

# Sutton-on-sea

# Follow-Up Structural Inspection Report 03 on North Colonnade

For East Lindsey District Council

Project number: 60586167 60586167-ELDC-ACM-REP-0001-P1

7<sup>th</sup> February 2019

## Quality information

Prepared by	Checked by	Verified by	Approved by
C. Robinson	Tom Howse	Brian Ward	Brian Ward
Principal Engineer	Engineer	Technical Director	Technical Director

## **Revision History**

Revision	Revision date	Details	Authorized	Name	Position
P1	7-2-19	First Edition		Brian Ward	Technical Director

### **Distribution List**

# Hard Copies	PDF Required	Association / Company Name
	1	ELDC

#### Prepared for:

East Lindsey District Council

#### Prepared by:

C. Robinson Principal Engineer T: 0115 907 7015 E: Colin.robinson@AECOM.com

AECOM Infrastructure & Environment UK Limited 12 Regan Way Chetwynd Business Park Nottingham NG9 6RZ United Kingdom

T: +44 (115) 907 7000 aecom.com

#### Prepared in association with:

1. SCAPE

© 2019 AECOM Limited. All Rights Reserved.

This document has been prepared by AECOM Limited ("AECOM") for sole use of our client (the "Client") in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

## **Table of Contents**

Executive Summary	5
1. Introduction	7
2. Summary of Previous Inspections	8
3. Site Inspection 03	9
4. Visual Observations of Concrete Defects	10
5. Recommendations and Conclusions	26
Appendix A	28
Drawings	28
Appendix B	31
Summary of Sketch of Visual Concrete Defects	31

Project number: 60586167



Photo no. 01: North West Elevation of Colonnade in Sept 2018

## **Executive Summary**

AECOM was commissioned by East Lindsey District Council (ELDC), on 16th August 2018, to undertake a series of structural inspections to the north section of the historic concrete Colonnade which is partly open to the public at the Pleasure Gardens, Sutton-on-sea. The assets required to be inspected comprised a single-storey, reinforced-concrete (RC) structure whose east rear spine wall was built abutting the (landside) side of the North Sea shoreline defence structure. The west side of the structure faces the Pleasure Gardens and the bowling green situated at a lower ground level. The first floor of the structure is at the raised promenade level which was accessed by two built-in staircases until they were closed off, to the public, for essential maintenance. A number of beach huts have recently been removed, from the first floor slab of the northern and central sections of the Colonnade, by ELDC, leaving just ten huts on the southern section. The north colonnade structure also forms a covered walkway to the north staircase (GL B-E & 1-3) which formally housed a shop and café until they were recently closed for essential maintenance.

The aim of the follow-up structural inspections, as recommended in the Condition Report on the Concrete Colonnade by AECOM (Ref 60586167-ELDC-ACM-REP-0001-P1) in June 2018, was to visually inspect and hammer test the RC structure leading to the north staircase. This was to ensure that the route was safe to remain open to the public for another 10 weeks, until robust remedial measures undertaken, or the structure isolated from public use.

For this third follow-up visual inspection the Client requested an additional review of the upper surface of the first floor slab exposed by the removal of the beach huts, and advice on erecting additional temporary props, to the first floor, in the toilet of the café. The brief to AECOM excluded inspection of timber members, beach huts, ancillary equipment and services.

The ageing structure is exhibiting common defects for a reinforced concrete design, understood to be constructed between 1948 and 1955 (although anecdotal local reports suggest an earlier inception), and exposed to an aggressive marine environment. Some of the concrete defects are currently affecting the safe use of the structure as there is a potential risk of small sections of concrete cover to the reinforcement being forced off by ferrous oxide expansion from the higher sections of the structure and falling and potentially injuring persons moving close to and/or within the structure. This safety risk is expected to increase with time unless robust remedial measures are undertaken or parts of the structure decommissioned from its present usage. Some temporary safety provisions have already been implemented on site in the form of solid barrier fences and structural props to the enclosed area under the first floor. These temporary provisions separate sections of the structure from public access and will need to be maintained by the client until remedial measures are implemented.

