



Harborwalk Structural Assessment for the City of Georgetown, SC

August 17th, 2017

Prepared for:

City of Georgetown Engineering Department
2377 Maybank Drive 29440
PO Box 939, Georgetown, SC 29442

Prepared by:

COLLINS
ENGINEERS INC.

225 Seven Farms Drive, Suite 100
Charleston, South Carolina 29492
843.884.2027 • www.collinsengr.com
Project No. 40-9844

Contents

EXECUTIVE SUMMARY	3
1.0 INTRODUCTION	4
1.1 Purpose and Scope.....	4
1.2 Site Description.....	4
1.3 Inspection Team.....	6
2.0 OBSERVATIONS	6
2.1 Procedure.....	6
2.2 Condition Assessments.....	6
3.0 LOAD RATING	20
3.0 RECOMMENDATIONS	21
4.0 CONCLUSION	21
Appendix A: 2010 Historic Renovation Plans	22
Appendix B: ASCE Waterfront Inspection Manual Excerpts	32

EXECUTIVE SUMMARY

- Project:** City of Georgetown Harborwalk Above-Water Emergency Assessment
- Purpose of Project:** To review the structural condition of the Harborwalk located in downtown Georgetown, SC. The Harborwalk was constructed with timber piles, framing, and decking.
- Inspection Team:** Team Leader – Brian Rhett, PE
Team Member – Will Gwaltney
- Inspection Date:** August 15, 2017

Summary of Findings:

Deteriorated elements were observed at a number of locations along the Harborwalk. The following is a summary of the typical deterioration observed:

- The inspected elements, which included treated timber decking, stringers, pile caps, piles, and cross bracing, and associated galvanized steel connection hardware, were generally in satisfactory condition.
- Approximately 15 percent of the cross bracing exhibited significant deterioration and may require replacement within the next 5 to 10 years.
- Isolated areas with structural defects significant enough to warrant structural analysis were observed along the Harborwalk. A list of these defects is provided in Section 2.2.
- One split pile cap at Station 2+60 was determined to have significant enough deterioration to reduce the local load-carrying capacity of the Harborwalk. Station 2+60 is located between Broad St. and Screven St. (in front of the empty lot).
- The load rating for the fixed walkways and landings indicated that the boardwalk has a capacity of 100 pounds per square foot (psf), which is a typical load capacity for a public access area with pedestrian traffic. **The load rating for the span supported by the defect at Station 2+60 is 60 psf**, which is reduced due to a full-penetration crack in the stringer which passes through the bottom bolt.

Loading should be restricted near Station 2+60 until the stringer is repaired, and it is recommended that other deteriorated stringers and cross bracing be repaired within a year of the date of the inspection. An underwater inspection to monitor and determine the severity of marine borer activity in the piles and cross bracing should be conducted as soon as possible to further assess the Harborwalk's structural capacity and establish a baseline for future inspections.

1.0 INTRODUCTION

1.1 Purpose and Scope

Collins Engineers Inc. (Collins) was engaged by the City of Georgetown (the City) to perform an above-water structural assessment of the condition of the approximately 1,480 foot long Harborwalk located along the Sampit River in Georgetown, South Carolina. The Harborwalk is comprised of a fixed timber walkway with numerous floating finger-piers which are used for berthing. Collins was engaged to review the condition of the Harborwalk due to hardware corrosion and other timber defects observed by the City of Georgetown Engineering Department. See Figure 1.1-1 for an overall view of the site.



Figure 1.1-1. Satellite View of the Harborwalk

1.2 Site Description

The Harborwalk, which was reportedly constructed along the northeastern bank of the Sampit River in the 1980's, extends approximately 1,480 feet in the northwest-southeast direction. According to the City, no original construction drawings exist, but a set of renovation plans generated by Collins Engineers, Inc. and dated January 2010 were available for review (Appendix A). The dock is comprised of a 12-foot wide walkway (Appendix A, Fig No.2, Section B-B) between Stations 0+00 and 10+40 and an 8-foot wide walkway (Appendix A, Fig No. 6, Section H-H) between Stations 10+40 and 14+80. Landings were constructed at isolated/various locations along the Harborwalk. The structural elements typically consist of treated southern yellow pine timber, with untreated Brazilian ipe timber for decking and handrails. Refer to Appendix A, Figure 1 for stationing and Photographs 1 through 2 for inspection nomenclature.



