; however, changes in texture are not simply facilitated. (b) (7)(E).
	(b) (7)(E)
	The submitted solution (b) (7)(E)

The (b) (7)(E) design (b) (7)(E)

3.4.4.6 Prototype (b) (7)(E)

Table 49 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 49: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E)
	The (b) (7)(E) structure manufacturing process facilitates changes in color and textures pursuant to site specific requirements. The (b) (7)(E) urface does facilitate changes in color pursuant to site specific requirements; however, changes in texture are not simply facilitated. (b) (7)(E)
	(b) (7)(E)
	The submitted solution (b) (7)(E)

The (b) (7)(E) desig (b) (7)(E)

3.4.4.7 Prototype (b) (7)(E)

Table 50 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 50: (b) (7)(E) Constructability Performance Characterization Statements

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E)
	The (b) (7)(E) structure does facilitate changes in color pursuant to site specific requirements; however, changes in texture are not simply facilitated. The (b) (7)(E) (b) (7)(E) structure manufacturing process facilitates changes in color and textures pursuant to site specific requirements. (b) (7)(E) (b) (7)(E)
	(b) (7)(E) .
	(b) (7)(E)

The (b) (7)(E) design (b) (7)(E)

3.4.4.8 Prototype (b) (7)(E)

Table 51 lists the Constructability Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 51: (b) (7)(E) ***Constructability Performance Characterization Statements***

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution is (b) (7)(E) in height, which is physically imposing in height per the RFP definition.
	The submitted solution (b) (7)(E)
	The (b) (7)(E) structure does facilitate changes in color pursuant to site specific requirements; however, changes in texture are not simply facilitated. Th (b) (7)(E) structure does facilitate changes in color pursuant to site specific requirements; however, changes in texture are not simply facilitated. (b) (7)(E) (b) (7)(E)
	(b) (7)(E)
	(b) (7)(E)

The (b) (7)(E) design (b) (7)(E) .

3.5 Engineering Design Review Test Case

The Engineering Design Review Test Case characterized the performance of the submitted solutions' incorporation of specific design elements. The Engineering Design Review Test Case was executed by USACE engineers using as-built design packages and OFAM engineer's observations from the prototype construction.

3.5.1 Requirements

Table 52 lists the engineering design review requirements for both the Solid Concrete and Other Border Wall submitted solutions.

Table 52: Engineering Design Review Requirements

Solid Concrete Wall Reference Name	Other Border Wall Reference Name	Requirement
(b) (7)(E)		The wall design shall be able to accommodate (b) (7)(E).
		The wall design shall be able to accommodate Border Patrol approved design standards for pedestrian and automated mechanized vehicle sliding gates (b) (7)(E) (b) (7)(E).
		The wall design shall be constructible to slopes (b) (7)(E).
		The wall design should be cost effective to construct, maintain and repair.

3.5.2 Test Case Execution

The submitted design packages were analyzed by subject matter experts to provide performance characterizations for each submitted solution. Subject matter experts were led by USACE engineers and include a design review lead, a civil engineer, and a structural engineer. The design review team consulted with other engineering disciplines and OFAM engineers as needed.

3.5.3 Analysis

USACE led the design review by developing a scoring system, conducting engineer expert analysis, and providing system performance characterizations for each submitted solution.

USACE provided a team of subject matter experts, which review the submittal and photos. Subject matter expertise covered the disciplines of structural engineering, geotechnical engineering, and civil engineering.

Cost estimate analysis

The estimates were created using the design information submitted for the prototype construction. Where variations existed between the as-built and the design submittal, the "as-built" submission was used to determine the actual constructed design and used as the costed design. No estimates were calculated for design alternatives not built.

The cost estimate analysis produced a Current Working Estimate (CWE) for each prototype. USACE ER 1110-3-1300 defines the CWE as the latest construction cost estimate, which includes the estimated contract cost, construction contingency, and supervision and administration (S&A) costs.