The previous inspection undertaken on 29<sup>th</sup> October 2018, to the inside the suspended ceiling in the café revealed four hairline cracks in the roof slab, across the width of the café, which had reportedly leaked water. Steel drip trays had been fixed to the underside of three of the cracks to collect and drain off the water to overflow pipes. Three of the four cracks reflected the repaired cracks on the roof slab, at promenade level, that were observed during the May 2018 inspections. The drip trays under three of the roof slab cracks prevented close inspection and the assessment of the degree of concrete degradation. A spalled area of concrete GL 2, E-F was also slowly dripping water onto an existing fibre ceiling tile. Following the observation in the toilet of the café, a

large piece (approx. 0.5m square) of spalled concrete on the soffit of the roof slab was observed. A temporary prop has been erected by the client and the cafe taken out of use for essential maintenance.

The third of the follow-up inspections, undertaken on 24<sup>th</sup> January 2019, revealed more hollow concrete along the lower rear edge of the central down-stand beams GLs 2, C-G. These sections were not removed but recommended to be supported by additional temporary props at 1.5m centres with scaffold boards as spreader boards. This was because the staircase access had been closed off to the public by solid barrier fences for essential maintenance. Two of the earlier visible cracks on the soffit of the first floor slab were now exhibiting damp patches with one or two droplets of water visible. Three small areas of the top edge on the front Fascia beam (GL 1, H to K, and K to L.) at first floor slabs, had cracked further and were removed for safety reasons. There was further cracking to a section of hollow concrete identified on the rear corner of the column GL 1F, at mid height, (outside café) which was removed for safety reasons. The north staircase, south side wall, top faces had developed additional hairline cracks with rust stains. The north side wall of staircase additional had developed a small area of hollow concrete towards the top of the stair flight. Waterproofing of the 25 small openings, observed through the first floor slab, should be considered in the short term otherwise water ingress into structure will potentially cause additional structural deterioration over time.

The recommendation from the inspection was that the walkway to the north staircase should stay closed to the public. In view of the continued concrete degradation, a further 10 weekly inspections should be undertaken by an appropriately qualified engineer to ensure that the existing structure does not need more temporary propping for structural stability. Therefore it is recommended that the next structural inspection of the north colonnade should be undertaken on the 26<sup>th</sup> March 2019.

## 1. Introduction

AECOM was commissioned by East Lindsey District Council, under the SCAPE consultancy framework agreement, on 16th August 2018, to undertake a series of six structural inspections to the north section of the historic concrete Colonnade while it was partly open to the public, at the Pleasure Gardens, Sutton-on-sea. The assets required to be inspected comprised a single-storey, reinforced-concrete (RC) structure whose east rear (spine) wall was built abutting the (landside) side of the North Sea defence structure, which is owned by the Environment Agency. A number of beach huts have recently been removed from the first floor slab of the northern and central sections of the Colonnade by ELDC, leaving just ten huts on the southern section.

The west side of the structure faces the Pleasure Gardens and the bowling green situated at a lower ground level. The north colonnade structure also forms a covered way to the north staircase (GL B-E & 1-3) which formally housed an ice-cream shop and café until they were recently closed for essential maintenance. The concrete beam, slab and column framed structure, which spans over the public access to the north staircase, are showing signs of degradation to the concrete.

The aim of the follow-up structural inspections, as recommended in the Condition Report on the Concrete Colonnade by AECOM (*Ref 60586167-ELDC-ACM-REP-0001-P1*) in June 2018, was to visually inspect and hammer test the RC structure leading to the north staircase. This was to ensure that the route was safe to remain open to the public for periods of 10 weeks, until robust remedial measures could be undertaken, or the structure isolated from public use.

The first, follow-up structural inspection was undertaken by AECOM on the 20<sup>th</sup> August 2018 and the second was undertaken on the 29<sup>th</sup> October 2018. The third inspection was undertaken on the 24<sup>th</sup> January 2019 when the weather was overcast and temperatures just above freezing.

For this third inspection the Client requested a review of the upper surface of the first floor slab exposed by the removal of the beach huts and advice on erecting additional temporary props, to the spalling to the first floor in the toilet of the café. The brief to AECOM excluded inspection of timber members, beach huts, ancillary equipment and services.