Photo 1: Typical Bent – Southeastern section, 12 foot wide (Sta. 0+30)



Photo 2: Typical Bent – Northwestern section, 8 foot wide (Sta. 13+70)

1.3 Inspection Team

The assessment was performed on August 15, 2017 by a two-person team, one of whom is licensed Professional Engineer. The assessment was purely visual and tactile in nature; no destructive testing or material sampling was performed.

2.0 OBSERVATIONS

2.1 Procedure

The assessment was conducted from the waterway via a jon boat and from the topside of the Harborwalk. The inspection was performed using visual and tactile methods in accordance with the ASCE Manual No. 130 *Waterfront Facilities Inspection and Assessment*. Marine growth was removed at suspect locations to better observe defects. In order to document defects, stationing was established along the Harborwalk starting from the southeastern end (Sta. 0+00) and moving to the northwestern end (Sta. 14+80). Refer to Appendix A for a plan view of the Harborwalk with stationing.

2.2 Condition Assessments

Overall, the boardwalk was in *Fair Condition*: most primary structural elements are in sound condition, but minor to moderate defects/deterioration were observed. One isolated area was significant enough to decrease the load bearing capacity of the structure; this local area is considered to be in *Poor Condition*. Refer to Table 2 in Section 3 for additional information regarding this structurally deficient area. The typical structural deficiencies observed included minor-to-moderate marine borer activity in the piles and cross bracing, minor-to-major cracking of the split-cap and cross bracing, and minor-to-major deterioration of the connection hardware. General defects are defined below in Section 2.2.1 and significant defects are described in Section 2.2.2. Defect ratings (Minor, Moderate, Major, Severe Condition) are defined below and in Appendix B.

2.2.1 Typical Conditions

Defects and conditions that were observed throughout the Harborwalk are documented below based on general size of defect, location on the structural element, and condition rating. Specific defects are documented in Section 2.2.2. Percentages and estimates are based on engineering experience and are approximate.

EMERGENCY ASSESMENT

City of Georgetown Harborwalk
Georgetown, SC • August 15, 2017

1. Timber Piles- approximately 90 percent of piles exhibited rot and/or fungal decay with less than 5 percent section loss (Minor Condition). Approximately 10 percent of the piles exhibited marine borer activity near the low water line. Marine borer activity was typically localized to a quadrant of the pile and estimated maximum section loss of approximately 15 percent (Moderate Condition, Photo 3). With the exception of the piles with observed marine borer activity, the wood treatment appears to be functioning.
2. Split Cap/Pile Cap- Approximately 95 percent of the caps were in Minor Condition: all exhibited rot and/or fungal decay with less than 5 percent section loss. Approximately 20 percent of the caps also exhibited minor cracking less than 1/8 inch wide that had not penetrated through the entire member cross section (Photo 4). The remaining 5 percent (approximate) were in Major Condition with splits/cracks that penetrated the full depth of the member. The caps rated in Major Condition are outlined in Section 2.2.2.
3. Stringers- Approximately 95 percent of stringers were in Minor Condition with minimal rot and fungal decay observed (Photo 5). Approximately 5 percent of stringers were observed to have cracks up to 1/2 in wide (Minor to Moderate Condition, Photo 6); these cracks were all located on fascia stringers and do not appear to affect the structural capacity of the Harborwalk.
4. Decking- all decking was observed to have minimal ultraviolet (UV) damage and isolated areas of surface fungal growth (No Defects, Photo 7).
5. Connection Hardware- Approximately 75 percent of the connection hardware was in Minor Condition with surface rust and oxidation of the galvanized coating. Approximately 20 percent of the connection hardware was in Moderate Condition with pitting and flaking corrosion that was typically localized to the washer and bolt (Photo 8). The remaining 5 percent (approximate) was in Major Condition with 25-to-50 percent section loss; the significantly corroded hardware was typically located within the tidal/splash zone and was connecting cross bracing to piles (not a primary structural connection).
6. Fender Pile Connection Hardware- Approximately 80 percent of the fender connection hardware was in Minor Condition with surface rust and oxidation of the galvanized coating. Approximately 15 percent of connection hardware was in Major Condition with corroded hardware exhibiting pitting and flaking corrosion that was typically localized to the washer and bolt (Photo 8). The remaining 5 percent (approximate) was in Severe Condition with 50 to 100 percent section loss (Photo 10); while these hardware connections were often completely failed, they do not affect the structural capacity of the Harborwalk, as the connection is simply a restraint for fender piles.

