Getty

DZC Tecton Project

Conservation Management Plan Version Two

DUDLEY ZOO & CASTLE

BPN ARCHITECTS

Prepared by **BPN** Architects for **Dudley Zoo & Castle & The Getty Foundation, September 2022, Revised September 2023**

Fig 1. Front Cover - Image of Dudley Zoo Entrance from Castle Hill

„Dudley undoubtedly represents the fullest realisation of Lubetkin‟s philosophical attitude towards nature, not only in terms of housing wild animals but also in the relation of the whole Architectural ensemble to an outstanding natural setting. It is this combination of consistent aesthetic vision and its diversity of application within a single project that makes Dudley Zoo a unique episode in the history of modern British Architecture."

John Allan, 1990

Tecton's Dudley Zoo

Berthold Lubetkin once said: "I have the unfashionable conviction that the proper concern of Architecture is more than self-display. It is a thesis, a declaration, a statement of the social aims of the age." Encapsulated in the playful pavilions at Dudley is a call to remember the higher calling of all Architecture, embracing not just material needs but also the desire to inspire and delight. Dudley Zoo did not change the world but it does stand as a monument to a vision of an alternative modernism. As with much of Tecton's work, it seems to anticipate a more relaxed and joyful approach to form and function. It is not the dour, one-size-fits all Architecture that came to epitomise so much of post-war Britain , but rather a unique, three-dimensional manifesto, written in concrete, for an enjoyable and humane urban future.

Ben Flatman

Constructed between 1935 and 1937 around a wooded medieval motte surmounted by a Castle, Dudley Zoo represents the only collection of interrelated designs at one site by Berthold Lubetkin's practice, Tecton. The design of the Dudley Zoo ensemble, unique in the UK and rare within Europe, consists of 12 surviving reinforced concrete animal display "houses" and pavilions, juxtaposed against a natural setting. It dramatically communicates the interrelationships of artistic, social, civic, research and natural values which typify the early (British) Modernist movement.

Over time and due to changing Zoological practice, the design of the Zoo has been adversely affected by disuse of some Tecton structures by newer constructions in other areas and by the alteration of the natural, wooded, setting into a more manicured garden environment.

WMF 2010 Watchlist

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1 Summary

Dudley Zoo & Castle is located in the grounds of the ruined medieval Dudley Castle, about 0.5 miles from Dudley Town Centre.

Dudley Castle is a scheduled Ancient Monument and Grade I listed building dating from the 11th to the 15th centuries. The Castle was extensively rebuilt in the 16th century. In 1935 the 4th Earl of Dudley, Captain Frank Cooper and Mr Ernest Marsh formed the Dudley Zoological Society. In April 1936, Sir Herbert Humphries, who had been the City Engineer of Birmingham became the Zoo's first director.

Twelve structures designed by the Architectural practice Lubetkin and Tecton and completed in 1937 make up the principal animal enclosures of the Zoo and all are Listed Buildings. The Tecton structures at Dudley represent a unique collection of works by an early modernist practice and exemplify many ideas associated with the international Modern Movement. A thirteenth structure, the extraordinary Penguin Pool, was demolished in the late 1970's.

The surviving 'Tectons', as they have affectionately become known, have suffered greatly over the intervening decades as the Zoos popularity and public image has waxed and waned. Debate about their suitability as animal enclosures has understandably been paramount but in recent years, the Zoo management has begun to see the Tectons, not as a liability, but an asset. They remain the largest collection of Tecton buildings in the world and in 2010 their plight and indeed their international significance was recognised when they were placed on the World Monuments Fund (WMF) Watchlist, an international heritage alert for important historic sites in crisis. The Twentieth Century Society was responsible for putting them forward for consideration and received widespread support.[1]

This document assesses the cultural significance of the Tecton buildings and their setting and highlights some current issues and vulnerabilities which affect the site. The Tectons will be analysed through previous repair methods, maintenance and use understanding how to support the future of these significant buildings. The site is still a fully functioning Zoo and together with the Castle attracts approx 300,000 visitors every year.

Repair works to four Tecton structures (Phase 1) was completed in 2014 supported by HLF Funding and an experienced design team. BPN have been appointed to undertake the planning submission for a further four Tectons (Phase 2), supported by funding assistance from the 'Keeping It Modern' grant from the Getty Foundation. The grant focuses on the Architectural conservation of important buildings of the twentieth century. The Tecton structures will be used as a learning resource for the repair of future concrete structures, providing vital information to be shared with the conservation community.

Fig 2. View of Dudley Zoo & Castle from the East showing the Town Centre and Dudley College. Image taken from Google Earth

[1] *Dudley Zoo Tour notes 13th August 2011 Jon Wright C20*

1.1 Phase Two

The Getty Foundation funding focuses on four of the Tecton structures:

The former Bird House, former Moat Cafe, former Castle Restaurant and Elephant House.

Former **Bird House** now Tropical Bird House, north of the former Castle Restaurant

Listed Building (II*) - 1227761

The former Bird House, currently closed, will be brought back into use as a flexible indoor space for the Zoo, providing alternative functions.

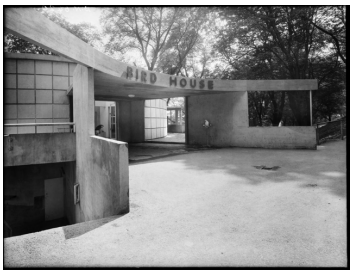

Fig 3. Former Bird House

Former **Moat Cafe** now Discovery Centre

Listed Building (II) - 1227873

The building will undergo a transformation to reveal the original design exposing the overlapping roof structure and return the building to its original use as a Cafe.

Fig 4. Former Moat Cafe

Former **Castle Restaurant** now Queen Mary

Listed Building (II) - 1076025

The building still fulfils its original use, to reinforce this use we will consolidate the M&E, reinstate the elevations as per the original design and address the surrounding landscape.

Fig 5. Former Castle Restaurant

Elephant House, to the south east of the Castle

Listed Building (II) - 1076028

This partially subterranean building will require extensive investigation to address the water ingress. Building to provide an enclosure for primates and a connection to the hillside opposite and the surrounding landscape to be reinstated as per the original design.

Fig 6. Former Elephant House

2 Introduction

2.1 Introduction

This Conservation Management Plan has been prepared by BPN Architects, 3 Mary Street, Birmingham B3 1UD Telephone 0121 233 1818 l contact Larry Priest / Dean Shaw / Georgina Martin

Bryant Priest Newman (BPN) have been previously involved with the Tecton structures as part of the 'Phase One' works in 2011 when BPN were appointed based on a competitive tender to work with DZC to support their application for Stage 2 HLF Funding. BPN were then appointed to prepare RIBA Stage D proposals for the four Tecton structures (Listed Building Consent applications).

Following our involvement in the Phase One works to the Tecton Structures, BPN were asked to support Dudley Zoo and Castle (DZC) in collaboration with Dudley Metropolitan Borough Council (DMBC) who were seeking to deliver a programme of improvements and investments to Dudley Castle, Dudley Zoo and Castle Hill Woodland.

In 2017, DZC successfully obtained funding from the Black Country Local Enterprise Council (BCLEP) to progress the proposals in order that a project development and master planning exercise could be undertaken. The aim of the project was to explore with key stakeholders, the range of potential options available, allowing the client to better realise and reveal the significance of the on-site heritage assets whilst also enhancing the tourism and leisure opportunities for DZC. These developments will build upon the catalogue of already successfully delivered improvements and investments to-date by DZC.

BPN Architects alongside an extensive Design Team published the Castle Hill Vision Phase 2 in 2019, a comprehensive funding document for ten projects across Dudley Zoo and Castle, this included: the Castle, the Lodge, the Giraffe House, a Mixed Use Facility with access to Stores Cavern, the former Moat Cafe, the Elephant House, the former Castle Restaurant and the former Bird House.

In 2020 BPN Architects were appointed to conduct further works supported by the 'Keeping It Modern' Getty Foundation for four of the Tecton Structures (Full Planning and Listed Building Consent applications).

2.2 Contributors and Consultees

<u>Phase One</u>

The Phase One works were prepared in consultation with the following:

Peter Suddock CEO - DZC
Jill Hitchman
Peter Middleton - L & R Consulting
Tim Caulton - L & R Consulting
Peter Boland - Conservation Architect Dudley MBC
Chris Cheetham - Planning Officer Dudley MBC
Alan Taylor - English Heritage
Catherine Croft - C20
Jon Wright - C20
Jon Allan - Avanti Architects
Stuart Tappin - Stand Consulting Engineers
Martin Rowe - PMP Project Services QS
Natasha Fitzgerald and Catherine Gregg

Construction
Carlo Dipinio - Construction Supervisor
Martin Baker - Concrete Specialist
Aaron Gelder - Apprentice
Nathan Beaman - Apprentice

The Phase Two proposals were formulated in consultation with the following:

Phase Two

Derek Grove CEO - DZC
Peter Middleton, - L & R Consulting
Jayne Pilkington - Conservation Officer, Dudley MBC
Liz Dickinson - Design and Delivery Manager, Dudley MBC
Sarah Wilkes - Planning Officer, Dudley MBC
John Fraser - Tree Protection Officer, Dudley MBC
Sarah Lewis - Historic England
Nick Carter - Historic England
Katriona Bryne - C20
Matthew Vaughn - Donald Insall Architects
Stuart Tappin Stand Consulting Engineers
Martin Rowe - PMP Project Services QS
Elliot Finch - PMP QS
David Farrell - Rowan Technologies
Mick Boddy - Symbiosis Consulting Ltd

2.3 Planning History

With assistance from DMBC local planning authority we have reviewed the previous planning applications that were submitted to DMBC seeking consent for works on all of the Tecton structures. This provides us with an understanding of when previous repairs or works were undertaken on the Tecton structures and an insight into the methods that were used. Please refer to section 11.2 in the appendices for the planning application references.

We are aware that the structures had extensive repairs in the 1980s by Alan Powell in conjunction with DMBC and further works in 2005 but only have access to a limited amount of drawings denoting the proposals, sadly there is no online record of the works that were undertaken and submitted to DMBC.

2.3.1 Getty Concrete Research

Historic England (UK), Getty Conservation Institute (USA) and the Laboratoire de Recherche des Monuments Historiques (LRMH) are undertaking joint research to evaluate the success and what can be learned from past repairs undertaken in each country over the last 20 years. This research will lead to advice being provided on specification of repairs in concrete and avoid the use of polymer modified repair mortars. The Tectons at Dudley were chosen as the research base for the UK for undertaking trails and sampling, involving damage to five previous patch repairs and taking cores for various laboratory tests.

We believe that this research combined with the findings in this plan can be combined to formalise better understanding of appropriate repairs for these significant structures and are awaiting their final analysis to combine within this report.

2.3.2 Previous Works

The completed Phase One works have allowed us to analyse the appropriate way to approach the repair works for these structures. For us to learn we need to be critical of previous works and understand what has worked well and what hasn't. Due to a succession of well documented repair works being undertaken in less than a decade and completed by a similar design team we are in a unique position at Dudley to assess whether products and techniques that were specified were appropriate. This document will explore through 'lessons learnt' whether new methods of working will benefit the Tecton structures.

2.4.1 Outline Client Brief to the Design Team - Phase Two

- **Former Bird House** - to repair and make good the existing structure including concrete canopies, support columns, inverted cone roof, reinstate the central aviary and opening up the promenade terrace to the public. The Bird House does not currently have a defined use and it is the intention that this space will be used as a multi purpose space. The central aviary will be enclosed and the original drainage restored, a portion of the bird cages will be reinstated to demonstrate the original use.

- **Former Moat Cafe** - This building has been considerably altered and it is intended that this space will revert back to its original use as a cafe but with the majority of it remaining enclosed. An extensive strip out process will be undertaken to reveal the original fabric and features and the form of the former cafe, reinstating the underslung entrance canopies,

revealing the split roof slabs, exposing the original soffit and reinstating windows along the side and rear as per the original design.

- **Former Castle Restaurant** - The Restaurant will receive a light touch approach, addressing all elevations and reinstating parts of the original design where possible. The roof has been cluttered with M&E items and we will look to remove water tanks and extract fans where feasible, reinstating the original circular roof light to the rear of the restaurant space, repairing all external windows. removing the surrounding canopy to the north of the building and reducing the tree cover to the rear to reveal views to the surrounding enclosures and the former Bird House.

- **Elephant House** - Elephants are no longer kept in an enclosure such as this and therefore DZC seek to reinstate this building as an animal enclosure. All rooms will be stripped back to original features and finishes and two high level tunnels will be provided to the hill parallel to the building, to allow the primates to migrate between the two spaces. High level tunnels will also be provided between the main rooms and side enclosures.

The repairs and lessons learnt from the Phase One works will inform the approach to the Phase Two works. This will help to avoid any unnecessary harm to these structures and provides us with a strong base of knowledge. This has helped to inform the repairs, renovations and strip out drawings submitted as part of the full planning and listed building consent applications.

The aim is to preserve and protect as much of the original structure as possible. To understand the extent of the original fabric and features we have undertaken an analysis of original structure against any interventions completed after the projects completion in 1937. These drawings help to support and reinstate the true intention of these drawings.

The opening up works, concrete reports and structural engineers advice are paramount in ensuring that these structures can be protected to best of our knowledge.

2.4.2 Scope of the Getty Foundation Project

The Phase Two works have been supported by the Getty Foundation, their understanding of modern Architecture and their continued conservation and support for these structures is conveyed in the below paragraphs.

The Getty website states that, 'Modern Architecture is one of the defining artistic forms of the 20th century. Set free from traditional structural requirements, Architects and engineers used experimental materials and novel construction techniques to create innovative forms and advance new philosophical approaches to Architecture.

