Structural Engineers Report
The External Balconies and Concrete Testing

Southwick Estate, Southwick, West Sussex BN42

Watling Court
Sea House
Grange Court
Coates Court
Locks Court
Rock Close

For Faithorn Farrell Timms

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REF: E13339-221201rp-001
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Sheppard
CONSULTING CIVIL AND STRUCTURAL ENGINEERS

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1.0 Introduction

EAR Sheppard Consulting Engineers were instructed by Faithorn Farrell Timms to prepare a structural engineers report on the condition of the external balconies with recommendations for remedial works.

The report includes a discussion on the life expectancy of the balcony structures and remedial actions required to prolong the life expectancy for a period of eight years together with a discussion on the current condition and suitability of the balcony railings.

A visual inspection of the condition of the external balconies was made, and marked up site notes of photographs to show the results of the visual survey and observed defects are included in the report.

Reference should also be made to the investigation works undertaken in 2019 and presented in the Ellis and Moore report ref. 17830roc-190214rp-001 which includes Locks Court and Rock Close together with the material testing undertaken by Heritage Testing Ltd Report References HT/18-4829 & 4830/FFT dated January 2019.

2.1 Coates Court Balcony Assessment

Coates Court | Type 1 Balcony - Results of Testing					
Assessment of Risk of Steel Reinforcement corrosion associated with carbonation, cast in chloride content and environmental conditions. Reference documents BRE Digest 444 pt 2 Figure 4 | 40 and 60+ year old concrete structure | Damp Environment. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Risk	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
1-parapet	50	2	0.16	0.6	<0.02
Risk 40+		Low	Low	Moderate	Low
Risk 60+		Low	Low	High	Low
2-Soffit	34	2	0.48	0.58	0.46
Risk 40+		Low	Moderate	Moderate	Moderate
Risk 60+		Low	Moderate	Moderate	Moderate

Coates Court | Type 1 Balcony - Results of Testing					
Assessment of Probability of Steel Reinforcement corrosion associated with ingressed chloride in the absence of carbonation. Reference documents BRE Digest 444 pt 2 Figure 5. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Probability	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
1-parapet	50	2	0.16	0.6	<0.02
Probability		Low	Low	High	Low
2-Soffit	34	2	0.48	0.58	0.46
Probability		Low	Moderate	High	Moderate

Coates Court | Type 1 Balcony - Results of Visual Inspection			
Refer to drawing E13339-VI-02. Recommended works to prolong the life expectancy for a period of eight years.			
Item	Description	Condition	Recommended Works
Balustrade	Painted metal balustrade with timber hand rail and bolted fixings.	Corroded base fixings and missing sections of timber hand rail. Due the corroded fixings the balustrade is considered not to be structurally adequate.	1. Removal of the metal balustrade and replacement with galvanised steel sections. 2. Extensive survey of all concrete units. 3. Extensive concrete repairs to the projecting balcony fins and concrete units. 4. Removal of existing coatings and application of protective coatings to all exposed concrete surfaces to restrict the ingress of carbon dioxide, and moisture and chlorides. 5. Regular monitoring of the condition of the balconies is undertaken due to the risk of falling lumps of concrete and public safety. 6. Temporary support is put in to support the front edge of the balconies or removal and replacement with a new construction.
Concrete Parapets and soffits	Painted slender precast concrete units cast with balcony slabs and supported on projecting insitu concrete fins.	Generally paint coverings in poor condition with rust staining from corroding balustrade. No significant cracking or damage to concrete. General high probability of chloride induced corrosion.	
Concrete supporting fins	Slender projecting reinforced concrete fins.	Generally in poor condition with visible signs of spalling of concrete due to corroding reinforcement. Noticeable deflection causing outward rotation of the balcony units. General high probability of chloride induced corrosion.	