EMERGENCY ASSESMENT

City of Georgetown Harborwalk

Georgetown, SC • August 15, 2017

7. Cross Bracing- Approximately 15 percent of the braces were observed to have marine borer activity with section loss up to 25-to-40 percent of the cross section (Major Condition, Photo 11). The remaining 85 percent (approximate) exhibited rot and/or fungal decay primarily within the tidal/splash zone; approximately 5-to-10 percent section loss was typically observed in this zone (Moderate Condition, Photo 12).



Photo 3: Pile – Typical marine borer damage (Moderate, Sta. 0+10)



Photo 4: Split Cap – Typical minor crack, typical fungal growth (Minor, Sta. 0+30)



Photo 5: Underside – Typical condition stringer and pile cap



Photo 6: Stringer – Cracking on fascia (Minor, Sta. 1+50)



Photo 7: Deck – Typical deck condition (Sta. 13+50)



Photo 8: Hardware – Typ. surface corrosion (bottom) and oxidation of galvanization (top)



Photo 9: Fender Pile Hardware – Severe Condition



Photo 10: Fender Pile Hardware – Severe Condition (Failed, Sta. 0+49)



Photo 11: Cross Brace – Major marine borer damage (Major, Sta. 0+10)



Photo 12: Cross Brace – Typical marine borer damage (Moderate, Sta. 0+15)

2.2.2 Inspection Records

Defects and conditions that were atypical or significant enough to potentially reduce the load-carrying capacity of the structure are described in the below table. Photographs of defects follow the table.

Table 1: Inspection Record

ELEMENT	DEFECT	DIMENSION	STATION	RATING
Cap	Crack/Split	½" wide by 6' long by full member depth	2+60	Major (Photo 13, Photo 14)
Cap	Crack/Split	¼" wide by 5' long by full member depth	2+90	Major (Photo 15)
Cap	Crack/Split	¼" wide by 6' long by full member depth	6+15	Major (Photo 17, Photo 18)
Cap	Crack/Split	¼" wide by 7' long by full member depth	7+65	Major (Photo 19)
Cap	Crack/Split	½" wide by 6' long by full member depth	8+15	Major (Photo 20)
Cap	Impact Damage	6" high by 18" wide by full member depth	10+80	Major (Photo 21)
Cap	Crack/Split	¼" wide by 5' long by full member depth	10+90	Moderate (Photo 22)
Cross Brace	Crack/Split	Connection compromised	3+10, 4+95, 6+90	Major (Photo 16)



Photo 13: Split Cap – Face View, Full penetration crack (Major, Sta. 2+60)



Photo 14: Split Cap – End View, Full penetration crack (Major, Sta. 2+60)



Photo 15: Split Cap – End View, Full penetration crack (Major, Sta. 2+90)



Photo 16: Cross Brace – Split at end with heavily corroded hardware (Major, Sta. 4+95)



Photo 17: Split Cap – Face View, Full penetration crack (Major, Sta. 6+15)



Photo 18: Split Cap – End View, Full penetration crack (Major, Sta. 6+15)



Photo 19: Split Cap – Full penetration crack (Major, Sta. 7+65)



Photo 20: Split Cap – Full penetration crack (Major, Sta. 8+15)



Photo 21: Split Cap – Impact damage on outboard end (Major, Sta. 10+80)



Photo 22: Split Cap – Full penetration crack (Major, Sta. 10+90)

3.0 LOAD RATING

At the request of the City of Georgetown, a load rating of the Harborwalk was performed based on the observed conditions and dimensions. The analysis was performed in accordance with the National Design Specifications for Wood Construction and ASCE 7: The Minimum Design Loads for Buildings and Other Structures. The decking, stringers, and pile caps of the main walkways and landings were analyzed to determine their respective structural capacity for gravity loading. Areas with observed defects were analyzed to determine reduced structural capacity. The structural bearing capacity of the piles could not be assessed due to insufficient historical data on embedment length and pile grade. The gangways, floating platforms, and finger piers were not assessed during this analysis nor was analysis conducted for lateral loadings.