Today this modern Architectural heritage is at considerable risk. The cutting-edge building materials and structural systems that define the modern movement were often untested and have not always performed well over time. Heritage professionals do not always have enough scientific data on the nature and behaviour of these materials and systems to develop the necessary protocols for conservation treatment. To address these challenges, The Getty Foundation developed 'Keeping It Modern', an international grant initiative that continues our deep commitment to architectural conservation with a focus on important buildings of the twentieth century. As a service to the field, technical reports from grant projects are made freely accessible online through the Keeping It Modern Report Library. The library is updated periodically with new reports as they are completed.[2]

Dudley Zoo and Castle's Tecton collection is one of just thirteen 20th century buildings across the globe to receive a share of $2.2 million from the Getty Foundation's Keeping It Modern scheme, and is the only project to benefit in the UK in 2020 – with other grantees in Chile, Kuwait, Nigeria, Portugal and Senegal.

Director of the Getty Foundation, Joan Weinstein, added: "Modern Architecture, with its experimental materials and structural innovations, is a powerful cultural expression that took many forms worldwide.

These buildings embody human ingenuity, but many are showing their age and face irreversible damage or even demolition if we fail to act.[3]

The funding stream from Getty will allow the preparation of a Conservation Management Plan and detailed analysis and investigation of four more Tecton Structures. It will also allow investigation into sustainable re-use and design proposals to safeguard the structures futures.

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[2] *Getty Website - https://www.getty.edu/foundation/initiatives/current/keeping_it_modern/index.html*

[3] *Dudley Zoo Website - https://www.dudleyZoo.org.uk/grant-funds-Tecton-revamp/. 16th July 2020*

3 Understanding the Heritage

3.1 Dudley & West Midlands Zoological Society

Dudley & West Midlands Zoological Society is a registered charity and a company limited by guarantee. Dudley Metropolitan Borough Council (DMBC) is the sole of the Society, which has eleven trustees and around eighty staff. The executive team is led by Zoo Director **Derek Grove** and the management team also comprises the Zoo Manager, Finance Manager, Marketing Manager, Retail Manager and Zoo Curator.

The object of the Dudley and West Midlands Zoological Society (the Society) is to operate a conservation based organisation for the benefit and education of their visitors to promote Zoology, arboriculture, horticulture and botany, which is reflected in their Mission Statement: ***"Caring for the future of the planet by encouraging people to develop a sustainable and harmonious relationship with nature. In doing so, Dudley Zoo & Castle shall provide for the recreation and education of the people, the conservation of wildlife, and the discovery of biological knowledge".***

The Society's principal activity is the operation of Dudley Zoo & Castle (DZC). Founded in 1937, the 40 acre site is home to some of the rarest animals in the world with international conservation programme's for Sumatran tigers, Asiatic lions, Humboldt penguins, Lar gibbons and Madagascan lemurs. DZC runs a range of events, activities and programmes including Keeper for a Day, Horrible Histories, Down on the Farm, Creature Feature, Little Zoo Keeper and outreach workshops. It welcomes some 16,000 education visits annually. Many of the on-site activities include sessions in the Discovery Centre, recently expanded with the provision of the Go Wild Theatre. DZC also plays host to a range of events such as Barnardo's Big Toddle, a Zoo Olympics, ghost walks and a reindeer run (in association with the RNLI). DZC has over 3,200 members.

3.2 Local Context

Dudley Castle is set within historic parkland and the basic structure of this remains visible in the present landscape. The principal surviving element is the woodland with its carriageways and mineral railways surrounding the Castle. This current woodland area has been used for recreational purposes since at the least the 19th century, and contains informal paths through the glades and ravines formed by quarrying.

The Castle, Zoo and adjoining woodland (Caste Hill Wood) comprise a designated Conservation Area, which is also, in whole or part, identified as a Landscape Heritage Area (whose purpose is to protect the character and quality of open landscapes of particular importance by virtue of their ecology, geology, history and scenery) under the adopted and emerging Unitary Development Plan, and as a Site of Importance for Nature Conservation.

This area has such outstanding geological interest that the Black Country was awarded UNESCO global geopark status in 2020, known for its exceptionally well-preserved fossils and rich in resources, which propelled the region into being the centre of the Industrial Revolution.

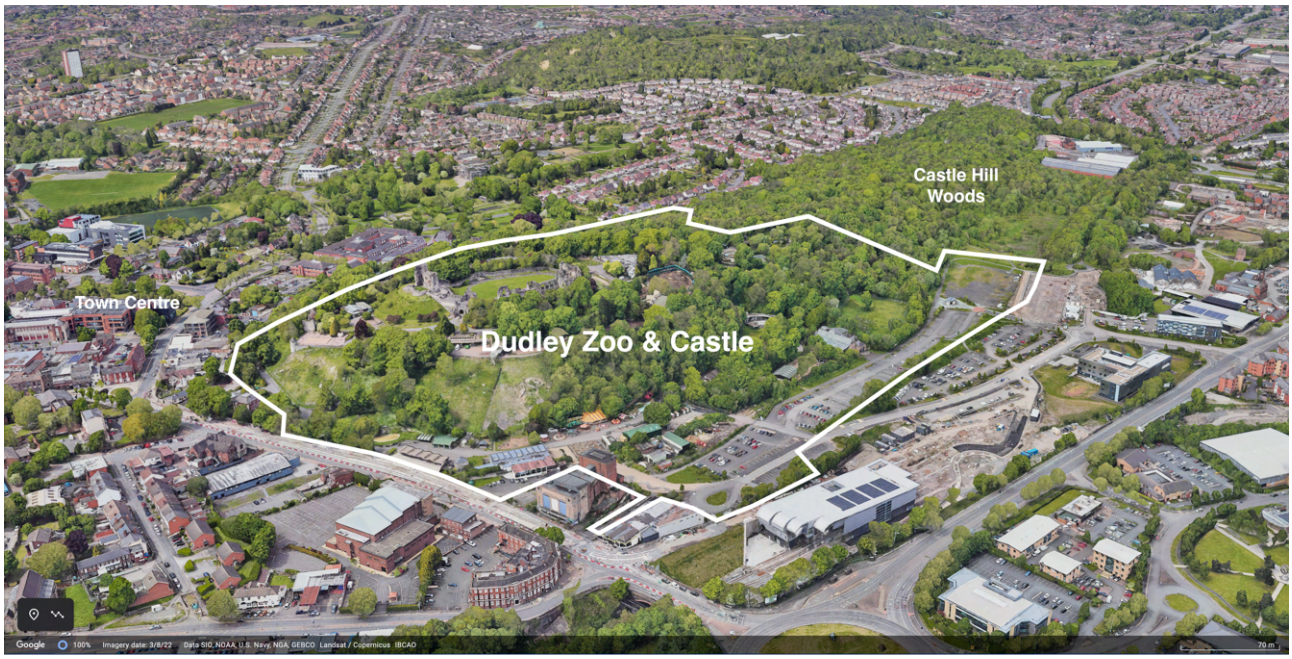


Fig 7. Dudley & West Midlands Zoological Society - relationship to Town Centre. Image taken from Google Earth

3.3 History

The idea of a Zoo at Dudley Castle was first mooted in 1935. The site belonged to the Earl of Dudley and he, together with Ernest Marsh (director of Marsh and Baxter, a meat producer) and Captain Frank Cooper (owner of the marmalade factory) combined to form the initial board of directors of The Dudley Zoological Society. Captain Cooper owned Oxford Zoo and wanted to sell his own collection of animals. They appointed Dr Geoffrey Vevers, the Superintendent at London Zoo as their Advisor. Vevers had previously worked with Berthold Lubetkin and Tecton at London Zoo, where their Gorilla House and Penguin Pool were completed in 1934 and 1935 respectively. It was through him that the practiced received the commission. In addition, the contractors were JL Kier, for whom the engineer Ove Arup was working at the time, prior to establishing his own company. The resident site engineer was Michael Sheldrake and the job Architect was Francis Skinner. The budget for the work was roughly £40,000 and there was pressure from the clients to open the new Zoo for the summer season of 1937 and, in Lubetkin's words, 'to get as many goods as possible in the shop window'. In the event, the Zoo opened on May 6, 1937 and a crowd of circa 250,000 arrived, of whom only 50,000 could be admitted. The thirteen buildings designed by Berthold Lubetkin and Tecton included a restaurant and two cafés. As the Architectural Review of November 1937 made clear, the problem for the designers was as much one of circulation and town planning as of building. A solution was found by free planning, which utilised the natural features of the Castle site. At the centre was Dudley Castle, a Scheduled Monument in a state of semi-ruin, dating from the C11 to the C16 and built around a central courtyard.[4]