2.2 Locks Court Balcony Assessment

Locks Court | Type 1 Balcony - Results of Testing					
Assessment of Risk of Steel Reinforcement corrosion associated with carbonation, cast in chloride content and environmental conditions. Reference documents BRE Digest 444 pt 2 Figure 4 | 40 and 60+ year old concrete structure | Damp Environment. Heritage Testing Ltd Report ref: HT/18-4829/FFT dated January 2019					
Test Location Risk	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
5-first floor parapet	25	12	0.31	0.14	0.07
Risk 40+		Low	Low	Low	Low
Risk 60+		Low	Low	Low	Low
6- first floor soffit fin	2	12	1.41	1.62	1.35
Risk 40+		High	Very High	Extremely High	Very High
Risk 60+		High	Very High	Extremely High	Very High

Locks Court | Type 1 Balcony - Results of Testing					
Assessment of Probability of Steel Reinforcement corrosion associated with ingressed chloride in the absence of carbonation. Reference documents BRE Digest 444 pt 2 Figure 5. Heritage Testing Ltd Report ref: HT/18-4829/FFT dated January 2019					
Test Location Probability	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
5-first floor parapet	25	12	0.31	0.14	0.07
Probability		Low	Low	Low	Low
6- first floor soffit fin	2	12	1.41	1.62	1.35
Probability		High	Extremely High	Extremely High	High

Locks Court | Type 1 Balcony - Results of Visual Inspection			
Refer to drawing E13339-VI-02. Recommended works to prolong the life expectancy for a period of eight years.			
Item	Description	Condition	Recommended Works
Balustrade	Painted metal balustrade with timber hand rail and bolted fixings.	Corroded base fixings and missing sections of timber hand rail. Due the corroded fixings the balustrade is considered not to be structurally adequate.	1. Removal of the metal balustrade and replacement with galvanised steel sections. 2. Extensive survey of all concrete units. 3. Extensive concrete repairs to the projecting balcony fins and concrete units. 4. Removal of existing coatings and application of protective coatings to all exposed concrete surfaces to restrict the ingress of carbon dioxide, and moisture and chlorides. 5. Regular monitoring of the condition of the balconies is undertaken due to the risk of falling lumps of concrete and public safety. 6. Temporary support is put in to support the front edge of the balconies or removal and replacement with a new construction.
Concrete Parapets and soffits	Painted slender precast concrete units cast with balcony slabs and supported on projecting insitu concrete fins.	Generally paint coverings in poor condition with rust staining from corroding balustrade. No significant cracking or damage to concrete. General high probability of chloride induced corrosion.	
Concrete supporting fins	Slender projecting reinforced concrete fins.	Generally in poor condition with visible signs of spalling of concrete due to corroding reinforcement. Noticeable deflection causing outward rotation of the balcony units. General high probability of chloride induced corrosion.	

2.3 Grange Court Balcony Assessment

Grange Court | Type 2 Balcony - Results of Testing					
Assessment of Risk of Steel Reinforcement corrosion associated with carbonation, cast in chloride content and environmental conditions. Reference documents BRE Digest 444 pt 2 Figure 4 | 40 and 60+ year old concrete structure | Damp Environment. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Risk	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
6-parapet	25	2	0.06	0.18	0.2
Risk 40+		Low	Low	Low	Low
Risk 60+		Low	Low	Low	Low
7-Soffit	39	2	0.22	0.94	0.88
Risk 40+		Low	Low	High	High
Risk 60+		Low	Low	Very High	Very High

Grange Court | Type 2 Balcony - Results of Testing					
Assessment of Probability of Steel Reinforcement corrosion associated with ingressed chloride in the absence of carbonation. Reference documents BRE Digest 444 pt 2 Figure 5. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Probability	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
6-parapet	25	2	0.06	0.18	0.2
Probability		Low	Low	Low	Low
7-Soffit	39	2	0.22	0.94	0.88
Probability		Low	Low	Very High	High