## 2. Summary of Previous Inspections

As discussed in the earlier Condition Report on the Colonnade by AECOM, the ageing structure is exhibiting common defects for a reinforced concrete design, understood to be constructed between 1948 and 1955 (although anecdotal local reports suggest an earlier inception), and exposed to an aggressive marine environment. Some of these defects are currently affecting the safe use of the structure as there is a potential risk of small sections, of concrete cover to the reinforcement, being forced off by ferrous oxide expansion from the higher sections of the structure and falling, and potentially, injuring persons moving close to and/or within the structure. This safety risk is expected to increase with time unless robust remedial measures are undertaken, or parts of the structure decommissioned from its present usage.

Temporary safety provisions have already been implemented on site in the form of a solid barrier fences and structural props, to the enclosed area, under the first floor. These temporary provisions separate sections of the structure from public access and will need to be maintained by the client until a remedial proposal is implemented.

The safety precautions erected during the initial condition inspection works was to prop the more severely degradated concrete beams and slabs with steel adjustable props. The critical beams propped during the inspection included fascia beam GL 1, G to H, either side of a half-lap joint, the beam across the stair access GL 2, Z-AA and longitudinal beam GL 1 to 2, LL-MM. During the first follow-up inspection, the temporary structural props were inspected and found to be secured against unauthorised person interference.

For the second follow-up inspection the Client requested an additional detailed inspection to the inside of the ice cream shop and café, as they were closed for the winter season. This inspection inside the suspended ceiling to the café revealed four hairline cracks in the roof slab, across the width of the café, which had reportedly leaked water. A steel drip tray had been fixed to the underside of three of the cracks to collect and drain off the water to overflow pipes. Three of the four cracks reflected the position of repaired cracks on the roof slab at promenade level that were observed during the initial May 2018 inspections. The drip trays under three of the roof slab cracks prevented close inspection and the assessment of the degree of concrete degradation. A spalled area of concrete under the former beach hut no 2 (GL 2, E-F) was also slowly dripping water onto an existing fibre ceiling tile. Following the observation in the toilet of the café, of a large piece (0.5m square) of spalled concrete on the soffit of the roof slab, a temporary prop has been erected by the client and the toilet taken out of use. Following the second structural inspection of the café, it has been taken out of use by the client for essential maintenance.

## 3. Site Inspection 03

In preparation for the third follow-up site inspection, East Lindsey DC arranged for the through route to the north staircase to be barriered off from public access, by their framework contractor Gelders. ELDC also arranged for the café to be opened up to allow AECOM to inspect the RC slab soffit in the toilet to allow additional temporary props to be erected. On the day of the inspection the weather was overcast and temperatures just above freezing.

Detailed records, material samples and photographs were obtained from site and a representative sample has been incorporated in the Report.

A typical plan and cross-section sketch has been developed for the northern section, and included in Appendix A. The current visible concrete defects to the structural elements in the concrete structure leading to the north staircase have been added to the defect sketches included in AECOM's earlier Condition Report and an updated copy included in Appendix B.

To help assess the integrity of the structure, visual and hammer acoustic tests on the concrete surfaces were undertaken during the inspection.

The safety of the structure after the current inspection was a prime concern given the degree of degradation that the RC structure had suffered, over its believed 60 to 70 year life (Although anecdotal local reports suggest parts could be approximately ten years older) in the aggressive coastal marine environment. Owing to the risk of smaller sections of concrete being forced from the surface due to rust formation on the steel reinforcement and potentially falling, a substantial temporary solid timber barrier had been constructed by ELDC along GL 1 to separate the structure from the public until the structure is remediated, or sections taken out of service.

During the inspections by AECOM, all the visible loose concrete that could detach was generally removed for safety. The exception on the inspection no. 3 was with the hollow concrete on the down-stand beam to the first floor at GL 2, C-E, which was recommended for additional temporary support.

The third of the follow-up inspections revealed three small areas on the top edge on the front Fascia beam (GL 1, H, K, and K to L.) at first floor slab level which had cracked further since the last inspection. These cracked areas were removed for safety reasons as the fascia beam defects were outside the temporary safety barrier. There was also a section of hollow concrete identified on the rear corner of the column GL 1F, at mid height, (on the outside of the safety barrier) which was removed for safety reasons. Inspection also revealed three of the earlier visible cracks on the soffit of the first floor slab over the access to the north staircase (GLs 1-3, C-E) were now exhibiting damp patches with one or two droplets of water visible. A two metre length of hollow concrete was also detected by hammer testing along the soffit and east side face of the central down-stand beams GL 2, C-G which was recommended to be supported with additional temporary props. These sections were not removed during the visit as the staircase access had been closed off to the public by solid barriers. The north staircase, south side wall, top faces had developed additional hairline cracks and rust stains. The north side wall had developed an additional small area of hollow concrete towards the top of the stair flight.