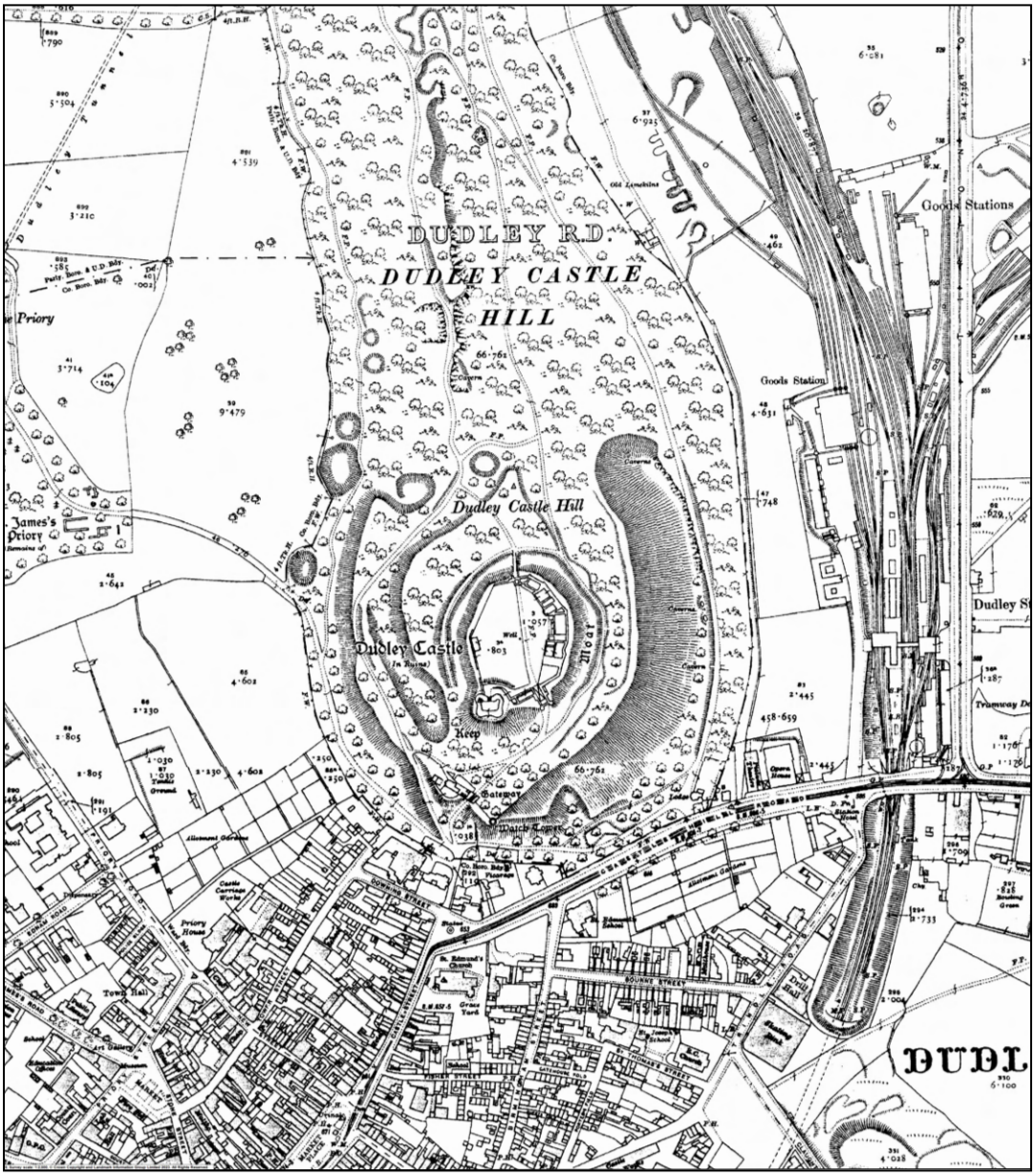


Fig 8. Dudley Castle, 1919. Map taken from Promap

[4] *English Heritage (Designation) 2011*

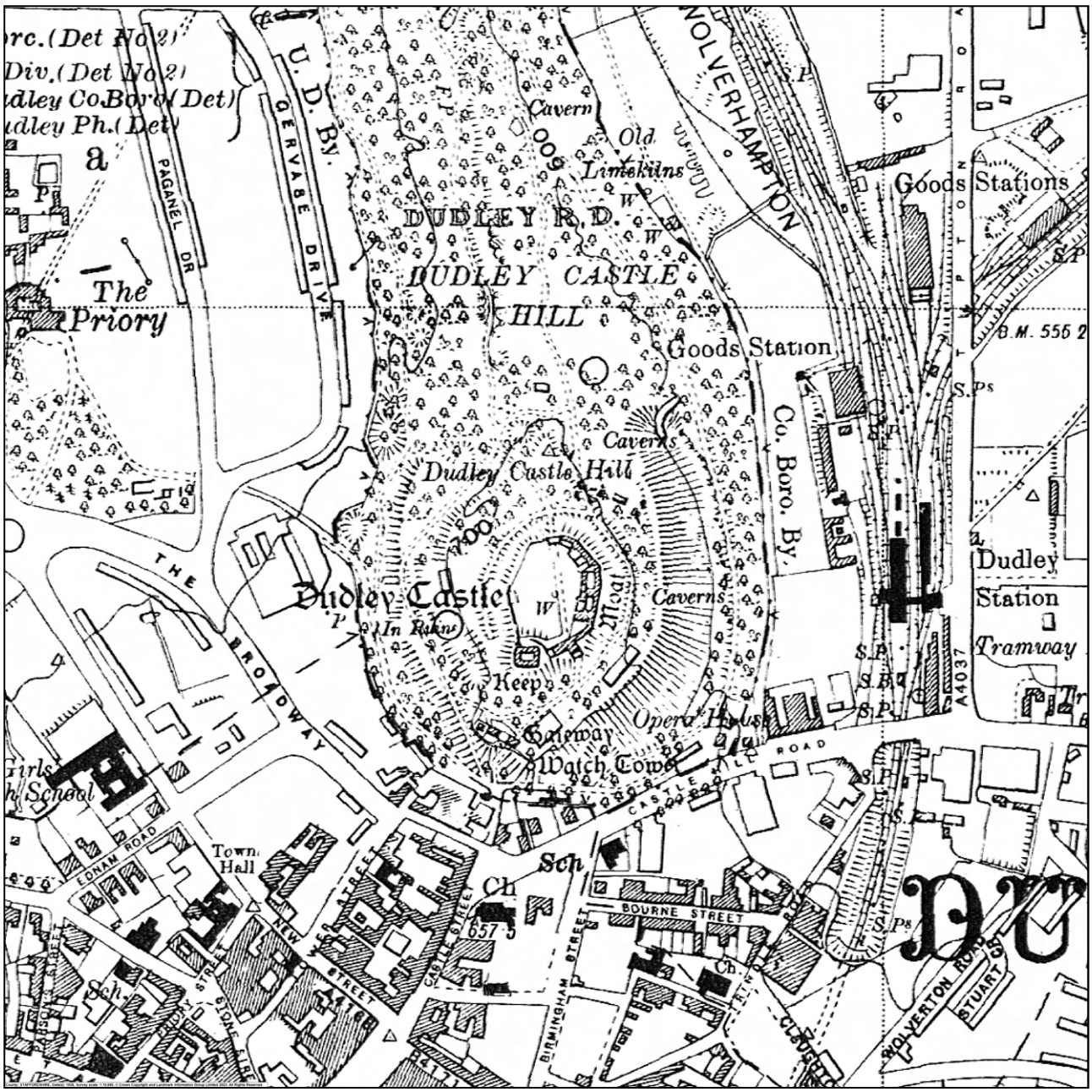


Fig 9. Dudley Zoo & Castle, 1938. Map taken from Promap.

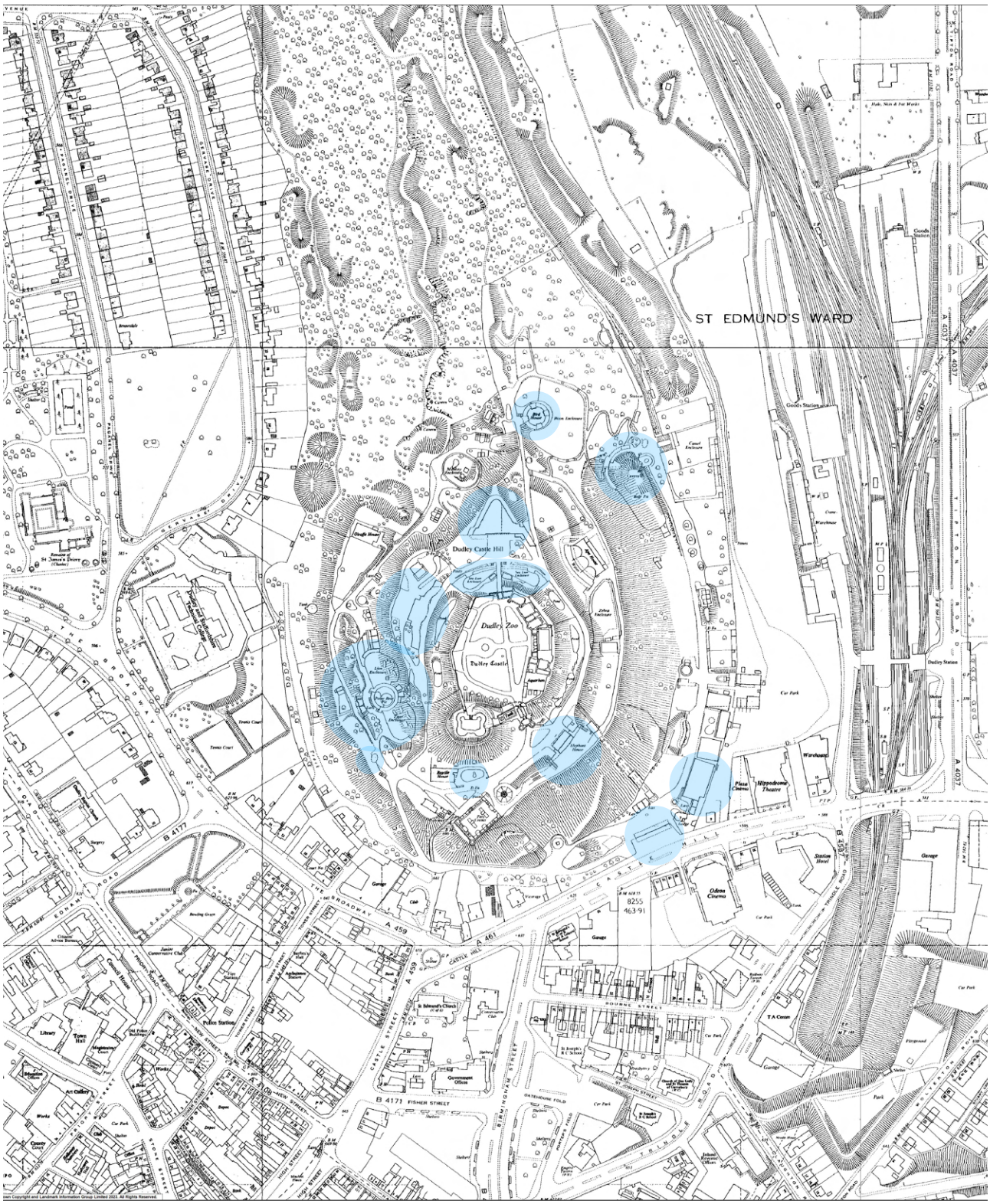


Fig 10. Dudley Zoo & Castle 1964, Tectons highlighted in blue. Map taken from Promap.

The site for the Zoo was the surrounding grounds of about thirty acres, which slope steeply down from the Castle on all sides, forming terraces at different levels. The site had the advantage that the railway station and tram terminus were both within a few yards of the entrance, but several disadvantages had to be overcome; these included the steepness and shape of the site, which reduced the number of possible positions for buildings and enclosures and made construction work difficult. Transport problems to most parts of the Castle grounds meant that the existing roads and paths, laid out as carriage drives and pathways in the C19, were used wherever possible, and construction work could not take place in wet weather. Moreover, extensive caverns associated with limestone workings from the C17 and C18 undermined large parts of the site and no accurate maps existed to guide the Architects in choosing safe building locations. During construction of the foundations, an unexpected cave, at least fifty feet in depth, opened up beneath the Bear Pit.

Almost as difficult was the fact that the limestone, which formed the Castle mound, was particularly hard, and although this created good foundations, blasting and clearing substantial areas of the site was considered unfeasible. Another consideration was that the Castle was scheduled, and the Ancient Monuments department of the Office of Works had a degree of control over development of the Castle grounds. Their position was that the educational value of the Castle would be increased by the construction of the Zoo buildings. Permission was allowed for buildings on the approach slopes to the Castle, but those structures which were near to the Castle, namely the restaurant, one café and the Elephant House and Sea Lion enclosure, had to be kept as low and inconspicuous as possible. It was also requested that the Sea Lion pools and the Restaurant should incorporate some areas of rubble stone walling to blend with the Castle. Further considerations were drainage, and the fact that half of the site was in shadow for most of the day. A planned route, grouping types of animals together, was not possible. Instead, the buildings had to signal the fact that they were related and the product of one overall scheme through congruities in their design; and functional buildings, such as cafés, lavatories and exits, had to indicate their purpose clearly. The sloping site allowed the Architects to create designs which often incorporated two levels, and allowed the public access to viewing platforms above the animal enclosures.

Lubetkin described his role in the creation of the Zoo buildings as 'designing architectural settings for the animals in such a way as to present them dramatically to the public, in an atmosphere comparable to that of a circus'. This attitude was not universally popular at the time and has since been superseded by a desire to give animals more privacy and where possible, a naturalistic setting. Several of the buildings have changed their function since the Zoo opened; these include the Reptiliary, the Polar Bear Pit and Lion and Tiger Ravines, the former Bird House, the Bear Ravine and the Elephant House, all of which now house different animals or are empty. Both of the cafés, which were originally open-air, have been adapted to be fully enclosed; and the Kiosks which formerly sold cigarettes and chocolate are no longer used for this purpose as they do not meet modern environmental health standards for the sale of food. The nature of the construction of the buildings, in reinforced concrete, has caused problems with rusting and spalling of the concrete surfaces, and repairs have been necessary, including patch repairs and a covering of colour wash. Only one major building has been demolished: the Penguin Pool, which was smaller than that at London Zoo, was filled with salt water which reacted with the reinforcement rods embedded in the concrete body and caused rapid and extensive corrosion. The building was demolished in 1979.

3.4 Tecton and Dudley 1935-37 – an overview of the development

"There are two possible methods of approach to the problem of Zoo design; the first, which may be called the naturalistic method, is typified in the Hamburg and Paris Zoos, where an attempt is made, as far as possible, to reproduce the natural habitat of each animal; the second approach, which for want of a better word, we may call geometric, consists of designing Architectural settings for the animals in such a way as to present them dramatically to the public, in an atmosphere comparable to that of a circus."

Lubetkin, c1938

Tecton[5]

Tecton had been formed in 1932 by Lubetkin and 6 graduates of the Architectural Association (Godfrey Samuel, Anthony Chitty, Lindsay Drake, Francis Skinner, Valentine Harding and Michael Dugdale). They were a young practice when commissioned at Dudley, but their reputation as designers of Zoo enclosures was already well-founded following their work at London Zoo *Gorilla House,* (1932-3) and *Penguin Pool,* (1933-4) and at Whipsnade Zoo with the *Shelter and Kiosk* (1934), *Elephant House* (1935) and *Restaurant* (1935).

Difficulties faced Tecton from the start at Dudley. Firstly, the Dudley Zoological Society had given a completion date for all the enclosures as the beginning of the 1937 summer season. This gave Tecton 18 months to design and construct the

[5] *Dudley Tour Notes August 2011 Jon Wright C20*

project from scratch. Secondly, the fact that all the development was to take place within the cartilage of a scheduled ancient monument, Dudley Castle, involved the Office of Works Ancient Monuments Department which was rightly concerned with protecting the integrity and setting of the Castle.

Lubetkin later recalled that both the department and the Zoo took a great deal of persuading that modern Architecture could be sympathetic to the existing, earlier structures on Castle Hill and that a series of mock medieval structures as enclosures was not the way to go. Despite Lubetkin winning the argument and convincing both the department and the client of his proposals, certain restrictions were placed on the heights of structures, so as not to obstruct views of the Castle and Tecton were forced to use limestone facings on those buildings immediately adjacent to the Castle – the Sea Lion Pool and the Castle Restaurant.

It was the geology of the area, however, that had the most significant impact on the designs for the individual structures as John Allan noted –

"Lying at the southern edge of the South Staffordshire basin, Castle Hill and its environs were rich in limestone and coal measures, and had been the scene of more or less continuous mining and tunnelling activity since 1750. Though Ordnance Survey maps of 1884 to 1919 show Castle Hill still in a wholly "natural" state, extensive underground workings were known to exist, but their exact extent and location were uncertain and there was neither the time nor resources for a comprehensive survey"

The difficulty of building on the slopes of Castle Hill, was therefore exacerbated by the unknown quantity of what lay beneath the ground. Looking back now, the combined difficulties that Tecton faced to make their achievements at Dudley all the more remarkable. The firm were closely assisted in the structural work by J.L Kier & Co's resident engineer, Michael Sheldrake. The use of pile foundations and column structures allowed for the groundwork investigations to be localised. Francis Skinner, the Tecton partner who was appointed job Architect for Dudley, made weekly trips to the site from London. The major design input, was however, Lubetkin's but in the range of standardised details – handrails, parapets encased in serrated formwork – there was an opportunity to make some alterations on site based on the local conditions.

What Tecton achieved at Dudley, the combination of the application of Lubetkin's architectural design principles, some daring structural engineering and impressive organisational discipline, stands as a high point in the brief, pre-war flowering of the International Style of the modern movement in England. Relatively few buildings were actually erected in this style, certainly compared with what was achieved in continental Europe and even fewer were grouped together as they are at Dudley.

Each building was tailored then, to the individual characteristics of the setting it was to be placed in, Lubetkin's exploitation of the indigenous features of the landscape gave Dudley a unique advantage over other Zoos that have to create natural scenery or backdrops artificially. Many of the structures incorporate changes in level or were used by the designers to connect different levels of the orbital pathways that snake round the hillside. The terrain, whilst posing a series of site specific problems, also had an impact on the overall distribution of the buildings at Dudley. At the main entrance to the Zoo, only the Penguin Pool and the cafe could be sited, whilst the western side of the hill, which is less precipitous, more substantial development was possible - with the Polar Bear Pit and Lion and Tiger Ravines and the Moat Cafe. The Bear Ravine follows the contours of an immense underground cavern with the Bird House placed on the hill above. The Restaurant and the Sea Lion Pool are positioned on one side of the large plateau of the 'summit' Castle Hill, with the Reptiliary and the Elephant House the other side. At the two points farthest from the restaurants, Tecton placed the two distinctive and near identical Kiosks.