According to Collins' structural analysis, the areas of the Harborwalk in **Fair Condition have a live load capacity of 100 pounds per square foot (psf)**, which is the typical load capacity for a public access area with pedestrian traffic. The area assessed to be in **Poor Condition has a reduced load capacity of 60 psf**; until the split cap can be replaced. The area deemed to be in Poor Condition due to structural deterioration is listed below.

Table 2: Deficient Areas (Poor Condition per ASCE Manual No. 130)

STATION	DEFECT	APPROX. LOCATION	LOAD RATING
2+50 to 2+65	2+60 - Crack/Split in Split Cap	Directly between Broad St. and Screven St. (In front of empty lot)	60 PSF (for the span supported by the deteriorated cap)

3.0 RECOMMENDATIONS

Following are Collins' recommendations for the Georgetown Harborwalk.

- Restrict pedestrian loading from Stations 2+50 to 2+65 (verify in field) until repairs are made to the damaged split caps.
- Pile Caps – Repair the deficient split caps listed in Table 1, with priority given to the split caps at Stations 2+60 and 10+80. Cracks in the caps with minor and moderate ratings should be monitored on a two year above-water inspection cycle.
- Cross Bracing – Repair deficient cross bracing and cross bracing connections.

It is recommended that an underwater inspection be conducted to further investigate and document the observed damage caused by marine borers and to assess the condition of underwater structural elements.

4.0 CONCLUSION

Collins Engineers, Inc. (Collins) performed a structural and inspection assessment of the Harborwalk in Georgetown, South Carolina. The assessment was performed on August 15, 2017 to determine the condition of the Harborwalk and to determine the load capacity of the structure based on deficiencies observed. Deteriorated elements should be monitored and repaired as necessary to ensure continuous operation of the Harborwalk.

No warranty, expressed or implied, is provided by Collins Engineers, Inc. for this assessment or report.

Collins appreciates the opportunity to work with the City of Georgetown on this project and looks forward to working with you in the future. We would be happy to discuss any aspect of this report with you in person or via phone or email.

Respectfully submitted,
COLLINS ENGINEERS, INC.



Jonathan Sigman, P.E.