Grange Court | Type 2 Balcony - Results of Visual Inspection			
Refer to drawing E13339-VI-03. Recommended works to prolong the life expectancy for a period of eight years.			
Item	Description	Condition	Recommended Works
Balustrade	Painted metal balustrade with plastic coated metal hand rail, wire glass infill panel and cast in fixings.	Some corrosion evident and peeling paint. Damage to brickwork where handrails are built in. Post sections infill panels and fixings are not structurally adequate to comply with current standards.	1. Removal of the metal balustrade, glass infill panels and replacement with galvanised steel sections. 2. Extensive survey of all concrete units. 3. Concrete repairs to the projecting balcony fins and concrete units. 4. Removal of existing coatings and application of protective coatings to all exposed concrete surfaces to restrict the ingress of carbon dioxide, and moisture and chlorides. 5. Regular monitoring of the condition of the balconies is undertaken due to the risk of falling lumps of concrete and public safety.
Concrete Parapets and soffits	Painted precast concrete units cast with balcony slabs and supported on projecting insitu concrete fins.	Generally paint coverings in poor. Vertical cracking on parapet panels and horizontal crack to slab soffit. Previous concrete repairs evident. General high to very high probability of chloride induced corrosion.	
Concrete supporting fins	Slender projecting reinforced concrete fins.	No significant visible signs of spalling of concrete due to corroding reinforcement or noticeable deflection. Previous concrete repairs evident. General high to very high probability of chloride induced corrosion.	

2.4 Sea House Balcony Assessment

Sea House | Type 2 Balcony - Results of Testing					
Assessment of Risk of Steel Reinforcement corrosion associated with carbonation, cast in chloride content and environmental conditions. Reference documents BRE Digest 444 pt 2 Figure 4 | 40 and 60+ year old concrete structure | Damp Environment. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Risk	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
9-parapet	34	2	0.26	0.3	0.54
Risk 40+		Low	Low	Low	Low
Risk 60+		Low	Low	Low	Low
10-Soffit	38	2	0.2	0.88	0.88
Risk 40+		Low	Low	High	High
Risk 60+		Low	Low	Very High	Very High

Sea House | Type 2 Balcony - Results of Testing					
Assessment of Probability of Steel Reinforcement corrosion associated with ingressed chloride in the absence of carbonation. Reference documents BRE Digest 444 pt 2 Figure 5. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Probability	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
6-parapet	34	2	0.26	0.3	0.54
Probability		Low	Moderate	Moderate	High
7-Soffit	38	2	0.2	0.88	0.88
Probability		Low	Low	Very High	Very High

Sea House | Type 2 Balcony - Results of Visual Inspection			
Refer to drawing E13339-VI-03. Recommended works to prolong the life expectancy for a period of eight years.			
Item	Description	Condition	Recommended Works
Balustrade	Painted metal balustrade with plastic coated metal hand rail, wire glass infill panel and cast in fixings.	Some corrosion evident and peeling paint. Damage to brickwork where handrails are built in. Post sections infill panels and fixings are not structurally adequate to comply with current standards.	1. Removal of the metal balustrade, glass infill panels and replacement with galvanised steel sections. 2. Extensive survey of all concrete units. 3. Concrete repairs to the projecting balcony fins and concrete units. 4. Removal of existing coatings and application of protective coatings to all exposed concrete surfaces to restrict the ingress of carbon dioxide, and moisture and chlorides. 5. Regular monitoring of the condition of the balconies is undertaken due to the risk of falling lumps of concrete and public safety.
Concrete Parapets and soffits	Painted precast concrete units cast with balcony slabs and supported on projecting insitu concrete fins.	Generally paint coverings in poor condition. Vertical cracking on parapet panels and horizontal crack to slab soffit. Previous concrete repairs evident. General high to very high probability of chloride induced corrosion.	
Concrete supporting fins	Slender projecting reinforced concrete fins.	No significant visible signs of spalling of concrete due to corroding reinforcement or noticeable deflection. Previous concrete repairs evident. General high to very high probability of chloride induced corrosion.	

2.5 Watling Court Balcony Assessment

Watling Court | Type 3 Balcony - Results of Testing					
Assessment of Risk of Steel Reinforcement corrosion associated with carbonation, cast in chloride content and environmental conditions. Reference documents BRE Digest 444 pt 2 Figure 4 | 40 and 60+ year old concrete structure | Damp Environment. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Risk	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
4-soffit	43	2	0.52	0.72	0.68
Risk 40+		Low	Moderate	High	High
Risk 60+		Low	Moderate	High	High