The costs for future replacement, based on assumed failure, is escalated 2% per year based on the average change for escalation based on Programming, Administration, and Execution System (PAX) (The DD Form 1391 is used by the Department of Defense to submit requirements and justifications in support of funding requests for military construction to Congress). Each option includes a demolition and disposal cost per mile as well.

Item prices in the estimate are based on information provided in Manufacturing Intelligence and Integration (MII) (second generation Micro-Computer Aided Cost Estimating System (MCACES)), a detailed cost estimating software application that was developed in conjunction with Project Time & Cost LLC (PT&C). The costs for future replacement based on assumed failure is escalated 2% per year based on the average change for escalation based on PAX. Each option includes a demolition and disposal cost per mile as well.

The CWE's were built based on a one-mile increment. Productivity for walls other than concrete is based on 80%, this accounts for the ground being both flat and hilly. The work for the concrete options is based on 65% and there is a factor of 10% added to account for waste due to precast paneling getting destroyed upon placement due to uneven terrain. The current estimate assumes a 5% contingency and 5.7% Supervision, Inspection, and Overhead (SIOH) for USACE supervision. For this analysis, life cycle costs are the costs to construct, complete demolition at the end of the wall life, and reconstruct with a 2% per year rate of inflation.

3.5.4 Engineering Design Review Results

Engineering design review results for each submitted solution in the corresponding section.

Severity levels used in performance characterization statement are defined as follows:

Extensive: Large or complete re-design of foundation, wall, and/or observed construction techniques would be required to address challenges of (b) (7)(E)

Substantial: Major design changes to foundation, wall, and/or observed construction techniques would be required to address challenges of (b) (7)(E)

Moderate: Some design changes to foundation, wall, and/or observed construction techniques would be required to address challenges o (b) (7)(E)

Minimal: Minor or no design changes to foundation, wall, and/or observed construction techniques would be required to address challenges of (b) (7)(E)

3.5.4.1 Submitted Solution (b) (7)(E)

Table 53 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 53: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution accommodates (b) (7)(E) only with substantial additional features incorporated into design. (b) (7)(E) will requires significant deviation from submitted design, resulting in variance in appearance and function.
	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates (b) (7)(E)
	The submitted solution design features (b) (7)(E) ctions of foundation and (b) (7)(E) panels, (b) (7)(E) (b) (7)(E)
	The submitted solution is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

The construction cost estimate for (b) (7)(E) a wall made of precast concrete panels 36-feetby 10 feet, is (b) (5) per mile. The cost estimate is impacted by the design and construction techniques required to construct this wall. (b) (5) he life cycle cost estimate for this design is (b) (5)

3.5.4.2 Submitted Solution (b) (7)(E)

Table 54 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 54: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution accommodates (b) (7)(E) only with substantial additional features incorporated into design. (b) (7)(E) will requires significant deviation from submitted design, resulting in variance in appearance and function.
	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with substantial additional features incorporated into design.
	The submitted solution presents (b) (7)(E)
	The submitted solution is estimated to cost $ (b) (5) per mile to construct and has an estimated life cycle cost of $3 (b) (5)

The construction cost estimate for (b) (7)(E) a wall made of a combination pre-cast panels and a cast-in-place fill is (b) (5) . Construction costs (b) (5) The life cycle cost estimate for the (b) (7)(E) design is $ (b) (5)

3.5.4.3 Submitted Solution (b) (7)(E)

Table 55 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 55: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution accommodates (b) (7)(E) only with substantial additional features incorporated into design. (b) (7)(E) will requires significant deviation from submitted design, resulting in variance in appearance and function.
	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with substantial additional features incorporated into design.
	The submitted solution (b) (7)(E)
	The submitted solution is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

The construction cost estimate for (b) (7)(E) a wall made of (b) (7)(E) is (b) (5). This cost would (b) (5). The life cycle cost estimate of the (b) (7)(E) design is (b) (5)

3.5.4.4 Submitted Solution (b) (7)(E)

Table 56 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 56: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
(b) (7)(E)	The submitted solution accommodate (b) (7)(E) only with extensive additional features incorporated into design. (b) (7)(E) will requires extensive deviation from submitted design, resulting in variance in appearance and function.
	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with extensive additional features incorporated into design.
	The submitted solution presents (b) (7)(E) .
	The submitted solution is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