Appendix A: 2010 Historic Renovation Plans

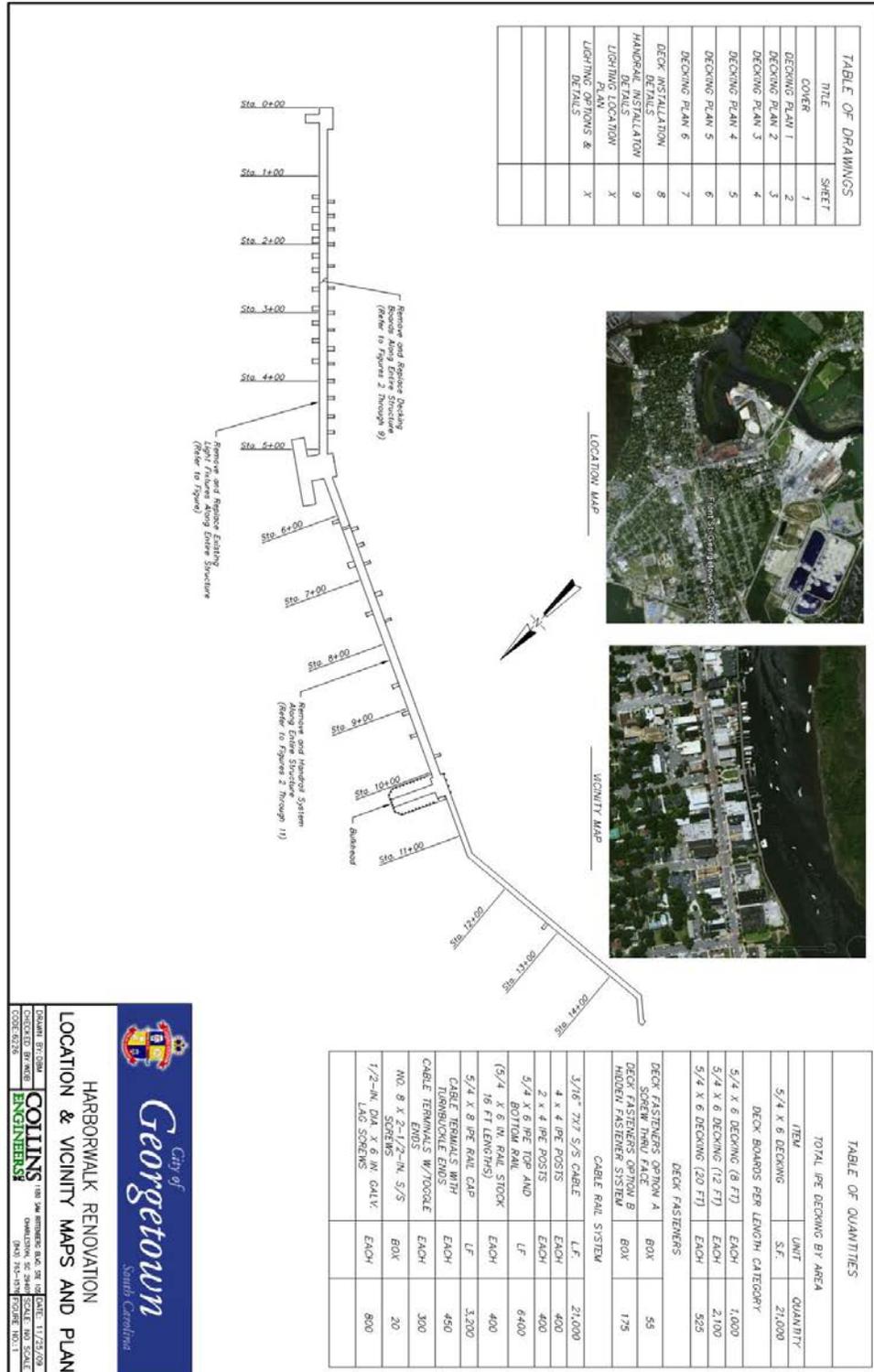


TABLE OF DRAWINGS

TITLE	SHEET
COVER	1
DECKING PLAN 1	2
DECKING PLAN 2	3
DECKING PLAN 3	4
DECKING PLAN 4	5
DECKING PLAN 5	6
DECKING PLAN 6	7
DECK INSTALLATION DETAILS	8
HANDRAIL INSTALLATION DETAILS	9
LIGHTING LOCATION PLAN	X
LIGHTING FIXTURES & DETAILS	X