Despite the distances between the structures and the inability of visitors to view the Tectons as a physical entity, Tecton achieved homogeneity and design unity through a common language, which is still highly legible. This 'family kinship' was based on geometric form and designed elements common to all the structures. To underline this, Lubetkin designed a system of signposting which consisted of 3-feet high concrete letters, unfortunately, this was never realised. Despite the ravages of time and the difficulty in converting the structures, the Tectons at Dudley remain impressive.

3.5 Original Zoo Layout & Buildings

Map of Dudley Zoo & Castle (around 1938) showing the Tecton Structures, including the demolished Penguin Pool. The six Tecton's which are included in the HLF funding application (Phase One) are highlighted in red. The four Tecton's which are included in the Getty funding application (Phase Two) are highlighted in blue.

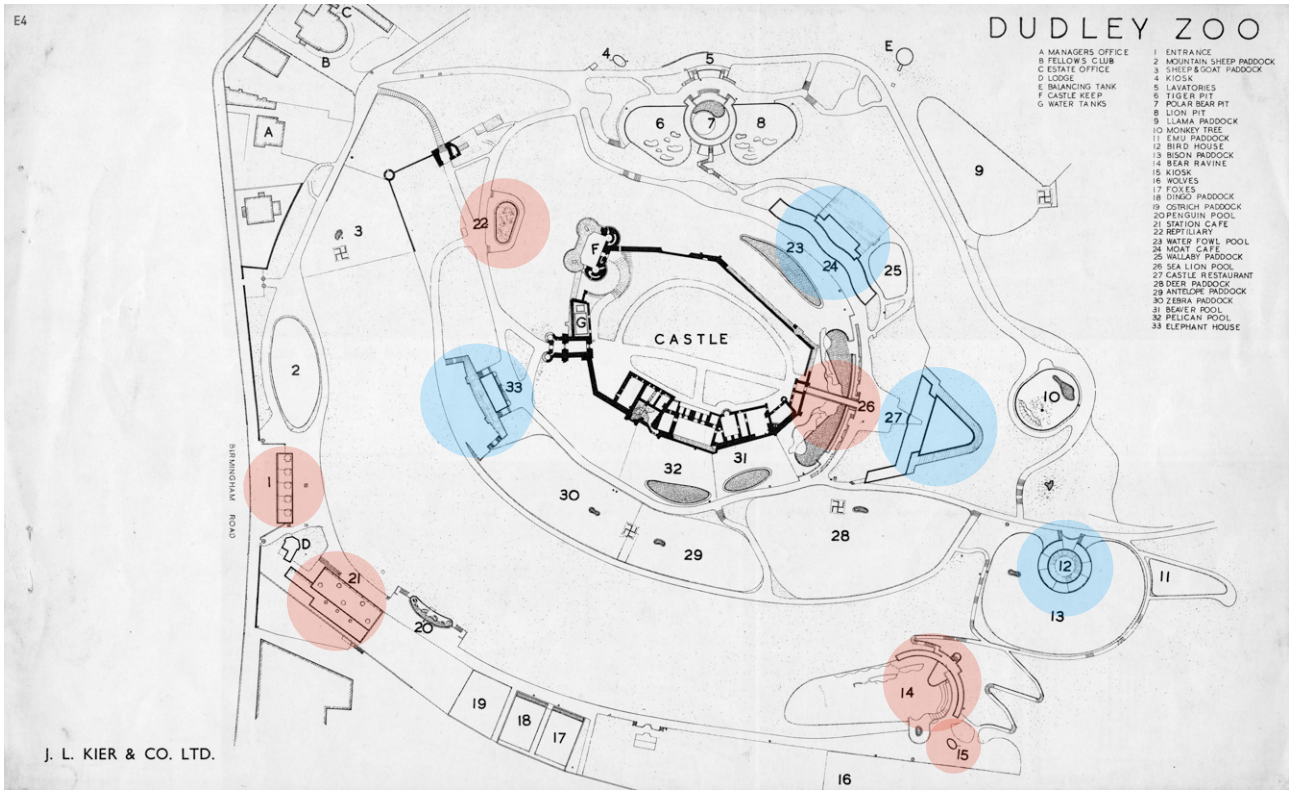


Fig 11. Drawing of Dudley Zoo and Gardens Site Plan.

Key to Tecton Buildings (red denotes structures in Phase One HLF project and blue denotes structures in Phase Two)

1	***Entrance***
4	*Kiosk*
6	*Tiger Pit*
7	*Polar Bear Pit*
8	*Lion Pit*
12	***Bird House***
14	***Bear Ravine***
15	***Kiosk***
20	*Penguin Pool*
21	***Station Cafe***
22	***Reptiliary***
24	***Moat Cafe***
26	***Sea Lion Pool***
27	***Castle Restaurant***
33	***Elephant House***

3.6 Thirteen Original Tecton Structures[6]

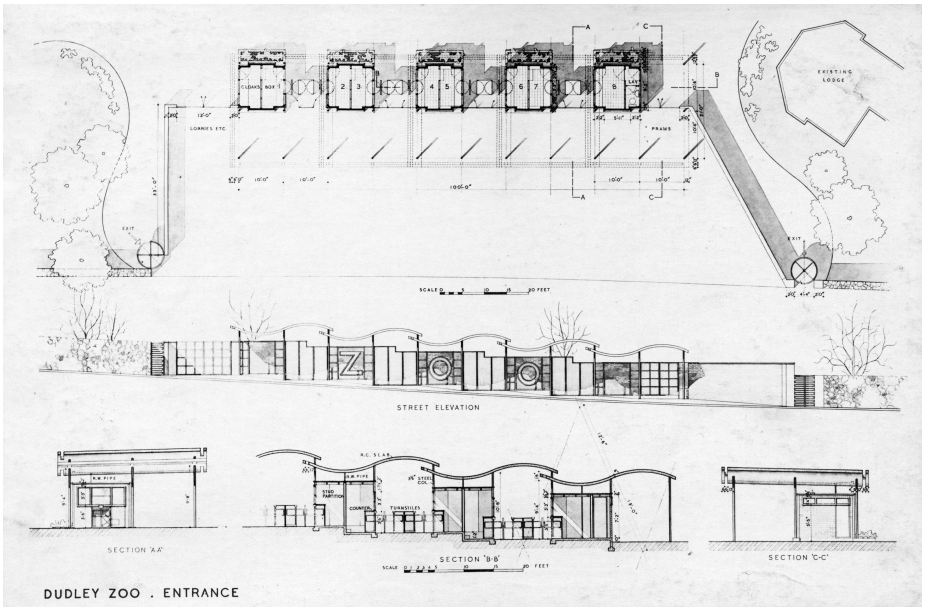


Fig 12. Drawing of the Entrance Gateway

1

Entrance Gateway

A row of 5 gates with simple ticket offices of blue engineering brick under a series of stepped 'S' shaped canopies on circular metal supports. Plain return walls of blue brick at either side.

Grade II*
1216535

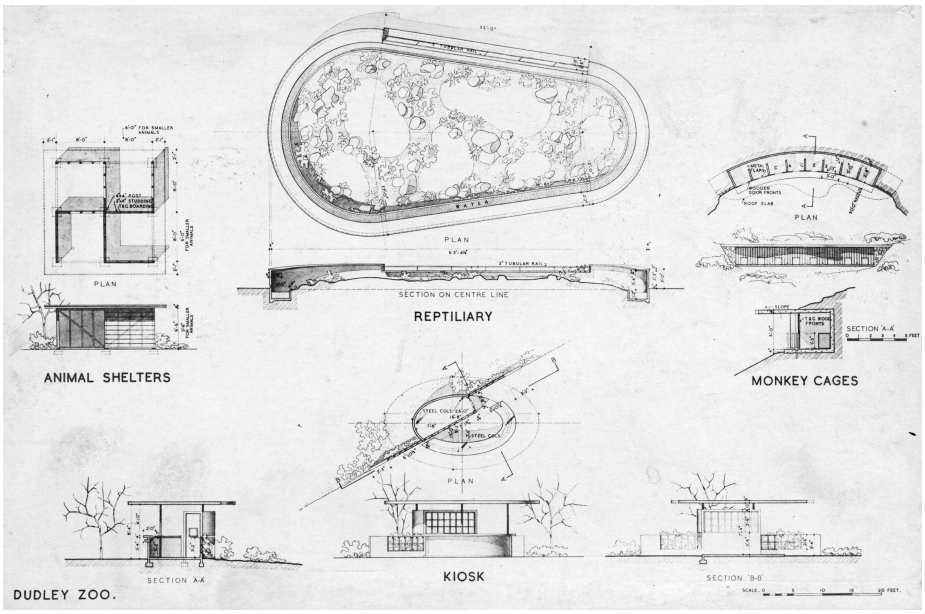


Fig 13. Drawing of the Kiosk / Reptilliary / Monkey and Animal Shelters

4

Tecton Kiosk to south of Bear Pit

Elliptical structure, largely open, with canopy supported on metal supports

Grade II*
1227903

15

Tecton Kiosk to east of Brown Bear Pit

Elliptical structure, largely open, with canopy supported on metal supports

Grade II*
1076024

[6] *Original drawings from Twentieth Century Society*

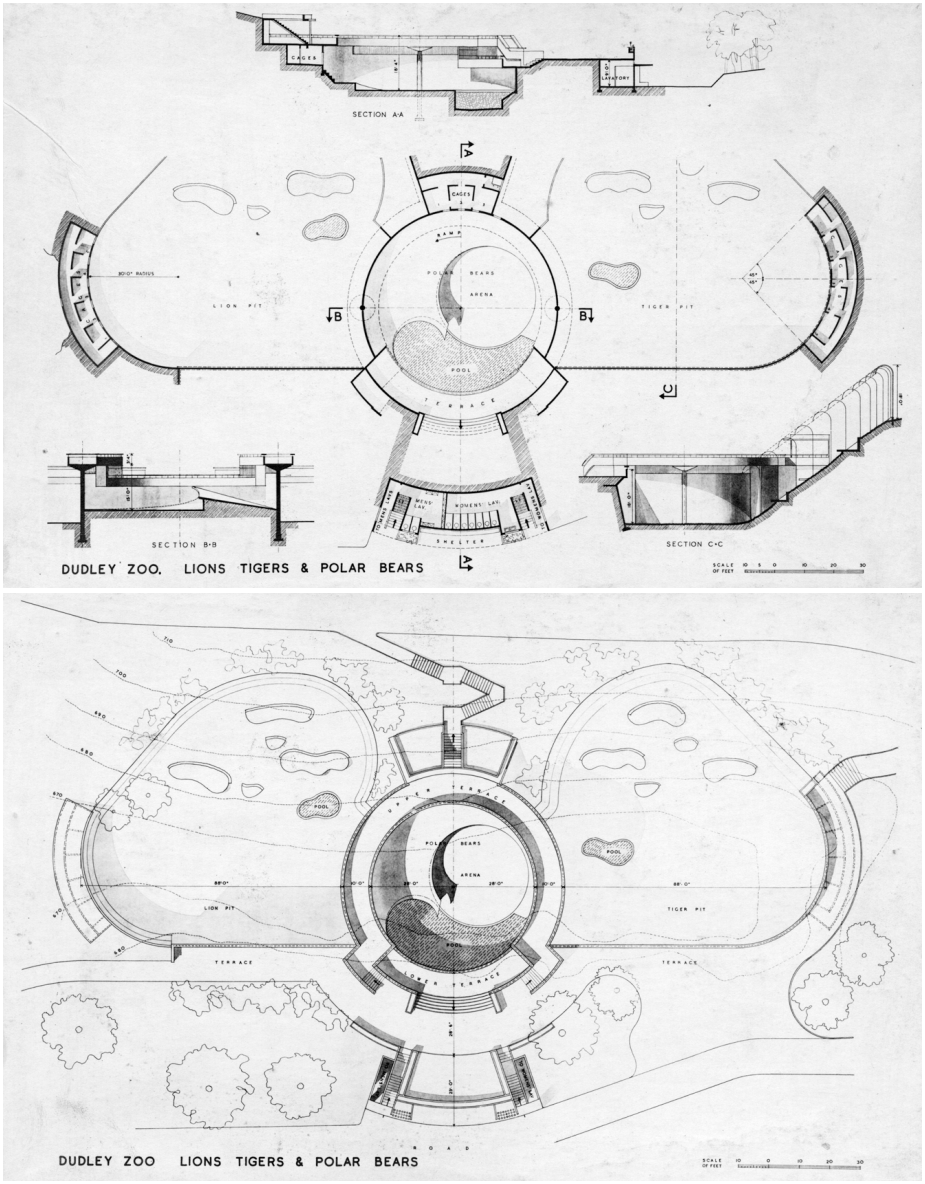


Fig 14 & 15. Drawing of the former Polar Bear Pit and Lion and Tiger Ravine

6,7 & 8

Former Polar Bear Pit and Lion and Tiger Ravines

Circular pit with pool, ramps, retaining walls, galleries, parapets, steps etc.