The construction cost estimate for (b) (7)(E) a (b) (7)(E) is (b) (5). The cost (b) (5). The life cycle estimate for the (b) (7)(E) design is (b) (5)

3.5.4.5 Submitted Solution (b) (7)(E)

Table 57 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 57: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
OBW-TR-07	The submitted solution accommodates (b) (7)(E) only with substantial additional features incorporated into design. (b) (7)(E) will requires significant deviation from submitted design, resulting in variance in appearance and function.
OBW-TR-08	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with substantial additional features incorporated into design.
OBW-TR-09	The submitted solution (b) (7)(E)
OBW-TR-11	The submitted solution is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

The construction cost estimate for (b) (7)(E) a (b) (7)(E) design, is (b) (5) This design is (b) (5) The life cycle cost estimate for the (b) (7)(E) design i (b) (5).

3.5.4.6 Submitted Solution (b) (7)(E)

Table 58 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 58: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
OBW-TR-07	The submitted solution accommodates (b) (7)(E) only with substantial additional features incorporated into design. (b) (7)(E) will requires significant deviation from submitted design, resulting in variance in appearance and function.
OBW-TR-08	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with substantial additional features incorporated into design.
OBW-TR-09	The submitted solution (b) (7)(E)
OBW-TR-11	The submitted solution is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

The construction cost estimate for (b) (7)(E) a (b) (7)(E) section design, is (b) (5). This design is (b) (5) The life cycle cost estimate for the (b) (7)(E) design is (b) (5)

3.5.4.7 Submitted Solution (b) (7)(E)

Table 59 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 59: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
OBW-TR-07	The submitted solution accommodate (b) (7)(E) only with minimal additional features incorporated into design.
OBW-TR-08	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with moderate additional features incorporated into design.
OBW-TR-09	The submitted solution (b) (7)(E)
OBW-TR-11	The submitted solution is e st (b) (5) per mile to construct and has an estimated life cycle cost o (b) (5)

The construction cost estimate for (b) (7)(E) a (b) (7)(E) , is (b) (5) This design is (b) (5) The life cycle cost estimate for the (b) (7)(E) design is (b) (5)

3.5.4.8 Submitted Solution (b) (7)(E)

Table 60 lists the Engineering Design Review Test Case performance characterization statements for the submitted solution (b) (7)(E)

Table 60: (b) (7)(E) ***Engineering Design Review Performance Characterization Statements***

Requirement	Performance Characterization Statement
OBW-TR-07	The submitted solution accommodates (b) (7)(E) only with minimal additional features incorporated into design.
OBW-TR-08	The submitted solution accommodates pedestrian and automated mechanized vehicle sliding gates only with moderate additional features incorporated into design.
OBW-TR-09	The submitted solution (b) (7)(E) .
OBW-TR-11	The submitted solution is estimated to cost (b) (5) per mile to construct and has an estimated life cycle cost of (b) (5)

The construction cost estimate for the (b) (7)(E) design, a (b) (7)(E) is (b) (5) This design is (b) (5) The life cycle cost estimate for the (b) (7)(E) design is (b) (5)

3.6 Stakeholder and Subject Matter Expert Feedback

Test team members documented stakeholder and subject matter expert feedback on the Border Wall Mock-ups and Prototypes. The primary source of feedback was from the breachers, scalers, and engineers onsite during the test event. The feedback was documented using TORs. The feedback is summarized in the results sections of the test cases. The full list of TORs is in Appendix B.

Appendix A RFP Requirements

Table 61 and Table 62 list the contract requirements for the Border Wall Mock-ups and Prototypes for Concrete and Other Material, respectively.