Inspection of the top surface of the first floor slab, following the removal of the beach huts by ELDC, revealed more transverse shrinkage cracks over the covered colonnade below between GLs. 1 to 2, and E to L. The section of first floor slab under the central section (GL 1 to 3, L to Y) had been boarded over with plywood sheets and a polythene sheet by ELDC so the slab was not visible. In addition, 14 number preformed openings (approximately 100 x 75 x 130mm deep) and 11 number circular holes (25mm diameter) were revealed extending through the first floor slab into the void behind the spine wall on GL 2 E to L. Some of the small openings contained evidence of cut handrail sections. These openings allow potential water leaks into the confined space void between the spine wall on GL 2 and the sea defence revetment wall and should be closed off for safety and structural stability reasons. Shrinkage cracks and preformed construction joints were now visible and generally corresponded to the cracks observed on the soffit of the first floor slab between GLs 1 to 2 and E to Y. Some of the cracks were showing wear such that they could be contributing to leaks into the covered colonnade and the café. A pair of parallel hairline cracks were also visible in the top surface of the first floor slab along the line of the supporting spine wall below (GL 2, E to L). The cracks were not new nor construction joints and generally followed the line of the two outer faces of the spine wall below.

In the next section of the report a more detailed description of the defects are shown annotated to detailed photographs.

## 4. Visual Observations of Concrete Defects

The deteriorated defects observed since the last inspection are detailed below and were similar to the defects found elsewhere on the structure during the condition inspection in May 2018 and were typical of an old RC structure built 60 - 70 years ago (Although anecdotal local reports suggest parts could be approximately ten years older). The significance of the inadequate (shallow) concrete cover thicknesses specified to the embedded unprotected steel reinforcement were historically not generally appreciated in an aggressive marine environment at this time. In addition, a number of different types and quality concrete patch repairs had been undertaken to earlier defects at various times, and a number of these had started to fail by becoming debonded. The recent observed cracked or loose (spalled) concrete was removed during the inspection to protect public, survey team and later inspectors whilst on site.

The RC elements inspected comprised rectangular cross-section columns supporting continuous spanning rectangular cross-section fascia beams, on GL 1, and simply supported cross-beams spanning between columns and the vertical sea defence revetment on GL 3. In addition, there were one and two-way spanning RC slabs spanning between fascia beams, cross beams, and sea defence revetment. The north concrete staircase was also inspected.

#### First Floor Fascia Beams GL 1, B to N.

Visual and hammer test inspection of the first floor level fascia beam, on GL 1, B to N, revealed an increase in cracked and spalled concrete on the top edge of the beam, which was removed as a precautionary measure because it was outside the safety barrier. The following photographs illustrate the recent defects.



Photo no. 02: Concrete spall from first floor fascia beam GL 1K adjacent to balustrade fixing bolt. Bolt fixing still tight on day of inspection but now partly exposed and needs periodic monitoring.



Photo no. 03: Close up of spalled concrete from Fascia beam GL 1K.



Photo no. 04: Spall and rust stain at Fascia beam GL 1, J-K.



Photo no. 05: Additional concrete spall at Fascia beam GL 1K.



Photo no. 7: Close up of concrete spall at fascia beam GL 1K.



Photo no. 8: Crack in fascia beam at GL 1, J-K.



Photo no. 9: Additional concrete spall at fascia beam GL 1H.

Visual and hammer test of the spalled area of concrete to the propped half-lap joint in the fascia beam at GL 1, G-H did not reveal any further visible cracking.



Photo no. 10: Close up of a thin mortar upstand spalling from the top face of fascia beam at first floor level GL 1, C-D.



Photo no. 11: Close up of mortar spalled from top face of the fascia beam at first floor level GL 1, C-D.

Project number: 60586167



Photo no. 12: Concrete spall on corner of column GL F1 at mid height near café entrance and outside safety barrier.



Photo no. 13: Concrete spall approx. 600mm long from corner of column GL F1 (Weight 8kg), removed for safety reasons. The column main steel bar reinforcement had lost some cross section area.