Grade II*
1076027

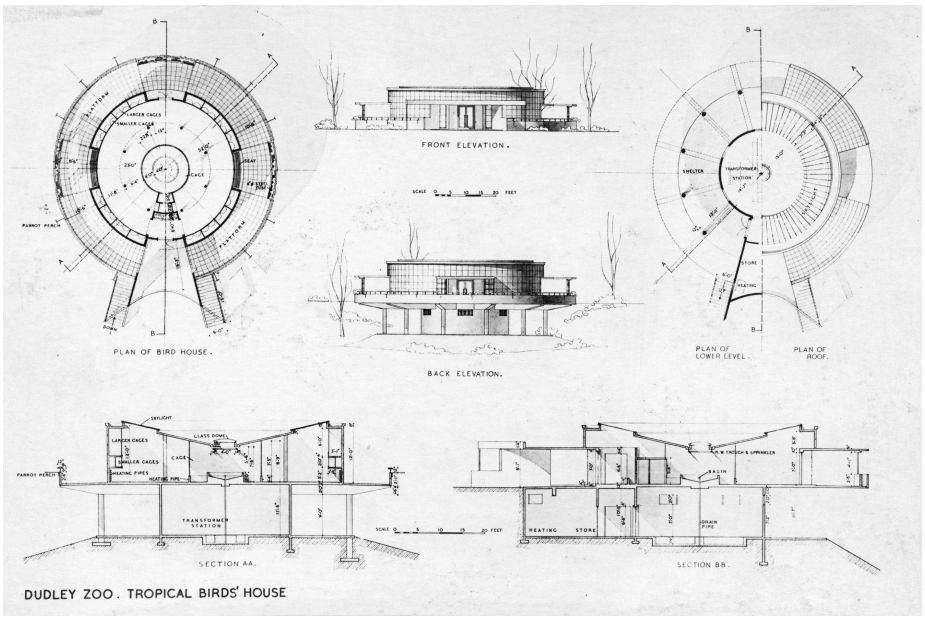


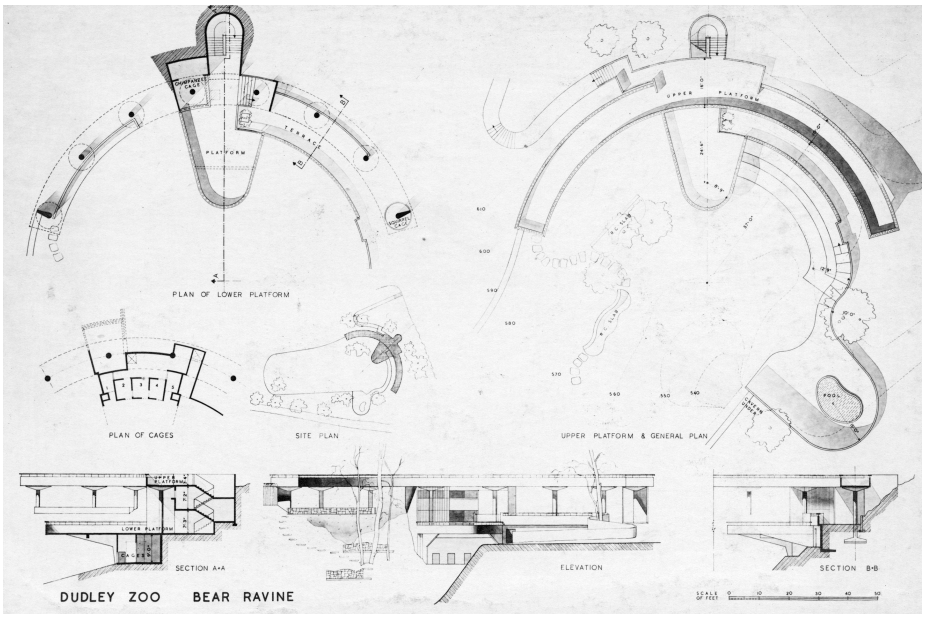
Fig 16. Drawing of the former Bird House

12

Former Bird House

Circular building of 2 storeys with balcony supported on columns. Canopies etc
to upper part. Lower part has been altered to form bison house.

Grade II*
1227761



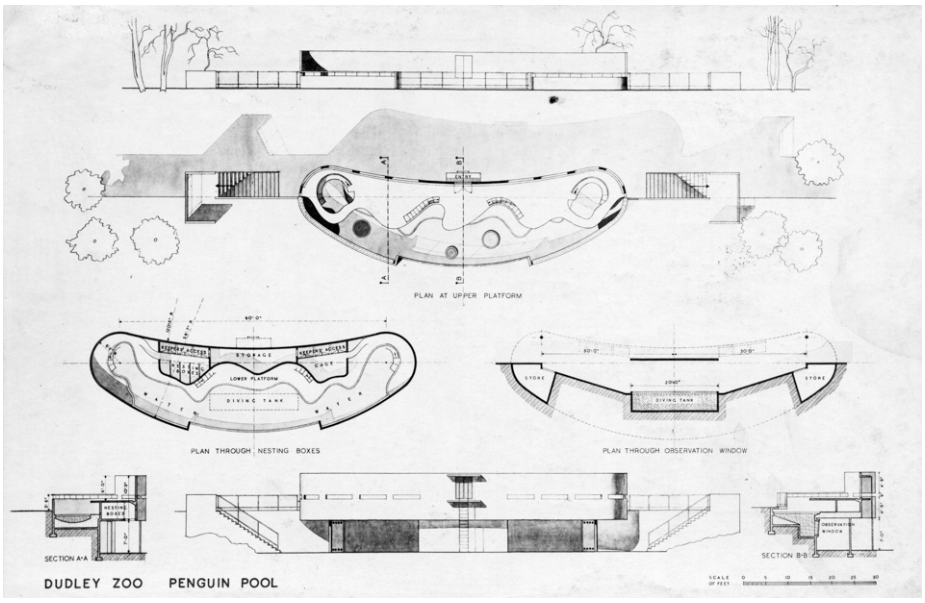
12

Bear Ravine

Substantial structure with shaped retaining wall, cantilevered balcony and upper terrace supported on mushroom columns. Steps, ramps etc.

Grade II*
1227748

Fig 17. Drawing of the Bear Ravine



20

Penguin Pool

Demolished 1979

Fig 18. Drawing of the now demolished Penguin Pool

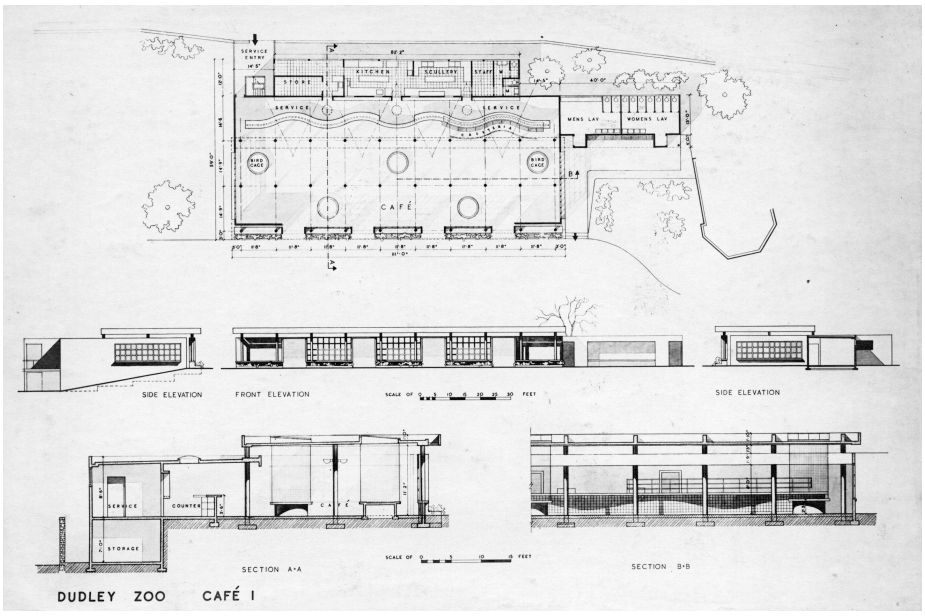


Fig 19. Drawing of the former Station Cafe

21

Former Station Cafe

Long, single-storeyed building with concrete framing, columns etc to front. 3 large windows and one to each return with timber mullions and transoms. 4 entrances with side lights. South extension containing lavatories.

Grade II
1076023

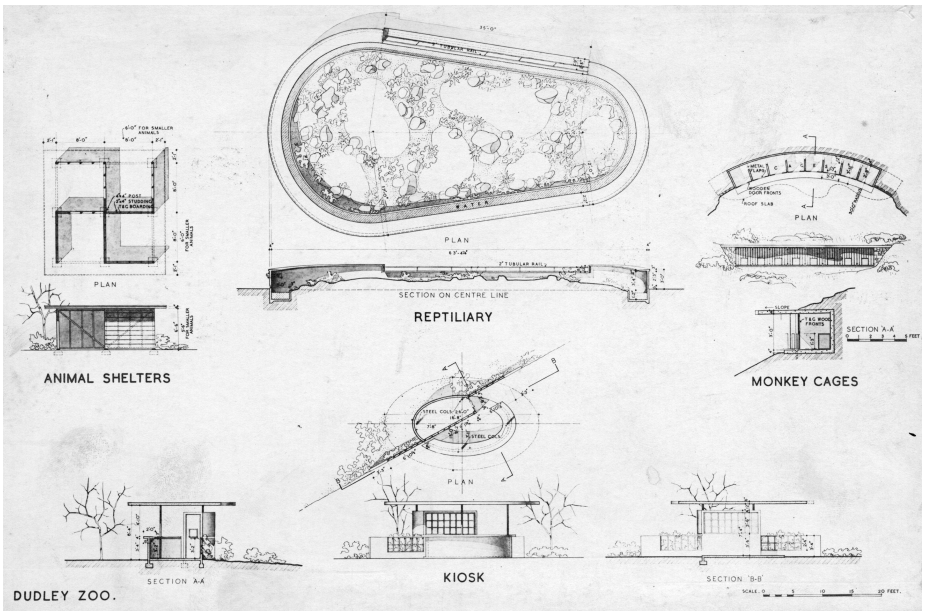


Fig 20. Drawing of the Kiosk / Reptilliary / Monkey and Animal Shelters

22

Reptiliary

Concrete. Low wall surrounding double apse ended pit and supporting concrete
shelf. Wall dips to north side where horizontal tubular metal bar is inset. Integral part of planned layout.

Grade II
1279273

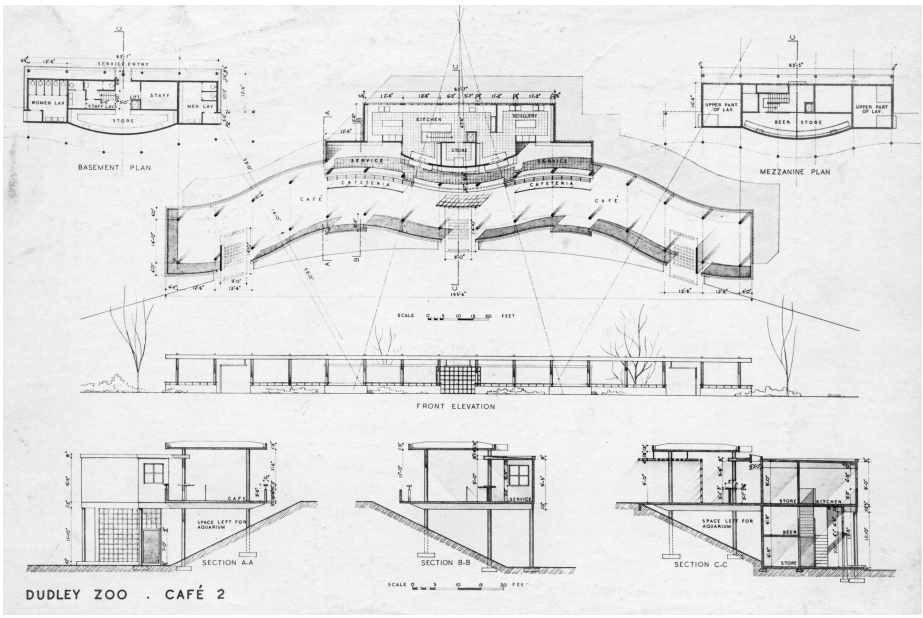


Fig 21. Drawing of the former Moat Cafe now Discovery Centre

24

Former Moat Cafe

Long, serpentine, single-storeyed structure, largely open at front with some mullioned and transomed glazing. Circular columns support roof and main structure at rear where there is a basement storey. Some alterations.

Grade II
1227873

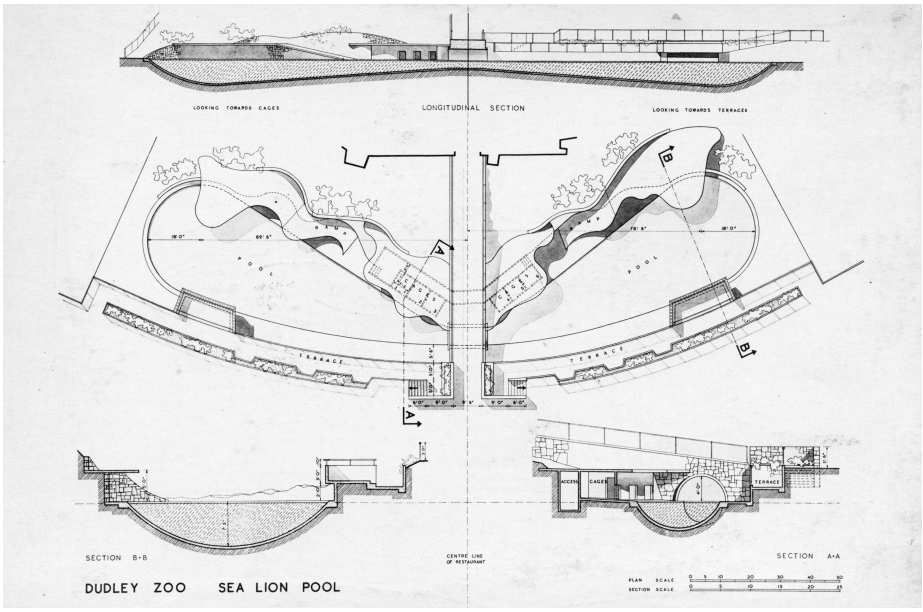


Fig 22. Drawing of the Sea Lion Pools

26

Sea Lion Pools

A pair of shaped pools connected under bridge to Castle. Retaining walls, viewing platform, shaped shelves etc.