Table 61: Concrete Border Wall Requirements

Reference Name	Requirement	Test Strategy
(b) (7)(E)	The wall design shall be (b) (7)(E) .	Inspection – Constructability
	The wall design shall be physically imposing in height. The Government's nominal concept is for a (b) (7)(E) (b) (7)(E) high wall. Offerors should consider this height, but designs with heights of at least (b) (7)(E) may be acceptable. Designs with heights of less than (b) (7)(E) are not acceptable.	Inspection – Constructability
	I (b) (7)(E) (b) (7)(E)	Test – Scaling (b) (7)(E) scenario
	The wall design shall include (b) (7)(E) (b) (7)(E)	Test – Scaling (b) (7)(E)
	The wall shall (b) (7)(E) (b) (7)(E)	Inspection – Constructability
	The wall shall (b) (7)(E) (b) (7)(E)	Test – Breaching scenario
	The north side of wall (i.e. U.S. facing side) shall be aesthetically pleasing in color, (b) (7)(E) , etc., to be consistent with general surrounding environment. The manufacturing/construction process should facilitate changes in color and texture pursuant to site specific requirements.	Test – Paired comparison test Inspection – Constructability
	The wall design shall be able to accommodate (b) (7)(E)	Analysis – Design Review
	The wall design shall be able to accommodate Border Patrol approved design standards for pedestrian and automated mechanized vehicle sliding gates (b) (7)(E)	Analysis – Design Review
	The wall design shall be (b) (7)(E)	Analysis – Design Review
	(b) (7)(E)	Inspection - Constructability
	The wall design should be cost effective to construct, maintain and repair.	Analysis – Design Review

(b) (7)(E)	It is operationally advantageous that the design of (b) (7)(E) wall height (as measured from the highest adjacent grade) (b) (7)(E) (b) (7)(E)	Test – Breaching scenario

Table 62: Other Border Wall Requirements

Reference Name	Requirement	Test Strategy
(b) (7)(E)	The wall design shall be physically imposing in height. The Government's nominal concept is for a (b) (7)(E) (b) (7)(E) high wall. Offerors should consider this height, but designs with heights of at least (b) (7)(E) may be acceptable. Designs with heights of less than (b) (7)(E) are not acceptable.	Inspection – Constructability
	It shall (b) (7)(E) (b) (7)(E)	Test – Scaling unassisted scenario
	The wall design shall include (b) (7)(E) (b) (7)(E)	Test – Scaling with climbing aids scenario
	The wall shall (b) (7)(E) (b) (7)(E)	Inspection – Constructability
	The wall shall (b) (7)(E)	Test – Breaching scenario
	The north side of wall (i.e. U.S. facing side) shall be aesthetically pleasing in color, (b) (7)(E), etc., to be consistent with general surrounding environment. The manufacturing/construction process should facilitate changes in color and texture pursuant to site specific requirements.	Test – Paired comparison test Inspection – Constructability
	The wall design shall be able to accommodate (b) (7)(E).	Analysis – Design Review
	The wall design shall be able to accommodate Border Patrol approved design standards for pedestrian and automated mechanized vehicle sliding gates (b) (7)(E)).	Analysis – Design Review
	The wall design shall be (b) (7)(E).	Analysis – Design Review
	(b) (7)(E)	Inspection – Constructability
	The wall design should be cost effective to construct, maintain and repair.	Analysis – Design Review

(b) (7)(E)	Incorporating (b) (7)(E) but does not negate the requirements listed above is operationally advantageous.	Inspection – Constructability
	It is operationally advantageous that the design of (b) (7)(E) of wall height (as measured from the highest adjacent grade) (b) (7)(E)	Test – Breaching test scenario

Appendix B Test Observation Reports

Table 63 lists the Test Observation Reports collected during the Border Wall Mock-ups and Prototypes Test.