#### **Downstand Beams to First Floor Slab**

A two metre length of hollow concrete was also detected by hammer testing along the soffit and east side face of the central down-stand beams GL 2, C-G. It is recommended that the beam is supported to soffit and side faces with additional temporary props at 1.5m centres and scaffold boards acting as spreader plates, for safety reasons.



Photo no. 14: Further hollow concrete along cross beam GL 2 C-D. Reinforcement corroded at spalled area with only a slight loss of cross section. Hollow concrete not removed and temporary propping (at 1.5m centres) with scaffold boards acting as spreader plates recommended along soffit and east side of beam.

#### North Staircase (GLs. 2-3, C-D)

The north staircase, (GL 3, C-D) south side wall, top faces had developed additional hairline cracks. The north side wall had developed a small area of hollow concrete towards the top of the stair flight, since last inspection.



Photo no. 15: Top of north stair south side wall showing cracks with rust stains. On far side wall a small area of hollow concrete near top corner.

#### First Floor Soffit Slabs Between GLs 1-2, D-E

Inspection of the first floor soffit slab between GLs 1-2, D-E, revealed a further small area of hollow concrete which on further hammer testing, cracked and was removed as a precautionary safety measure. The spalled area is on the line of a hairline crack between two existing spalled areas. At the spalled concrete locations, the bar reinforcement had suffered some rusting but no significant loss of cross-section to bar diameter.



Photo no. 16: Soffit of slab GLs 1-2, D-E, shallow spalling on a hairline crack. Reinforcement corroded with no significant loss of cross sectional area. Visual and hammer test inspection of the first floor soffit slab between GLs 1-2, C-D along a previously identified crack revealed some minor spalling and damp concrete with two water droplets. This may have been exacerbated by the cold weather at the time of the inspection.



Photo no. 17: Hairline crack in slab soffit at GLs 2-3, C-D with some minor damp patches and spalling.



Photo no. 18: Crack in soffit of first floor slab GL 1-2, C-E with some minor spalling.

#### First Floor Slab Soffit Inside The Café

As previously observed, during the last inspection, the large piece (approximately 0.5m square) of spalled concrete on the soffit of the roof slab over the café toilet, was further supported with two additional temporary steel props (erected by Gelders) for safety reasons. The main reason for this precaution was the fact that the exact extent of the defect could not be readily inspected.



Photo no. 19: Spalled area of roof slab above Café internal toilet, with temporary prop and spreader board (approx. GL 1-2, D-E.)



Photo no. 20: Three temporary props to spalled area of concrete at first floor roof slab over the toilet of Café GL 2, E-F

A previously observed spalled opening in the concrete on the roof slab soffit situated under the former chalet no 2 (GL 2, E-F) which was also dripping water was traced to a recent observed opening observed through the first floor roof slab at promenade level (which is shown in the following photo no. 24).

#### First Floor Slab at Promenade Level

Inspection of the top surface of the first floor slab, following the removal of the beach huts by ELDC, revealed more transverse shrinkage cracks over the covered colonnade below between GLs. 1 to 2, and E to L. The section of first floor slab under the central section (GL 1 to 3, L to Y) had been boarded over with plywood sheets and a polythene sheet by ELDC so the slab was not visible. In addition, 14 number preformed openings (approximately 100 x 75 x 130mm deep) and 11 number circular holes (approximately 25mm diameter) were observed extending through the first floor slab into the void behind the spine wall on GL 2 E to L and one into the café GL 2, E-F. The function of the openings is not known but are understood to be associated with the former removed beach huts. These openings are water leak sites generally into the confined space void between the spine wall on GL 2 and the sea defence revetment wall but one extends into the café. These openings should be closed off for safety and structural reasons.

Shrinkage cracks and preformed construction joints were now visible and generally corresponded to the cracks / joints observed on the soffit of the first floor slab between GLs 1 to 2 and E to Y, during previous inspections. Some of the cracks were showing some wear such that they could be contributing to leaks into the covered walkway to north stairs, the covered colonnade and the café. A pair of parallel hairline longitudinal cracks were observed in the top surface of the first floor slab along the line of the supporting spine wall below (GL 2, E to L). The cracks were not recent nor formed construction joints and generally followed the two outer faces of the spine wall.