Grade II
1076026

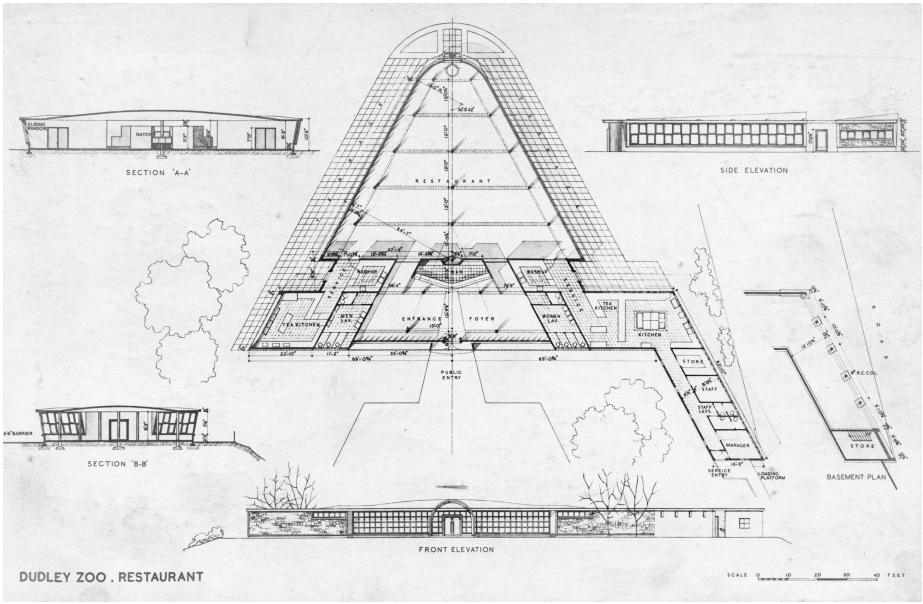


Fig 23. Drawing of the former Castle Restaurant now Queen Mary

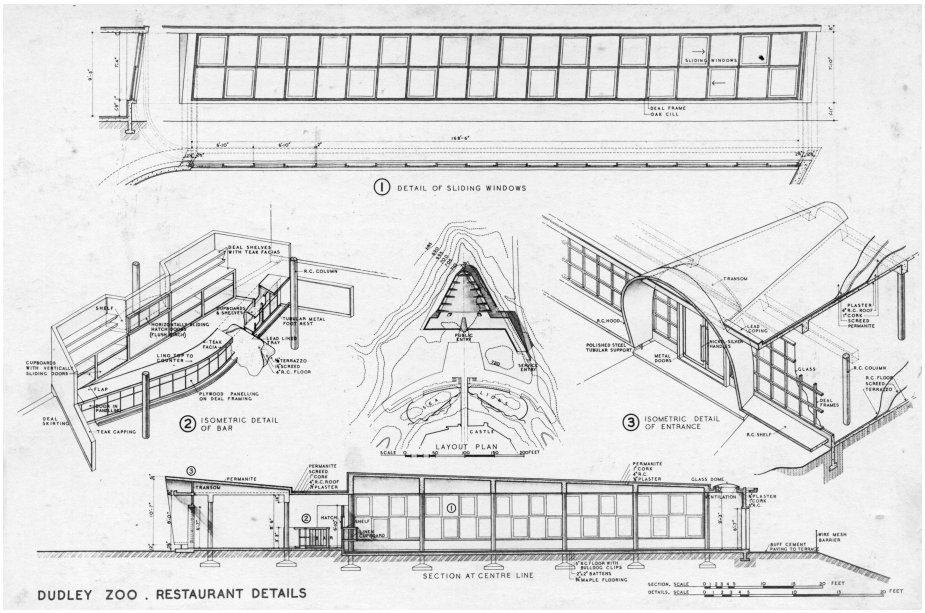


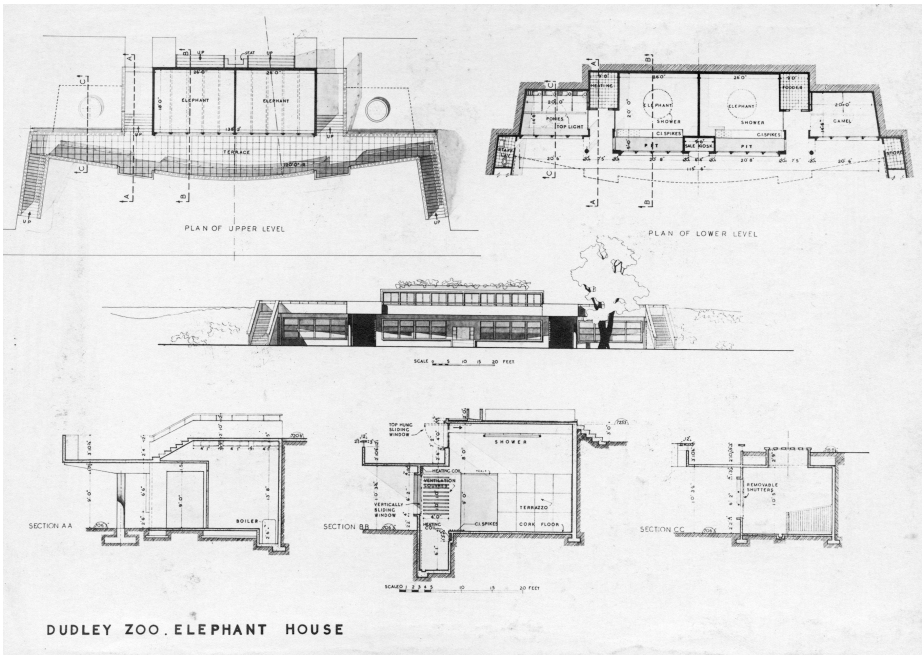
Fig 24. Drawing of the former Castle Restaurant now Queen Mary

27

Former Castle Restaurant

Single-storeyed building using a certain amount of stone rubble walling. Continuous glazing to front with timber mullions and transoms. Arch enclosing central entrance and running back as barrel vault. Alterations and additions.

Grade II
1076025



33

Elephant House

Curved single-storeyed building with clerestory rising through terrace above. Mullioned and transomed glazing. Pair of flanking staircases.

Grade II
1076028

Fig 25. Drawing of the former Elephant House

3.7 Management Information

Dudley & West Midlands Zoological Society occupies an extraordinary site encompassing a medieval Castle (Scheduled Ancient Monument), historic woodland setting, twelve Tecton structures (Grade II and II* Listed), uncoursed limestone Lodge (Grade II Listed) and restored chairlift. The management team, have gained considerable experience of dealing with such important Heritage assets on a day to day basis with very limited funding. As custodians of so many Listed and Nationally important structures they have a close working relationship with the local authority conservation officers and English Heritage.

DZC have a management budget in place that deals with the entire site, this is tabled in Section 8 later in the document which details the extent of works and the budgets assigned to the maintenance over the past three years.

4 Significance

The extraordinary significance of the area lies on its diversity of resources: from geological uniqueness, medieval to modern architecture, industrial heritage and nature conservation interest embodied in the Zoo and its surroundings.

Original pictures from the 1930s show the hillside as a dense forest of deciduous trees giving an almost unbroken canopy up to the edge of the Castle moat. Special care was taken to avoid disturbing the densely wooded hill more than was strictly necessary. All of these are readily accessible in one place, at the heart of a modern urban community.

4.1 Statutory Designations

Existing designations include:

- the Castle (as scheduled under the Ancient Monuments and Archaeological Areas Act 1979) which establishes it as of national importance
- Listed buildings from grade I (Castle) to II* and II (the Tecton buildings),
- World Monuments Fund Watchlist 2010
- Conservation Area, Castle Hill Special Landscape Heritage Area,
- Scheduled for its importance as a site where limestone extraction and processing occurred
- a number of regional and local, geological and nature conservation designations.
- UNESCO Geosite, Black Country Geopark

4.2 The Importance of Lubetkin and Tecton

The Tecton practice - the name the latter half of the Greek work Architecton, which means master or chief builder - was formed in 1932 by the Russian-born Architect Berthold Lubetkin (1901-90) with six graduates of the Architectural Association School of Architecture in Central London. The practice was arguably the most influential promoter of the modernist style in the UK. Lubetkin was a pioneering figure of the Modern Movement in Britain, an émigré and survivor of the Russian revolution, he believed strongly in the ability of design to improve society. The prime years of the practice are considered to be those between its inception and the beginning of the Second World War, when significant works in the fields of domestic building, healthcare and mass housing were built.

Combining socialist reformist aspirations, with a determined pursuit of technical innovation and aesthetic vision, Lubetkin and Tecton unquestionably designed some of the key works of the Modern Movement in Britain. The firm's role in the history of twentieth century Architecture has long been recognised and their achievements in the years before the firm's dissolution in 1948 were considerable. Much of their work is now listed, most notably Highpoint I and II in Highgate London, (Grade I), Finsbury Health Centre (Grade I), London Zoo Penguin Pool (Grade I) and the Elephant House at Whipsnade Zoo (Grade II*). Of the 25 other listed Tecton Structures in the UK, 12 are at Dudley Zoo.

Tecton's Zoo commissions helped to introduce Modern Movement Architecture to a mass audience, and allowed the firm to experiment with form and materials in a manner not possible in their other work. Through the Zoo projects at London, Whipsnade and Dudley, as well as other design commissions, Lubetkin formed a lifelong partnership with another pivotal figure in the history of British Modernism, the Danish engineer, Ove Arup. Their collaboration is widely recognised as one of the most fruitful of the Modern Movement.

Lubetkin is now remembered as arguably the most significant figure in the British Modern Movement, as an Architect, teacher, theorist and writer. The level of conservation designation given to Tecton's surviving structures is testament to a prolific and pioneering legacy that continues to inspire and inform architectural thought and criticism. Lubetkin was awarded the RIBA Gold Medal in 1982.

4.3 Historic significance of Tectons at Dudley

The significance and interest of the Tectons at Dudley lies not only in the buildings themselves, but in their interrelationship with both the local settings in which they are placed, and the Castle. They are also significant as part of Tecton's oeuvre of Zoo buildings, and as important and highly experimental examples of their Architecture as a whole.

The twelve surviving pavilions at Dudley are more than worthy of comparison with their better-known London precursors, London Zoo's Penguin Pool (1933-34) and Gorilla House (1933) and represent a unique collection of works by an early modernist practice on one site. Each structure is separately listed by English Heritage and has its own list description. The site is also a Conservation Area.

The significance of Dudley's structures within Tecton's Zoo work is outlined by Lubetkin's biographer, Architect John Allan.

"Although the better-known virtuoso pavilions are to be found at London and Whipsnade, it is in the comprehensive scheme opened at Dudley in 1937 that the most sustained example of Tecton"s work in this genre is to be seen. It is also at Dudley that the social dimension of this otherwise seemingly peripheral form of Architecture can be said to be most fully realised" [7]

The unusual challenges of designing for different species, and the technical freedom that providing unheated and minimally serviced structures facilitated, allowed Tecton's Zoo buildings, and pre-eminently the large collection of such structures found at Dudley, to act as experiments in form and attitude to brief. This gave the practice an extraordinarily creative freedom which fundamentally affected the development of their work.

4.4 Architectural and constructional significance of the Tecton structures at Dudley

Design and construction of Dudley Zoo was completed remarkably quickly from late 1935 to spring 1937 in conjunction with chief structural engineer Ove Arup, at a cost of £40,000. The three strands of Tecton's Architectural additions at Dudley can be categorised as infrastructural groundworks, animal enclosures and facilities buildings.

Designed to exploit the sites indigenous features in a variety of imaginative ways, each structure represents an attempt by Tecton to 'customise' Architecture to its immediate environment. They share, however, a common design language that depends on stylistic and material consistency. Symmetry, including the 'diametry' or diagonal symmetry which Lubetkin developed and a variety of geometric forms typify the buildings at Dudley, making what John Allan terms a "lexicon of geometric figures' in the landscape. This commonality is particularly significant since the buildings are, in the main, visually separated from one another. The Tecton structures at Dudley represent the most complete set of buildings produced by the important collaboration between Ove Arup and Lubetkin.

All the buildings exploit the structural and sculptural capabilities of concrete and remain some of the most virtuosic examples of the use of this material in Britain. The use of pile foundations and column structure eschewed the need for complex surveys and necessitated only localised surveying. The standardisation of many of the Architectural elements, including handrails and parapet walls also assisted in the economy of the construction.

The use of fairfaced board marked concrete predates the popularisation of this form of construction by le Corbusier in his Unite d 'Habitation in Marseilles (1946-52). It was a similarly inspired but pragmatic choice of construction methods and material, and one that was to prove fundamental to the later development of the New Brutalist Style, as first identified by critic Reyner Banham in his book The New Brutalism: Ethic or Aesthetic? (1966).

4.5 Communal significance of the Tecton structures at Dudley

On the day of the Zoo's opening on the 5th May 1937 an estimated quarter of a million visitors arrived hoping to gain entry. On the grounds of public safety only 50,000 were admitted and by the end of the first year around 700,000 had visited. The Zoo has welcomed over 30 million people to the Zoo in the 70 years since it opened and along with the Castle retains its position as a significant attraction in the wider Black Country area.

The wider history of the site and the specific history of the Zoo are both significant in the community history of the town of Dudley and both have played a role in shaping the impression of the town both for local people and visitors.