Table 63: Test Observation Reports

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171201 14:44	1	Prototype (b) (7)(E)	Climber Observation	(b) (7)(E)
20171201 11:14	2	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171204 09:30	3	(b) (7)(E)	Breach Team Observations	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171204 14:00	6	Prototype (b) (7)(E)	Climber Observation Alternate technique	(b) (7)(E)
20171204 14:00	7	Prototype (b) (7)(E)	Climber Observation	
20171204 09:48	8	Prototype (b) (7)(E)	Climber Observation	
20171204 09:29	9	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171204 10:57	10	Prototype (b) (7)(E)	Climber Observation	
20171204 11:41	11	Prototype (b) (7)(E)	Climber Observation	
20171204 11:59	15	(b) (7)(E)	Breach Team Observations	
20171205 09:32	17	Prototype [redacted] South Assisted	Climber Observation	
20171205 09:32	18	Prototype [redacted] South Assisted	Climber Observation	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171205 13:13	19	Prototype (b) (7)(E)	Climber Observation	(b) (7)(E)
20171205 09:35	20	(b) (7)(E)	Breach Team Observations	
20171205 13:50	23	(b) (7)(E)	Breach Team Observations	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171205 14:05	24	(b) (7)(E)	Breach Team Observations	(b) (7)(E)
20171205 14:57	25	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171205 10:36	26	Prototype (b) (7)(E)	Climber Observation	
20171205 14:57	27	Prototype (b) (7)(E)	Climber Observation	
20171205 09:43	28	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171205 14:00	30	(b) (7)(E)	Breach Team Observations	
20171205 09:15	31	Prototype (b) (7)(E)	Climber Observation Alternate technique	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 09:25	32	Prototype (b) (7)(E)	(b) (7)(E) Test	(b) (7)(E)
20171206 11:24	33	Prototype (b) (7)(E)	Test	
20171206 11:24	34	Prototype (b) (7)(E)	Test	
20171206 13:17	35	Prototype (b) (7)(E)	Test	
20171206 11:48	36	Prototype (b) (7)(E)	Test	
20171206 11:12	37	Prototype (b) (7)(E)	Test	
20171206 11:41	38	Prototype (b) (7)(E)	Test	
20171206 13:07	39	Prototype (b) (7)(E)	Test	
20171206 14:35	40	Prototype (b) (7)(E)	Climber Observation	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206	41	Prototype [redacted]	Climber Observation	(b) (7)(E)
20171206 14:39	42	Prototype all	Climber Observation Alternate technique	
20171206 15:00	43	Prototype [redacted]	Climber Observation Alternate technique	
20171206 14:30	44	Prototype [redacted]	Climber Observation Alternate technique	
20171206 13:14	45	Prototype [redacted]	Climber Observation	
20171206 14:35	46	Prototype [redacted]	Climber Observation	
20171206 07:28	47	Prototype [redacted]	Climber Observation Alternate technique	
20171206 15:00	48	Prototype [redacted]	Climber Observation Alternate technique	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206:07:36	49	Prototype [redacted]	Climber Observation Alternate technique	(b) (7)(E)
20171206 14:35	50	Prototype [redacted]	Climber Observation	
20171206 14:35	51	Prototype [redacted]	Climber Observation	
20171206 07:43	52	Prototype [redacted]	Climber Observation Alternate technique	
20171206 15:00	53	Prototype [redacted]	Climber Observation Alternate technique	
20171206 07:52	54	Prototype [redacted]	Climber Observation Alternate technique	
20171206 14:30	55	Prototype [redacted]	Climber Observation Alternate technique	
20171206 07:54	56	Prototype [redacted]	Climber Observation	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 14:35	57	Prototype (b)(7)(E)	Climber Observation	(b)(7)(E)
20171206 14:35	58	Prototype (b)(7)(E)	Climber Observation	
20171206 08:02	59	Prototype (b)(7)(E)	Climber Observation Alternate technique	
20171206 15:00	60	Prototype (b)(7)(E)	Climber Observation Alternate technique	
20171206 08:04	61	Prototype (b)(7)(E)	Climber Observation Alternate technique	
20171206 08:05	62	Prototype (b)(7)(E)	Climber Observation Alternate technique	
20171206 14:30	63	Prototype (b)(7)(E)	Climber Observation Alternate technique	
20171206 08:08	64	Prototype (b)(7)(E)	Climber Observation	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 14:35	65	(b) (7)(E) otype	Climber Observation	(b) (7)(E)
20171206 10:52	66	Prototype (b) (7)(E)	(b) (7)(E)	
20171206 13:10	67	Prototype (b) (7)(E)		
20171206 11:08	68	Prototype (b) (7)(E)		