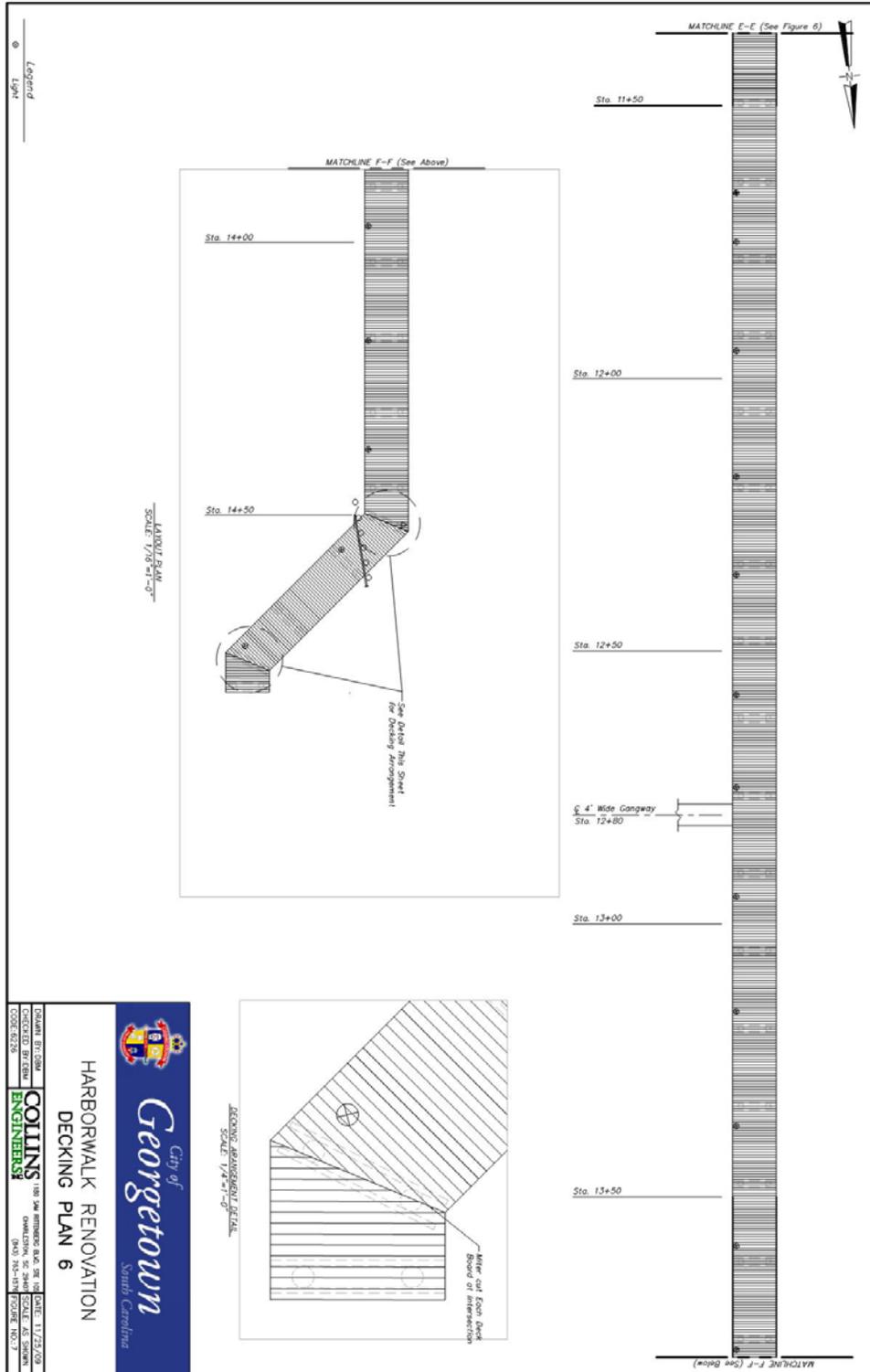
City of Georgetown
 Sandi Carlina

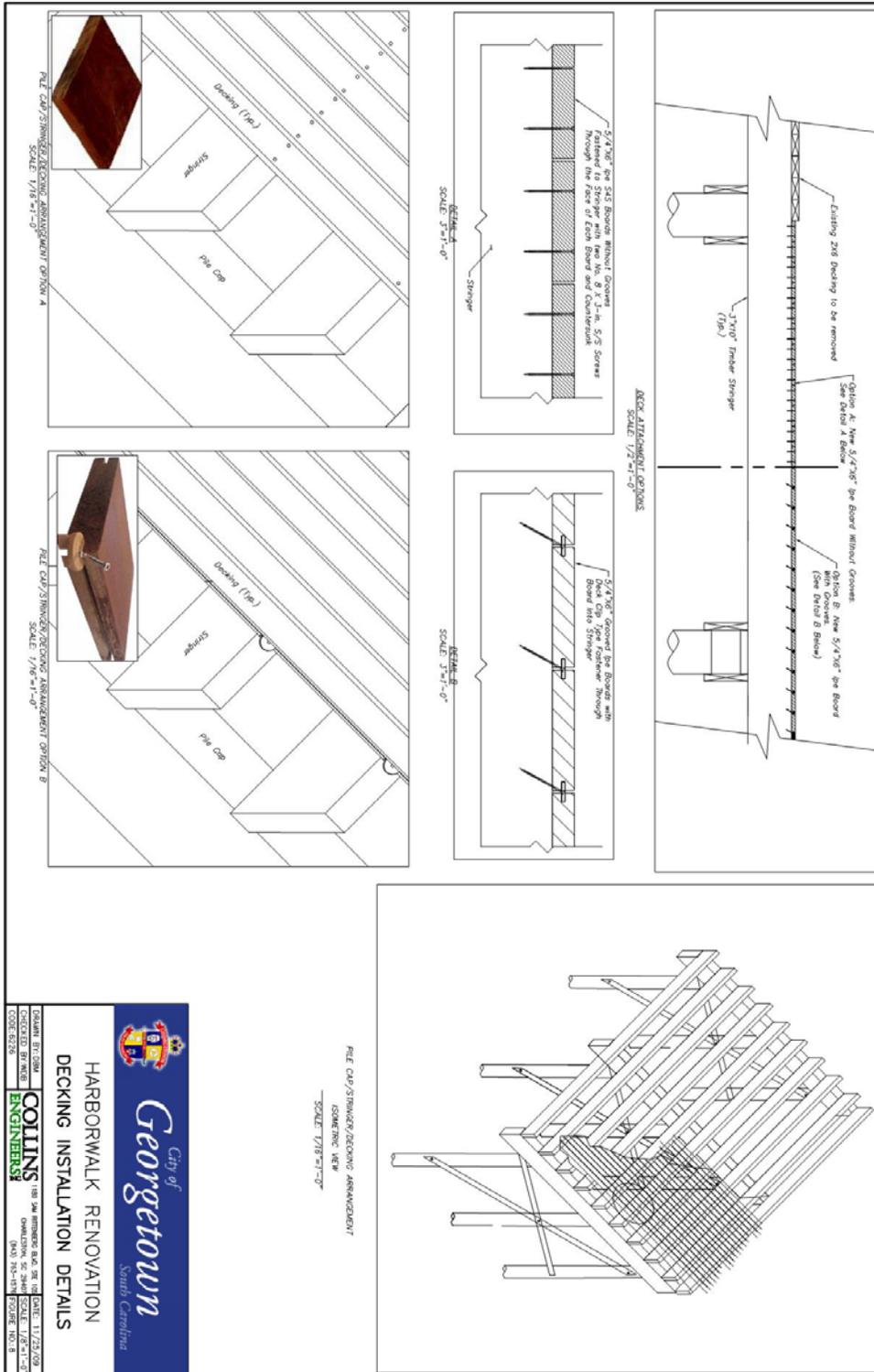
**HARBORWALK RENOVATION
 LOCATION & VICINITY MAPS AND PLAN**

DESIGN: ST. CLAIR
 CHECKED: BR. WALKER
 ENGINEERS

DATE: 11/23/09
 SCALE: 1"=40'-0"
 SCALE: 1"=40'-0"
 SCALE: 1"=40'-0"

EMERGENCY ASSESSMENT
 City of Georgetown Harborwalk
 Georgetown, SC • August 15, 2017






City of Georgetown
South Carolina
HARBORWALK RENOVATION
DECKING INSTALLATION DETAILS
COLLINS ENGINEERS
 1001 S.W. 10TH AVE. SUITE 200
 MIAMI, FL 33135
 (305) 375-1000
 FAX: (305) 375-1001
 WWW.COLLENG.COM
 DATE: 11/22/09
 SCALE: 1/2" = 1'-0"
 DRAWING NO.: 8

Appendix B: ASCE Waterfront Inspection Manual Excerpts

The following tables and graphics are taken from the ASCE Manuals and Reports on Engineering Practice No. 130, "Waterfront Facilities Inspection and Assessment."

Table 2-14. Condition Assessment Ratings

Rating	Description
6 Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
5 Satisfactory	Limited minor to moderate defects or deterioration observed, but no overstressing observed. No repairs are required.
4 Fair	All primary structural elements are sound, but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present, but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
3 Poor	Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2 Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components. Local failures are possible, and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1 Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

Table 2-4. Damage Ratings for Timber Elements

Damage Rating	Existing Damage ^a	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI Not Inspected	<ul style="list-style-type: none"> Not inspected, inaccessible, or passed by^b 	
ND No Defects	<ul style="list-style-type: none"> Sound surface material 	
MN Minor	<ul style="list-style-type: none"> Checks, splits, and gouges less than 0.5 in. wide Evidence of marine borers or fungal decay 	Minor damage not appropriate if <ul style="list-style-type: none"> Loss of cross section Marine borer infestation Displacements, loss of bearing, or connections
MD Moderate	<ul style="list-style-type: none"> Remaining diameter loss up to 15% Checks and splits wider than 0.5 in. Cross section area loss up to 25% Corroded hardware Evidence of marine borers or fungal decay, with loss of section 	Moderate damage not appropriate if <ul style="list-style-type: none"> Displacements, loss of bearing or connections