Watling Court | Type 3 Balcony - Results of Testing					
Assessment of Probability of Steel Reinforcement corrosion associated with ingressed chloride in the absence of carbonation. Reference documents BRE Digest 444 pt 2 Figure 5. Constructive Evaluation Report ref 22.1145 date November 2022.					
Test Location Probability	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
4-Soffit	43	2	0.52	0.72	0.68
Probability		Low	High	High	High

Watling Court | Type 3 Balcony - Results of Visual Inspection			
Refer to drawing E13339-VI-03. Recommended works to prolong the life expectancy for a period of eight years.			
Item	Description	Condition	Recommended Works
Balustrade	Galvanised metal uprights bolted to the face of the balcony edge with galvanised metal perforated panel infills.	General no observed corrosion to balustrade uprights, panels and fixings. Post sections infill panels and fixings appear structurally adequate to comply with current standards, but detailed structural calculations would be required to confirm this.	1. Extensive survey of the metal balustrade to check for defects in the fixing of the uprights to the face of the balcony slabs. 2. Structural calculations to confirm the adequacy of the balustrade uprights. 3. Extensive survey of all concrete units. 4. Concrete repairs to the cracking to the balcony soffits. 5. Remove existing coatings and application of protective coatings to all exposed concrete surfaces to restrict the ingress of carbon dioxide, and moisture and chlorides. 6. Regular monitoring of the condition of the balconies is undertaken due to the risk of falling lumps of concrete and public safety.
Concrete soffits	Painted insitu concrete cantilever balcony slab.	Generally paint coverings in fair condition. No significant signs of cracking, some fine horizontal cracking General high probability of chloride induced corrosion.	

2.6 Rock Close Balcony Assessment

Rock Close | Type 4 Balcony - Results of Testing					
Assessment of Risk of Steel Reinforcement corrosion associated with carbonation, cast in chloride content and environmental conditions. Reference documents BRE Digest 444 pt 2 Figure 4 | 40 and 60+ year old concrete structure | Damp Environment. Heritage Testing Ltd Report ref: HT/18-4830/FFT dated January 2019					
Test Location Risk	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
4-first floor soffit	10	13	1.57	1.61	1.26
Risk 40+		High	Extremely High	Extremely High	Very High
Risk 60+		High	Extremely High	Extremely High	Very High
5- Second floor side	59	12	0.64	1.07	0.74
Risk 40+		Low	Moderate	Very High	High
Risk 60+		Low	High	Very High	High

Rock Close | Type 1 Balcony - Results of Testing					
Assessment of Probability of Steel Reinforcement corrosion associated with ingressed chloride in the absence of carbonation. Reference documents BRE Digest 444 pt 2 Figure 5. Heritage Testing Ltd Report ref: HT/18-4830/FFT dated January 2019					
Test Location Probability	Concrete Cover mm	Carbonation Depth mm	Chloride ion % by mass of cement		
			5-25mm	25-50mm	50-75mm
4-first floor soffit	10	13	1.57	1.61	1.26
Probability		High	Extremely High	Extremely High	High
5- Second floor side	59	12	0.64	1.07	0.74
Probability		Low	High	Extremely High	High

Rock Close | Type 4 Balcony - Results of Visual Inspection			
Refer to drawing E13339-VI-03. Recommended works to prolong the life expectancy for a period of eight years.			
Item	Description	Condition	Recommended Works
Balustrade	Painted metal balustrade with timber hand rail and top surface covered with asphalt. The uprights are cast into pockets in the balcony slabs.	Generally some corrosion to the balustrade uprights, panels and cast in fixings. Post sections infill panels and fixings are not structurally adequate to comply with current standards.	1. Removal of the metal balustrade, glass infill panels and replacement with galvanised steel sections. 2. Removal of asphalt covering. 3. Extensive survey of all concrete units. 4. Concrete repairs to the cracking to the balcony soffits and edges. 5. Removal of existing coatings and application of protective coatings to all exposed concrete surfaces to restrict the ingress of carbon dioxide, and moisture and chlorides. 6. Regular monitoring of the condition of the balconies is undertaken due to the risk of falling lumps of concrete and public safety.
Concrete soffits	Painted insitu concrete cantilever balcony slab.	There is some localised reinforcement corrosion staining, spalling , delamination and exposed corroded reinforcement to the balcony soffits. The damage is generally to the soffits at the front edge of the balconies where there is the thinnest section of concrete and least concrete cover to the ends of the bars. General very high probability of chloride induced corrosion.	