Photo no. 21. Repaired cracks in first floor slab (not preformed construction joints), at promenade level, which approximately corresponds with cracks in the soffit over the access to north stair below. (GL 1-2-3, C-D).



Photo no. 22: Repaired cracks in first floor slab at promenade level with a minor defect corresponds with cracks in soffit to access to north stair below. (GL 1-2-3, C-D).



Photo no. 23: Repaired cracks in slab (not construction joint) at promenade level which approximately corresponds with crack across the Garden Café toilet ceiling below. (GL 1-2, D-E). Drilled hole in foreground penetrates through concrete slab.



Photo no. 24: In foreground a concrete ramp to former beach hut no. 2 with evidence of cut handrail posts. Circular holes (25mm diameter) through concrete slab (Mid height left photo) at promenade level which approximately corresponds with the hole in Café ceiling, weeping water below. (GL 1-2, E-F). Horizontal repaired crack in top of photo exhibiting damp patches on ceiling in café (to north side of front door).

Project number: 60586167



Photo no. 25: Photo showing an example of one of the seven pairs of openings (100 x 75mm) through slab (middle of picture) at promenade level which pass directly through into the confined space void between the spine wall (GL 2) and the sea defence revetment. These are potential leak sites. Also a shrinkage crack in concrete slab joins up with a preformed opening (from bottom to top of photo).



Photo no. 26: Photo showing an example of the seven pairs of formed openings (100 x 75mm) and seven 25mm diameter openings through the 130mm thick concrete slab (middle of picture) at promenade level which pass directly through into the confined space void between the spine wall (GL 2) and the sea defence revetment. These are potential leak sites.



Photo no. 27: A shrinkage crack in first floor concrete slab over colonnade, (from top to bottom of photo) GL 1-3, J-K. Preformed openings also shown.

A pair of parallel hairline cracks were observed in the top surface of the first floor slab along the line of the supporting spine wall below (GL 2, E to L), where some of the beach huts have been removed. The cracks were not new nor construction joints and generally followed the line of the two outer faces of the spine wall below slab.



Photo no. 28: Photo of plywood sheets and polythene membrane over recessed slab to former beach huts.



Photo no. 29: Photo of mastic asphalt over first floor slab over central staircase with broken edges and start of crack towards centre of slab (Potential leak).



Photo no. 30: Photo from promenade showing the north staircase with public access still available onto the first floor slab at the north end, despite Heras fence panel positioned across the staircase entry.

Project number: 60586167



Photo no. 31: Photo from first floor slab showing north staircase with public access still available onto the first floor slab at the north end, despite the single Heras fence panel to the staircase entry.



Photo no. 32: Photo of safety hoarding to the west elevation of the colonnade.

## 5. Recommendations and Conclusions

Following on from the Condition Inspection undertaken by AECOM in May 2018, on the Concrete Colonnade at Sutton Pleasure Gardens, a third follow up structural inspection of the north section of the Concrete Colonnade near the north staircase was undertaken on 24th January 2018, as it was still partly in use by the public. Following a review of the findings, we would make the following recommendations.

The ageing structure is exhibiting common defects for a reinforced concrete design understood to be constructed between 1948 and 1955 (Although anecdotal local reports suggest an earlier inception) and exposed to an aggressive marine environment. For the structure to be used for the benefit of the public over the coming decades, a number of defects would need to be remediated. Some of these defects are serious and currently affecting the safe use of the structure, as there is a potential risk of small sections of concrete cover to the embedded steel reinforcement being forced off, by ferrous oxide expansion, particularly from the higher sections of the structure and falling, and potentially injuring persons moving close to and/or within the structure. This safety risk is expected to increase with time unless robust remedial measures are undertaken, or parts of the structure decommissioned from its present usage. The temporary safety provisions that have already been implemented on site in the form of solid physical barrier fences and structural props, to the enclosed area under the first floor, separating sections of the structure from public access, will need to be continually inspected and maintained until a remedial proposal is implemented.

The first floor fascia beams, internal transfer beams, and slabs, which span over the public access to the north staircase to the promenade, which are currently closed off from the public, are showing signs of further concrete degradation.