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 10:14	69	Prototype (b) (7)(E)	(b) (7)(E)	(b) (7)(E)
20171206 14:35	70	Prototype	Climber Observation	
20171206 8:51	71	Prototype	Climber Observation Alternate technique	
20171206 14:30	72	Prototype	Climber Observation	
20171206 15:00	73	Prototype	Climber Observation	
20171206 09:01	74	Prototype	Climber Observation Alternate technique	
20171206 15:00	75	Prototype	Climber Observation	
20171206 09:03	76	Prototype	Climber Observation	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 12:55	77	Prototype (b) (7)(E)	(b) (7)(E) inspection	(b) (7)(E)
20171206 14:35	78	Prototype (b) (7)(E)	Climber Observation	
20171206 14:56	79	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171206 14:30	80	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171206 09:14	81	Prototype (b) (7)(E)	Climber Observation	
20171206 09:17	82	Prototype (b) (7)(E)	Climber Observation	
20171206 14:30	83	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171206 15:00	84	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171206 09:19	85	Prototype (b) (7)(E)	Climber Observation Alternate technique	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 09:27	86	Prototype [redacted]	Climber Observation	(b) (7)(E)
20171206 14:35	87	Prototype [redacted]	Climber Observation	
20171206 14:30	88	Prototype [redacted]	Climber Observation Alternate technique	
20171206 15:00	89	Prototype [redacted]	Climber Observation Alternate technique	
20171206 09:49	90	Prototype [redacted]	Climber Observation Alternate technique	
20171206 09:51	91	Prototype [redacted]	Climber Observation	
20171206 14:35	92	Prototype [redacted]	Climber Observation	
20171206 14:35	93	Prototype [redacted]	Climber Observation	
20171206 15:00	94	Prototype [redacted]	Climber Observation Alternate technique	
20171206 10:14	95	Prototype [redacted]	Climber Observation Alternate technique	
20171206 14:30	96	Prototype [redacted]	Climber Observation Alternate technique	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171206 10:15	97	Prototype (b) (7)(E)	Climber Observation Alternate technique	(b) (7)(E)
20171206 14:35	98	Prototype (b) (7)(E)	Climber Observation Alternate technique	
20171206 11:04	99	Prototype (b) (7)(E)	(b) (7)(E)	
20171206 10:30	100	Prototype (b) (7)(E)		
20171206	101	(b) (7)(E)	Breach Team Observations	
20171206 08:00	102		Breach Team Observations	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171208 08:15	103	(b) (7)(E)	Breach Team Observations	(b) (7)(E)
20171208 08:15	104		Breach Team Observations	
20171212 07:34	105		Breach cancelled	
20171213 11:14	106		Breach Team Observations	
20171213 11:17	107		Breach Team Observations	
20171213 11:18	108		Breach Team Observations	

Date/Time	TOR Number	TOR Location	TOR Subject	TOR Description
20171213 11:27	109	(b) (7)(E)	Breach Team Observations	(b) (7)(E)

Appendix C Acronyms

The acronyms used within this document are listed below.

BORTAC	Border Patrol Tactical Unit
CBP	Customs and Border Protection
CORE	Common Operating Response Environment
CRD	Capability and Requirements Division
CWE	Current Working Estimate
DSR	Daily Status Report
IDIQ	Indefinite Delivery Indefinite Quantity
I&D	Impedance & Denial
MARSOC	Marine Special Operations Command
MCACES	Micro-Computer Aided Cost Estimating System
MII	Manufacturing Intelligence and Integration
OFAM	Office of Facilities and Asset Management
RFP	Request for Proposal
TEA	Test Execution Analyst
TEGR	Test Event Gate Review
TOR	Test Observation Report
QLB	Quick-Look Brief
S&A	Supervision and Administration
SIOH	Supervision, Inspection, and Overhead
USACE	United States Army Corps of Engineers
USBP	U.S. Border Patrol
USSOCOM	United States Special Operations Command
V&V	Verification & Validation