3.0 Discussion on the Results of the Material Testing

Cover meter readings were taken to establish the depth of the reinforcement and depth of carbonation of the concrete at test locations. In general terms the alkalinity of the concrete provides protection to the embedded steel reinforcement. However, carbon dioxide will, over time, diffuse in to the concrete breaking down it's protective alkalinity and with the presence of moisture the protection of the embedded steel is lost and corrosion can occur.

The results indicate that the depth of carbonation is relatively low and there is sufficient cover to the embedded reinforcement leading to a low risk of corrosion due to carbonation. However, there are visible areas of corroding reinforcement and spalling of the soffits of the balconies at locations where there is minimal cover to the bars. There are also areas of previous concrete repairs which would be an indication of a general progressive deterioration over time of the concrete elements.

Samples of the concrete were taken at staged depths and tested for Chloride ion content.
The presence of oxygen and sufficient quantities of free chloride ions in the pore water of the concrete can cause corrosion of the embedded reinforcement. The source of the chloride can be cast in (added during the mixing of the concrete or present in the aggregates) or ingressed due to the marine atmospheric conditions.

The results indicate that the risk of reinforcement corrosion due to elevated levels of free chloride ions is significantly high for the majority of the samples tested. Chloride induced corrosion can lead to severe pitting of the reinforcement which can locally reduce the cross-sectional area of the bars while the remainder of the bar may be left uncorroded. The visible presence of the pitting of the bars will not necessary be apparent through expansive corrosion and spalling of the concrete and a warning of failure may not be seen.

4.0 Recommendations

Recommendations are considered to prolong the life expectancy of the balcony structures for a period of 8 years and suitability of the balcony railings.

Due to the deleterious effects of the elevated levels of cast in chlorides and, the more likely scenario of the continuing ingress of chlorides due to the coastal location, the remediation strategies would need to include for a longer term approach of chloride extraction from the existing concrete or replacement of the balcony structures.

Short term strategies would be to undertake patch repairs to the areas of already cracked or damaged concrete to mitigate the risks to the general public from falling lumps of concrete and to prevent the accelerated deterioration of the balcony structures.

In relation to Coates Court and Locks Court, Type 1 balconies, we would be of the opinion that the balconies have reached the end of their serviceable life and in the short term should be either temporarily propped, or removed and replaced with a new construction. These balconies are supported on slender projecting concrete fins with visible signs of spalling concrete due to corroding reinforcement and a noticeable deflection causing outward rotation of the balcony units.

The recommended works for each balcony type to prolong the life expectancy for a period of eight years is included in section 2 of this report and outlined below.

4.1 Short Term Strategy up to 8 years

- Undertake an extensive concrete condition survey of all the balconies to include 'percussive tap hammer' testing in order to fully identify the extent of delaminating concrete due to corroded reinforcement.
- Undertake a schedule of concrete patch repairs of corroded and spalling concrete identified in the concrete condition survey.
- Remove existing coatings and application of protective coating to all exposed surfaces to restrict the ingress of carbon dioxide, moisture and chlorides.
- Provide temporary propping to the front edge of the Type 1 balconies or removal and replacement with a new construction as identified in section 2 of this report. (Coates Court and Locks Court).
- Upgrade the existing balustrading and removal of corroded sections with galvanised mild steel sections to meet current standards.
- Undertake regular inspections and maintenance of the balcony structures.

4.2 Longer Term Strategy 8 Years +

- Undertake further investigation works on the suitability of a longer term solution of alkalization of the concrete and electrochemical methods for chloride extraction.
- Undertake an extensive concrete condition survey of all the balconies to include 'percussive tap hammer' testing in order to fully identify the extent of delaminating concrete due to corroded reinforcement.
- Undertake opening up works to provide information on the size and spacing of the embedded reinforcement to allow a structural assessment of the balconies.
- Undertake a cost assessment on the viability of repair and retaining the existing balconies or replacement with new structures.