The social value of the Zoo as a place of recreation for the huge industrial population of the Midlands at the time it was constructed cannot be understated and was recognised by Lubetkin as a visitor to the area in the 1920's. It is consistent with what we now know about the influences behind Lubetkin and Tectons projects that the Architects saw the scheme as a chance to improve the lives of the working classes of the area. This facet inexorably links the Tectons at Dudley to the social and communal history of the town and the Midlands.

Tecton's Zoo buildings, particularly those at Dudley, allowed more people to encounter modern Architecture and assess its possibilities than at any other site in the UK

'Dudley undoubtedly represents the fullest realisation of Lubetkin's philosophical principles towards nature, not only in the manner of exhibiting wild animals but also in the relation of the whole Architectural ensemble to an outstanding natural setting. It is this combination of consistent aesthetic vision and its diversity of application within a single project that make Dudley Zoo a unique episode in the history of modern British Architecture.'[8]

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7 Lubetkin – The Tradition of Progress" p224 8

[8] Architecture and the tradition of progress, Berthold Lubetkin, John Allan

5 The Tectons

5.1 Descriptions

The list below identifies the Tectons for repair and restoration as part of the next phase of works, for listing descriptions, historic photography and original drawings[9], for detailed information please refer to the appendices, section 11.1.

The former Bird House

The former Moat Cafe

The former Castle Restaurant

The Elephant House

5.1.1 Original Colours & Paint Analysis

A record of the original colours used by Lubetkin is included in John Allan's study 'The Tecton Buildings at Dudley Zoo'[10] (he consulted with Lubetkin and Skinner) - for reference Allan included a provisional guide :

	Dulux (Colour Dimension)	Nearest BS4800
White		00E55
Cream		10B15
Light Grey		00A05
Pale Blue	2040-R80B	
Dark Blue	4050-R80B	
Chocolate	7010-Y70R	
Terracotta	4533-Y77R	
Red	3070-Y90R	
Black		00E53

The original photographs were taken in black & white and the structures have been subsequently overpainted. Learning from the lessons of the previous repairs early paint analysis was undertaken to determine the colours used throughout each scheme, This concluded that there was a simpler palette than indicated above. Please refer to the Crick-Smith report in the appendices, section 11.7 for further information

5.1.2 General Policies

The following general policies have been proposed and agreed by DZC when considering any work to the Listed Structures. This criteria is applied to each structure in turn.

Policy 1 continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage
Policy 2 the continued use of the existing buildings/ structures through sympathetic and viable uses
Policy 3 to perpetuate concrete repair/ maintenance skills on the wider DZC site
Policy 4 maximise the range of visitors to the site through audience development
Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development
Policy 6 improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric
Policy 7 emphasise the need to include conservation advice within the decision-making process for future developments
Policy 8 maintenance and repair should be based upon sound knowledge of the building and its materials gained through regular inspections
Policy 9 the possibility of the existence of important below-ground archaeological evidence will be considered when planning any development or maintenance work, and appropriate action will be taken to mitigate the impact of any such work

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[9] *Source - C20*

[10] John Allan – The Tecton Buildings at Dudley Zoo – *A Feasibility Study for restoration and Re-use Avanti Architects 1990*

Policy 10	engage in public consultation on local planning policy for the Dudley Zoo & Castle which could affect the continued significance of the site
Policy 11	an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys
Policy 12	ensure every change is an opportunity for a wider holistic vision for landscape to be explored and implemented in terms of sense of place, historical context and original intention
Policy 13	seek opportunities to improve future biodiversity and experiential atmospheric landscape design with regard to international, national and local aspirations.

5.2 Tropical Bird House former Bird House

Use / Significance / Previous Repairs

Fig 26. Aerial Image of the former Bird House

5.2.1 Introduction

The former Bird House is sited in perhaps the most commanding position of all the Tecton buildings. Set east of the Castle on a steep, east-facing site, with views out over the wooded slopes to the north. It was built to house semi-tropical birds, such as Macaws, Amazon Parrots, Cockatoos and a number of smaller birds, and incorporated a heated indoor house and an external balcony, which allowed some of the birds to be displayed outside during summer. Unlike the animal houses closer to the Castle, the former Bird House was in a less sensitive site, and this enabled the Architects to create a bolder design without significant height restrictions. The two-storey building thus created was something in the manner of a belvedere, its drum form and hilltop location recalling the use of such towers in C18 English landscape design.

The steep site, with the ground falling away sharply to the east, served to link the two levels within the terraced grounds, similar to the other large animal houses at the Zoo. The upper level, which was the expected approach from the south, gave access into the bird house and surrounding balcony which cantilevered out over the paddock below. This allowed not only a view of the bison in the enclosure below, but also over a wide area of the Zoo grounds and the landscape beyond. A flight of steps gave access to the area immediately below the house, where the cantilevered balcony doubled as a shelter for visitors in wet weather. The central drum beneath the main house provided a discreet location for an electricity transformer station and electrical switchgear.

5.2.2 Use

On inception the building was originally used as a bird house, with enclosures within the depths of the walls and a central aviary on the ground floor.

In the mid 70s, the building was renamed the 'Tropical House', housing reptiles within the ground floor and an external aviary on the lower ground floor terrace accessed via the external stairs either side of the main entrance.

The Feasibility Study for Restoration and Re-Use conducted by Avanti Architects in 1990 explores three proposals for the Tropical Bird House, a Reptile House, Small Primates / Small Birds and Bar / Soda Fountain, sadly none of which came to fruition.

In the 2000s, the building provided an indoor play space for children but the building is now no longer in use. Currently, the paddock beneath houses Asiatic Lions, this has meant that modifications have been made to the perimeter and the terrace within the enclosure cannot be accessed.

The proposals seek to provide a mixed use building that can allow for adaptation to suit a range of activities, current ideas for the future use of the former Bird House are a soft play area or a virtual experience using the circularity of the building for curved screens, providing an insight into the history of Castle Hill and the Conservation work that Dudley undertake. During the public consultation, conducted in 2019, the public were asked which idea they would favour and the virtual experience was more popular. The current works provide flexibility for the Zoo to be able to implement either of these uses.

5.2.3 Significance:

Very significant- 'Architecturally distinguished'

Listed Status

Grade II* Listed

Architectural Interest

From the original drawings there is a purposeful simplicity of the concentric circles, made up of the external gallery, the outer walls, the four banks of cages, the circular roof structure and the central aviary. Lubetkin had a strong attraction to circular plans, drawing on historic significance of geometry and composition as exemplified in the classical tradition. Circular plans are reoccurring in the Library at the Dorset Estate, the Palace of Soviets and the Polar Bear Pit, Dudley Zoo.

The main space is made up of two structures a large external drum and a self supporting inverted roofcone, with its top lighting, central oculus and free standing colonnade has a unique, almost classical Roman quality. The glazing emphasising the structural concept. The structure has a cantilevered external gallery, similar to the Elephant House, using the same structural columns and downstands. The patterned treatment of the external wall provides more early evidence of Lubetkin's dissatisfaction with the weathering characteristics of plain concrete, and is of particular interest in being comparable to the experimental gridded (terrazzo) treatment of the Regents Park Animal Art Studio (1937) which most regrettably was demolished in the 1960s.

Aesthetic Qualities

Due to its location in a less sensitive area of the Zoo away from the Castle ruins the architecture here is bolder in design. This building was a showcase for what concrete was capable of and innovative structural techniques: the parabolic entrance and fan canopies supported on thin columns, the cantilevered external gallery, the seperate structures bridged by an unbroken circle of glazing. This culmination of features provided a spatial quality that no other Tecton at Dudley Zoo possesses.

The original drawings match the final construction almost perfectly, only minor alterations were made, the lower level was used for viewing the attractions as much as the upper floor, as curved bench seating was provided on the lower terrace as seen in the original black and white images. Another change from the original proposals was the depart from a gridded floor pattern in exchange for a simple floor finish to the external terrace, this also occurred to the Elephant House and Queen Mary.

Much of the original aviary has been altered with changes to the drainage, the lower walls of the central aviary, the removal of all of the bird cages and the removal and replacement of the original internal lobby. Only remnants of the original cages remain, the concrete formwork for the lower bird cages and the steel supports to the rear of the top cages, embedded into the outer walls.

Similar to the fluted concrete profile on the other Tecton structures, the former Bird House is a showcase for concrete profiling through the use of a moulded grid pattern which in turn helps to master the day joints and control weathering on the external face of the ground floor drum.

Materiality

Internally, large and small white-tiles lined the bird enclosures to allow the birds colouring to be on full display. There was a simple colour palette for the entire building with the majority of the building being bare concrete and white painted or tiled. A circle of wire mesh dropped down in the centre of the room surrounding the central roof light forming a large aviary which has since been removed the central aviary replaced by a central drainage pipe and three large props.

Externally the entire structure has been painted cream but the paint analysis has confirmed that the external face of the building was unfinished concrete. The current paint finish sadly detracts from the significance of the building and needs to be changed.

Colours
Original colours: Fascia and upper level drum panels - unfinished concrete; recess joints between grid pattern - unfinished concrete; canopy soffits - unfinished concrete; balustrade walls- unfinished concrete; undercroft and columns - unfinished concrete; external doors - varnished / dark brown oil paint; window frames/ trellises- white; light metalwork - aluminium paint finish - silver.

Social Value

The former Bird House is one of the most architecturally distinguished of the Dudley group and is an iconic building and is a piece that embodies the thesis of the Tecton Group and is arguably the most successful use of Lubetkin's favourite circular plan form.

5.2.4 Previous Repairs & Observations

During its lifetime the building has undergone two major internal changes, one to enlarge the enclosures and expand the amount of species on show and another to convert the building into a Childs play area.

In the 1970s the wall enclosures were enlarged and glazed whilst the central aviary was repurposed as a planter and seating area with four new roof lights punctuating through the existing roof as seen in the image below. The image shows the addition of four posts under the central down stand ring beam at the centre of the inverted roof cone, believed to have been added during this period of time.

In the 1980s, the building went through repair works conducted by Dudley Metropolitan Council and Historic England. There are drawings dating from September 1983 denoting the repairs that were undertaken and one note states that the four rooflights were to be removed and infilled.

The building was then converted into a Childs play area and undertook a suite of changes which seems to have included boarding out all external wall cages and painting the entire building.

It has been noted in the Feasibility Study produced by Avanti Architects in June 1990, that there have been multiple repairs to the Aviary, these are noted below in italics. This information gives us an understanding of the issues or works that were undertaken, building a picture of works that may need to be remedied, learning from issues that arose from past alterations. This is accompanied by our observations undertaken in 2022 to provide a picture of the current condition of the buildings.

Rooflights
The Aviary is currently out of use, an earlier refurbishment project having been halted prior to completion. This has left some items unstated and others unfinished. Additionally one particular amendment, the reglazing of the circular roof light and dome is to be remedied to meet the requirements of English Heritage who are unsatisfied by the enlargement of the roof light kerbs. - Item 5.8.2.1

Our observations in 2022 reflect that of Avanti Architects comments, however the repair works have also had an effect on this building. The replacement Georgian mesh roof lights are failing and the majority of the panes of glass are cracked or damaged. It was believed that this glazing system would enhance the strength of the glass but it has only weakened the panes. The roof lights therefore need to be replaced with a glazing system that is suitable for its location, with lack of maintenance access and below a sycamore which are known for sap accumulation a specialist glass will need to be specified.

Inverted Roof Cone
The inverted roof dish has received quite significant concrete repairs to infill skylight openings believed to have been cut out sometime in the 1960's. . . . Stalactites indicate some leaking through the 120mm thick canopy but this is not general despite there being no asphalt. - Item 5.8.2.2

Since the 80s repairs the inverted roof cone condition has improved, stalactites are no longer visible and the leaking seems to have been contained by the new roof lining but there is concern that the structural integrity may be compromised beyond repair and may not be reversible, structural opening up will reveal what works can be undertaken.

Roof Coverings
The roof coverings are recent, with felt laid to the central dish, outer ring and part of the front entrance canopy. This results in turn downs or aluminium edge trims which appear inconsistent with the original aesthetic. The roof drainage has been inhibited by uncleared leaf blockage of outlets. This appears to have caused some internal water penetration through cracks in the perimeter ceiling. - Item 5.8.2.3

The proposals seek to remove the additional three props and central downpipe in the original central aviary and therefore opening works need to be undertaken to understand whether adjustments can be made to the roof build up to remove the need for the additional support and ensure that this structure can return to its previous condition. Due to the lack of suitable access a suitable drainage system needs to address the accumulation of leaves, if the sycamore is managed well this may be the best way to resolve this.

This building is in relative good order, however the extensive structural repairs that will need to be conducted to allow the central cone roof to be self supporting without the use of the additional internal props may require a considerable structural solution to ensure its stability.

Parapet Walls
Externally there are noticeable watering patterns on the outside parapet wall associated with the secondary canopies, and a green 'tide mark' seem 300mm high runs around the foot of the inside parapet wall. - Item 5.8.2.6

As shown in the current image at the start of this section this is still occurring and may be resolved through the addition of a flashing along the length of the planter to allow the run off to project away from the wall fascia.

Fig 27. Image of the Tropical Bird House, View of the central winter garden and the exhibits,1976

5.3 Former Moat Cafe

Use / Significance / Previous Repairs

Fig 28. Image of the Discovery Centre, former Moat Cafe

5.3.1 Introduction

The building was constructed as the Moat Café, one of three eating places within the Zoo grounds. It was built on a site not originally considered suitable for a building, given that it would interrupt a key view of the Castle from the moat. However, it was eventually accepted by the Ministry of Works' Inspector and in order to lessen its impact, the structure was made as light and transparent as possible. The front of the building that directly faces the Castle has a low, single storey scale but the building has three storeys seen from the rear with a mezzanine and lower floor, housing stores, original beer cellar and staff rooms. The basement level was accessible externally from a service road at the rear of the building.