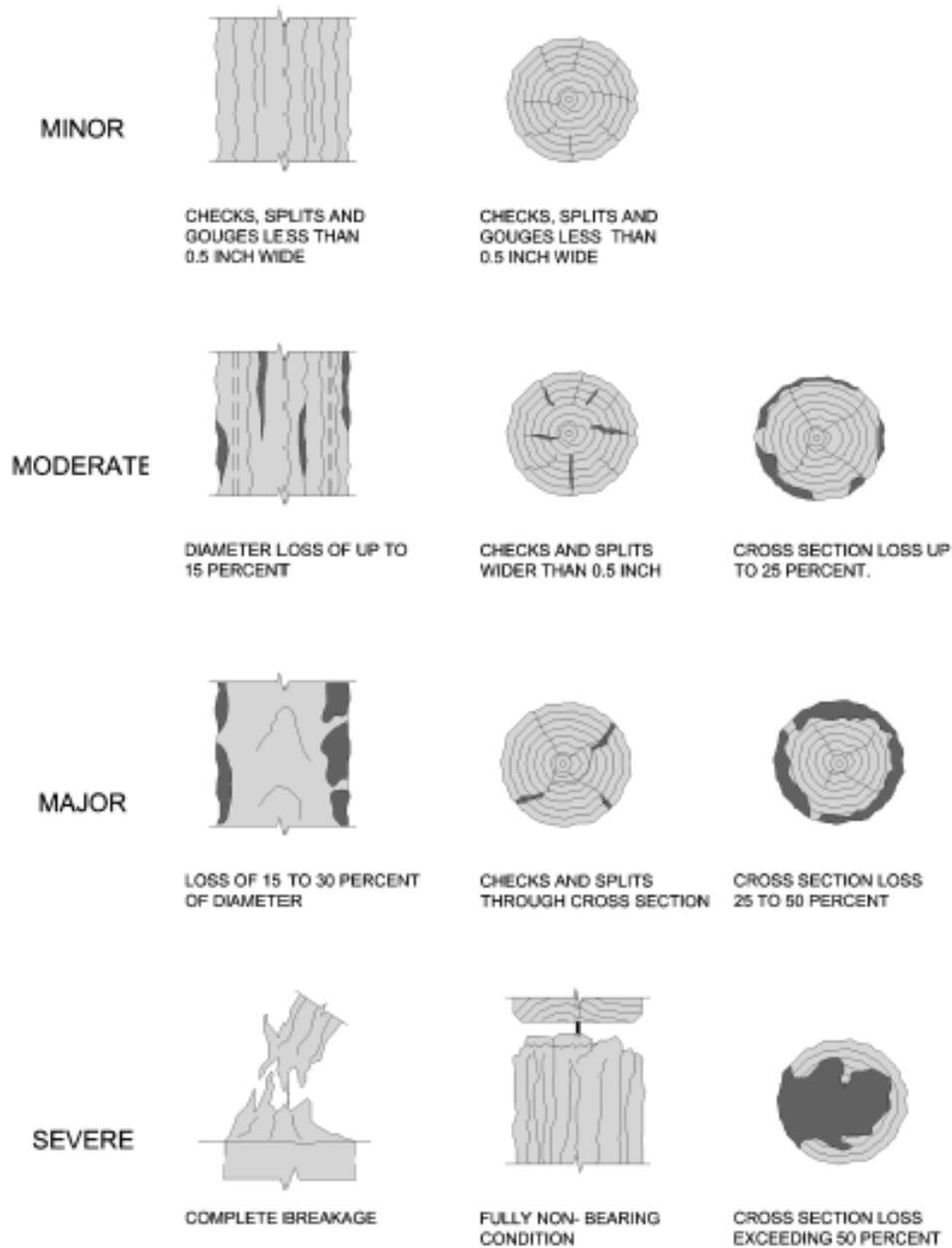
(Continued)

Table 2-4. Damage Ratings for Timber Elements (Continued)

Damage Rating	Existing Damage ^a	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
MJ Major	<ul style="list-style-type: none"> Remaining diameter loss 15 to 30% Checks and splits through full depth of cross section Cross-section area loss 25 to 50%; heavily corroded hardware Displacement and misalignments at connections 	Major damage not appropriate if <ul style="list-style-type: none"> Partial or complete breakage
SV Severe	<ul style="list-style-type: none"> Remaining diameter loss more than 30% Cross section area loss more than 50% Loss of connections and/or fully nonbearing condition Partial or complete breakage 	

^a Any defect listed below is sufficient to identify relevant damage grade.

^b If not inspected due to inaccessibility or passed by, note as such.



*Fig. 2-2. Condition ratings for timber elements
 Source: Courtesy of CH2M HILL, Inc. and COWI, Inc., reproduced with
 permission.*