Report prepared by
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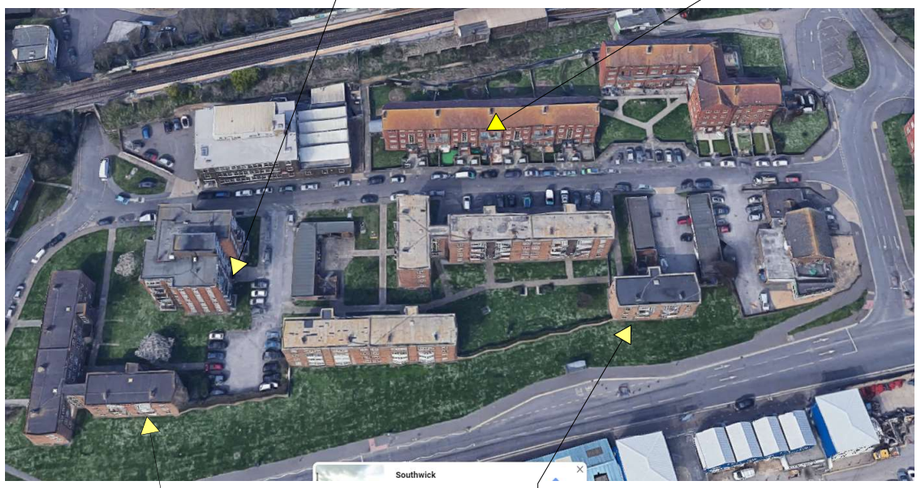
Grange Court Type2



Watling Court Type 3. Third Floor only

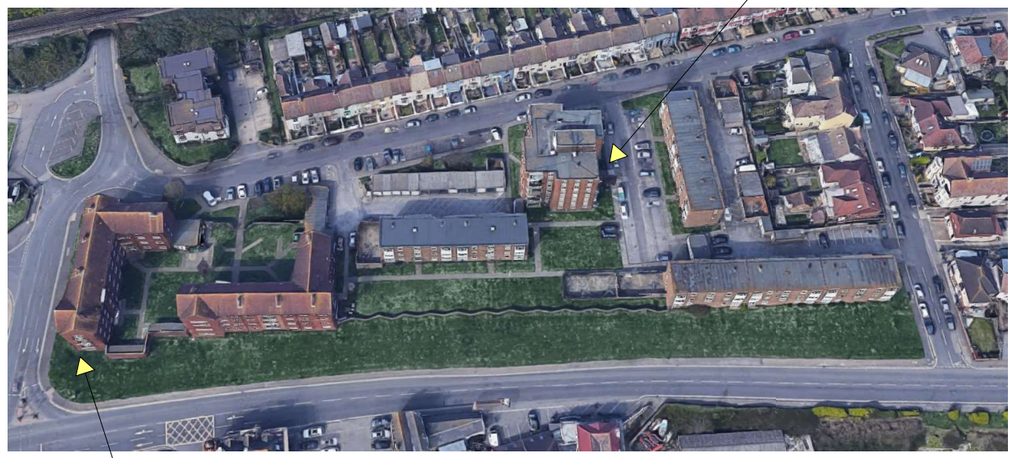


Sea House Type 2



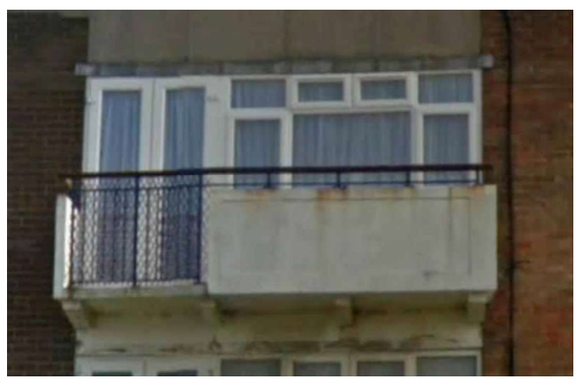
Locks Court Type 1.
Refer to previous report on investigation works dated January 2019.