This third follow-up inspection, revealed further hollow concrete along the lower rear edge of the central downstand beams GLs 2, C to D. These sections were not removed but recommended to be supported by additional temporary props at 1.5m centres with scaffold boards as spreader boards as recommended in the summary below. This was because the staircase access had been closed off to the public by solid barriers by the client for essential maintenance. Two of the earlier visible cracks on the soffit of the first floor slab were now exhibiting damp patches with one or two droplets of water visible. Three further small areas of the top edge on the front Fascia beam (GL 1, H, K, and K to L.) at first floor slabs, had cracked and were removed for safety reasons. There was further cracking to a section of hollow concrete identified on the rear corner of the column GL 1F, at mid height, (outside café) which was removed for safety reasons. The north staircase, south side wall, top faces had developed additional hairline cracks and rust stains. The north side wall of staircase has developed a further small area of hollow concrete towards the top of the stair flight since the last inspection.

Inspection of the top surface of the first floor slab, following the removal of the beach huts, revealed more transverse shrinkage cracks over the covered access to north stair, covered colonnade areas below between GLs. 1 to 2, and E to L. The section of first floor slab, under the central section (GL 1 to 3, L to Y), had been boarded over with plywood sheets so the slab was not visible. In addition, 14 number preformed openings (approximately 100 x 75 x 130mm deep) and 11 number circular holes (approximately 25mm diameter) were revealed extending through the first floor slab into the void behind the spine wall on GL 2, E to L. These openings are water leaks into the confined space void between the spine wall on GL 2 and the sea defence revetment wall and should be closed off for safety and structural deterioration reasons. The shrinkage cracks and preformed construction joints observed generally corresponded to the cracks observed on the soffit of the first floor slab between GLs 1 to 2 and E to Y on earlier inspections. Some of the cracks were showing isolated patches of wear and the onset of deterioration such that they could be contributing to leaks into the covered colonnade and the café and should be repaired as recommended in the summary below.

The key recommendations are summarised as follows:

- a. The suspended first floor slab, at promenade level over the enclosed colonnade area should be kept n free of live loading (e.g. beach huts, public and wind-blown beach sand.)
- b. The recommendation from the inspection was that the walkway to the north staircase should be closed off to public use because of the increased risk of falling concrete.

- c. The down-stand beam on GL 2, C-E should be supported on the soffit and sides with temporary props at 1.5m centres and scaffold boards acting a spreader plates.
- d. Restrict access onto first floor slab by extending barrier fence along the promenade across the north stairs access over the flood prevention wall.
- e. Close off the openings through the first floor slab to mitigate potential leaks into the colonnade structure and adverse structural consequences. Consider repairing the wear to the previous repairs to the cracks on the first floor slab between GLs 1 to 2 and E to Y as leaking water will adversely affect the RC structure below.
- f. Continually maintain in serviceable condition, all the temporary safety barriers and temporary props to the distressed structural members.
- g. Further 10 weekly inspections should be undertaken, by an appropriately qualified person, to ensure that the existing suspended structure does not need further temporary propping for structural stability. Therefore, it is recommended that the next structural inspection of the north colonnade should be undertaken on the 26<sup>th</sup> March 2019

As we approach a year since the first full condition inspection of the colonnade, consideration should be given to extending one of the follow-up structural inspections to the whole of the structure to ensure additional temporary propping is not required for structural stability.

Should the Council require further additional structural design, contract management or site supervision of specific remedial measures AECOM would be pleased to offer their professional services.

# **Appendix A**

## **Drawings**

Location Plan Figure 1

Typical Sections Figure 2 Rev A





Fig. No. 2

Concrete Structural Inspection East Lindsey District Council 60576167 Date: Rec B January 2019

# **Appendix B**

# **Summary of Sketch of Visual Concrete Defects**

Plan Figure 3 Rev C Elevations Figure 4 Rev C Enlarged Plan Figure 5 Rev A



60576167 Date: Revision C - January 2019

Fig. No. 3









Sutton-on-sea Colonnade

Concrete Structural Inspection

FIRST FLOOR SLAB PLAN SHOWING VISUAL STRUCTURAL DEFECTS



East Lindsey District Council

60576167 Date: Revision C - January 2019

Fig. No. 5

AECOM Infrastructure & Environment UK Limited 12 Regan Way Chetwynd Business Park Nottingham NG9 6RZ United Kingdom

T: +44 (115) 907 7000 aecom.com