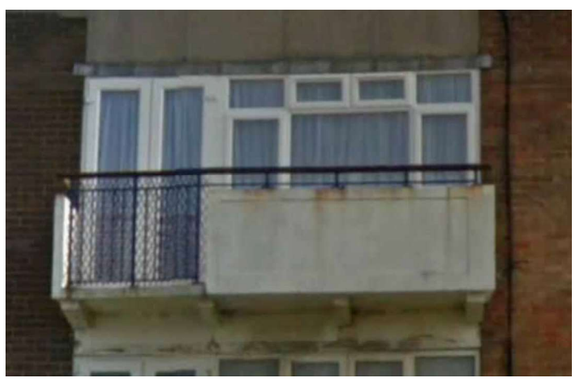
Coates Court Type 1



Rock Close Type 4
Refer to previous report on investigation works dated January 2019.

Plan Veiw







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Southwick Estates, Brighton BN42 | Investigation Works - Estate Location Plan + Balcony Types | E13339-SN-01







Rear Elevation











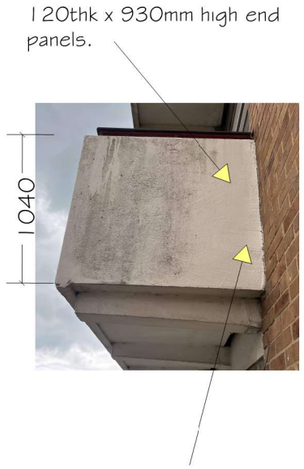
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Type - 1 Balcony

Southwick Estates, Brighton BN42 | Site Notes - Coates Court | E13339-SN-02









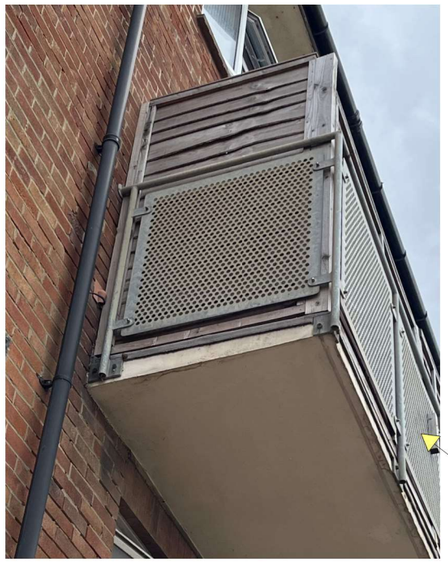
Typical Balcony Elevation



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Type - 2 Balcony

Southwick Estates, Brighton BN42 | Site Notes - Grange Court+Sea House | E13339-SN-03



Galvanised steel balustrading



Solid insitu concrete balcony



Typical Balcony Elevation

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Type - 3 Balcony

Southwick Estates, Brighton BN42 | Site Notes - Watling Court | E13339-SN-04



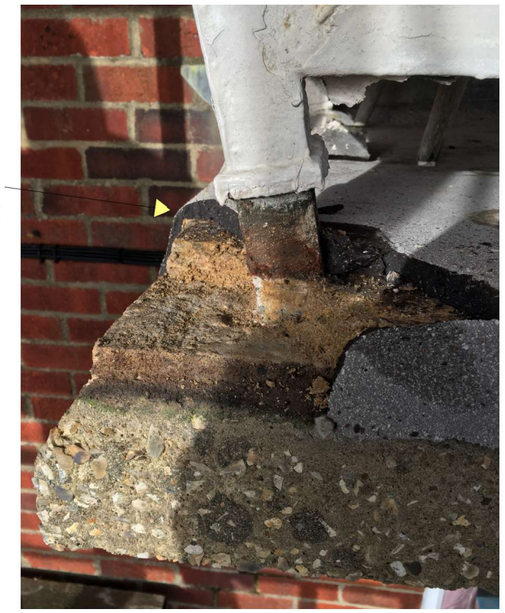
Typical elevation showing balustrade.



Typical elevation showing balustrade.



Exposed corroding rebar



Cast in balustrade fixing

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Type - 4 Balcony

Southwick Estates, Brighton BN42 | Site Notes - Rock Close | E13339-SN-05