The single-storey front section was built on stanchions, to allow for the subsequent excavation of the rocky outcrop on which it stands and to further emphasis the buildings lightweight and transparent concept. The buildings plan was constructed with flowing, serpentine curves, designed to break up the building's outline when viewed from above. The side and rear elevations were glazed, while the front of the building was left open to increase its transparency.

The entrances were indicated by floating slabs suspended from the roof and breaks in the low wall. The main space, between the entrances, was defined by the use of a low wall with coping raised on short steel struts – the standard walling used for viewing areas and some enclosures around the Zoo, which was one of the unifying details of the Tecton structures.

5.3.2 Use

The former Moat Cafe, now called the ‘Discovery Centre’ has changed significantly, originally conceived as an open-air serviced shelter, the building has undergone significant alteration since its completion, most crucially in the infilling and glazing of the entire front elevation. Over time the building was converted to a teaching and education space, at first only a portion of the structure being converted in the early 1970s. Following this the whole building was dedicated to teaching and learning for visitors with the original kitchen being used to store the various animals and reptiles for show and tell. This building has only been through one major change of use since its conception.

The proposal seeks to revert this building back into a cafe space making alterations to the rear to provide amenities at ground floor allowing the building to be accessible to all. It is the intention that a portion of the building remains open air, true to the original design intent.

5.3.3 Significance

Status: Significant

Listed Status

Grade II Listed

Architectural Interest

The building is made up of two distinct roofs, one seemingly floating above the other with a slight overhang between the front and rear sections. The rear service block is covered by a rectangular roof slab which includes a strip of top glazing and the front by a serpentine curved roof slab. Research has revealed that the serpentine roof solution superseded an earlier less subtle rectangular solution.

The 200ft long serpentine structure is symmetrical about the centre line and is reminiscent of the shelter and Kiosk at Whipsnade Zoo, supported on thin metal columns, built around the same time as the Moat Cafe at Dudley, The shelter at Whipsnade was sadly demolished and the structure at Dudley remains the only surviving example.

The form of the Moat Cafe are from Lubetkins conceptual sweeping curvaceous lines, reminiscent of the shapes of earthworks and the landform of the Castle, the Moat Cafe embodied this concept, similar to the Entrance building with its individual horizontal rhythmic curved roof slabs supported on slender columns.

Aesthetic Qualities

The Architectural solution to the task of placing such a large building so close to the Castle was to make it as light, detached and transparent as possible. With its floating canopy, suspended floor slab and minimal enclosure, the original scheme allowed views along, across and beneath it. The geometry typified Tecton's style of relaxed formality, and a visitor who knew the Zoo in the early days has recalled the easy way in which the cafe absorbed and released the passing throng.

Due to the buildings change of use the Moat Cafe has been enclosed through various means, providing a jumbled elevation to the front whilst to the rear the building has been wrapped temporarily by any means to stave off bad weather. To embody the original concept the buildings elevations require serious attention to provide a simplified design solution that allows this building to be enclosed providing well needed protection but embody the original design idea of a transparent space.

The original drawings show the intended connection of the floor slab with the adjacent walkways only at three access points, separating the main Zoo walkway from the structure helping to emphasise its lightweight presence on the hillside. The original drawings indicate a proposed an aquarium beneath the proposed walkways which would have provided views into an aquarium below, but this never materialised during construction.

The underslung canopies marking the entrances to the building, a significant feature of the Moat Cafe and only featured on this building were removed between 1937-1948, this has been ascertained through aerial imagery taken in 1948. Further investigation should be conducted to understand the failings of the canopies to understand how and whether these can be reinstated.

Similar to the Zoo entrance and shop, the original 'back of house' areas, sit subtly lower allowing the curved roof shape to overlap with a simple rectangular flat roof to the rear. Again, similar to the Kiosk and shelter at Whipsnade where individual blocks sit seperately beneath the main structure. Lubetkin utilises a strong use of interplay between shapes and builds on previous tested ideas elsewhere in the country. Innovative engineering techniques were used on the Moat Cafe roof, to avoid the use of downstands to the underside of the roof slab, upstands were used on the external face of the roof to create a clean finish to the ceiling within the space, this was also used on the entrance and gift shop.

Its listing as only Grade II unstarred almost certainly results from the considerable subsequent changes made to the building, rather than form the lack of Architectural quality in the original design.

Materiality

The Tectons had a simple palette of materials and colours that bound these buildings as a group. White, red and blue were used in the majority of the Tectons either by themselves or a combination. This is clearly supported by the findings from the paint analysis report conducted on the original Phase One and Phase Two Tectons. The building is currently a combination of green, white and ochre externally with a vast array of safari scenes painted internally.

The building has been painted multiple times over the years as demonstrated in the paint sections provided by Crick-Smith but from the paint analysis and inspection of the original black and white images it is known that the original building was unfinished concrete with white ceilings, terrazzo floors, white gridded windows and red and unfinished concrete columns and a red fascia matching the columns.

The current windows are a culmination of wood and aluminium windows, gridded and slender windows whilst the rear and side have been removed and replaced or covered, but the rear block still contains the original hardwood windows to the upper and lower floors, testament to the craftsmanship at the time.

Colours
Original colours: Fascia - red; main canopy soffit - white; columns - red - front columns, unfinished concrete to the server columns; entrance sub canopy lens reveals- unfinished concrete (assumed); trellis screens- white; parapet walls and balustrade - unfinished concrete; rail upstands - aluminium paint - silver.

Social Value

The former Moat Cafe is an important building at the Zoo, teaching visitors about the conservation and research that Dudley Zoo provides and this building has provided the Zoo with a platform for this social use. When the Tectons were conceived social value around animal welfare and observation was different to the beliefs 40 years later and Dudley Zoo wanted to provide that experience and learning to visitors, this building seemed a surplus on cafe provision with its proximity to the Queen Mary and was subsequently changed for alternative use.

This change of use has been enabled by DZC proposing a purpose built mixed use facility that will provide educational facilities that are easier to access at the base of the Castle Hill, allowing the Moat Cafe to return to its original use and provide support to the Queen Mary.

5.3.4 Previous Repairs & Observations

Below are our observations of the former Moat Cafe, this is supported by observations made in the Feasibility Study produced by Avanti Architects in June 1990 (highlighted in italics). There have been multiple repairs to the former Moat Cafe which are noted below:

Columns
The rear columns have recently been replaced, with - Architecturally speaking - less than 100% success, due to the adoption of an in situ technique and the resultant difficulty of camouflaging the residual pour. (It is felt that a pre-casting approach could have achieved a better quality result. - Item 5.5.2.2

These columns have since had multiple layers of paint applied to the surface and therefore it is not clear the finish of these columns. It is noted in the paint analysis that the front columns were painted red and the rear columns were left unfinished, therefore once the paint has been removed during the repair works it would be best to examine the original finish, understand whether repairs with like for like concrete are required and/or whether a concretal paint finish may need to be applied.

Due to the extent of suspended ceiling in the former Moat Cafe we don't fully understand the condition of the roof slab but based on the exposed area within the exhibition/lecture room there are stalactites forming on the underside of the slab due to cracks in the slab, we therefore believe that concrete repairs and a new roof lining are required, also ensuring that pooling does not occur on the flat roof and providing falls where necessary.

The rear roof slab looks like it is in a fairly good condition, this is a different construction technique to the front slab, seemingly an early form of beam and block. Paint has been applied to this construction and it is unclear whether this was originally painted or left unfinished. Further analysis may need to be conducted or a clear design decision made at detailed design stage to understand the condition and what finish would be best.

Similarly to the Phase One repairs we believe all downpipe holes will need to be enlarged to ensure these don't become blocked and allow consistent surface run off from the roof surfaces.

5.4 Queen Mary former Castle Restaurant

Use / Significance / Previous Repairs

Fig 29. Image of the Queen Mary, former Castle Restaurant

5.4.1 Introduction

The former Castle Restaurant's design needed to be sensitive to the Castle due to its proximity and similar to the Moat Cafe is a single-storey structure, with a deliberately low profile so as not to disturb the view from the monument. Its shape was determined by the symmetrical triangular apex of the limestone outcrop on which it is set, which gives views over the steep, wooded slopes of Castle Hill to the north. The main elevation looks out onto the sea lion pools, with the curtain wall of the Castle rising beyond it. This front elevation is constructed mostly by glazed timber lattice frames, the two end sections being uniquely rubble stone, to reflect its sensitive location. The building is now referred to as the Queen Mary.

5.4.2 Use

This large single-storey triangular restaurant was the premier food venue of the original Zoo, being formally tailored to exploit its pole position on the northern tip of the summit plateau. The restaurant was the main space for formal eating in the Zoo, supported by two cafés and two Kiosks. The seating area to the rear of the bar was used in the 1960s and 1970s as a venue for evening entertainment, including dancing and live acts. There have been accretive changes associated with changing needs, and some upgrading and alteration of the internal fittings to reflect modern usage, as it remains in use as a restaurant.

The proposal seeks to retain the buildings intended use and make minor alterations to the facades and overall building to return this building to its original design intent. Management of the surrounding landscape will aid views across the Zoo and beyond.

5.4.3 Significance

Significant

Listed Status

Grade II Listed

Architectural Interest

Located at the north end of the Castle opposite the North Gateway, the Queen Mary provides an axial relationship to the gateway in the shape of an arrowhead sat on top of an escarpment. Its shape based on the outcrop it sits above, likened to the bow of a ship. This is clearly defined in the original drawings demonstrated by the surrounding contours.

Aesthetic Qualities

Most visitors approach the Queen Mary from the Castles North Gateway. The most distinguished feature along the front elevation is the circular formwork, defining the entrance to the building supported by the gridded window fanning outwards from the entrance finalised by two solid wings originally painted blue, the screen included centre pivot opening sashes in the top and bottom four last bays. A visual plinth is created with a suspended concrete bench which rises up over the doors into an arch that in this case is pierced by the continuing roof edge as a flying transom. The entrance arch is continued internally as a conic vault originally painted pale blue, leading to a wide foyer/bar. Sadly, the overall impact of the frontage is detracted by a large rooftop shed and multiple lights, vents and extracts, most of which have been a permanent fixture since the late 1970s.

The architectural virtuosity is somewhat obscured by the proportions of the entrance elevation which are too long and low to achieve an entirely convincing facade, The downward slope of the foreground approach does not help. This may be considered as much as inevitable outcome of the site constraints as an aesthetic criticism of the Architect, as a visual anchoring device. Nevertheless, these reservations mean that the success of the main elevation is highly dependent on its being kept as simple, symmetrical and clear of attachments as was originally the case. The arched entrance surround is a characteristic Tecton motif, first used at the Whipsnade Restaurant in 1935 and later in the modified form at Finsbury Health Centre, but well applied here, as a visual anchoring device.

Beyond the bar the main dining room extends forward to a curved prow, originally top lit at the apex by a circular rooflight, since been infilled. The main space has an arched soffit to increase the sense of space despite the restricted roof height, curving like the hull of a ship. The roof is supported by central and edge columns, cantilevered at the sides to ensure the canted windows stay free of structure. This combination ensures that the chequer pattern windows are uninterrupted and have the desired aesthetic. The windows angle outwards to allow the visitors to look across to the surrounding Zoo enclosures, originally through the sparsely laid out trees, however over the years the surrounding landscape has slowly eroded away this original vision as self seeded saplings and younger trees dominate the landscape and shade the main dining space. The effectiveness of the interior and the splendid views are the buildings most positive features, resulting from its dramatic form and location.

Materiality

The Queen Mary is mainly concrete and coursed stonework, the paint analysis has indicated that the building features internally and externally were originally adorned with colour. The entrance fins were painted blue, as were the roof scapes, the columns were red and internal walls were painted with large animal murals. The list below denotes the colours and finishes used at the Queen Mary.

The front elevation facing the Castle was originally coursed stonework but this has changed to rough limestone bedded with mortar. The stone facing of the wings were required by the Office of Works on account of the buildings proximity to the Castle. This is the only instance were stone was used on a prominent elevation on a Tecton structure, the Tecton Group originally provided a modern interpretation of the stone walls through the use of coursed stonework. During the next phase of works, further investigation into the removal of the coursing should be undertaken to see if the coursing could be added once more.

The external perimeter terrace paving retains the original oblique geometric pattern as shown in the original drawings although it seems to have dulled in colour over the years.

Colours
Original colours: Roof fascia - unfinished concrete; internal face of entrance arch and flanking walls at each end of the elongated glazed facade - pale blue, reveal and seat - unfinished concrete; plinth wall below glazing - white; skirting - mid blue; plinth wall below windows of the main facade, internal face - blue; glazed screens, windows - white; elongated ceiling vault in reception - blue; ceiling in reception - white; interior beams and flat ceiling margins in dining area - pale blue; columns- red; lower walls below glazing in the main dining hall - blue; down stand beams and the ceiling plat band around the room between the columns and windows - white; curved ceiling beds between downstands - blue.

Social Value

The Queen Mary has a successful use that has only changed slightly to accommodate more daytime visits, formal meals have become more informal and the kitchen capacity along with it. This is a vital resting spot for all visitors and is well used.

5.4.4 Previous Repairs & Observations

Below are our observations of the Queen Mary, this is supported by observations made in the Feasibility Study produced by Avanti Architects in June 1990, highlighted in italics. There have been multiple repairs to the Queen Mary, these are noted below:

Front Facade
Following analysis of the original photos we are aware that the stone to the front facade has been replaced, the original being a coursed stonework now is a rougher stone with large mortar joints, it is unclear why this changed happened and when it occurred.

Side Doors
A set of double doors were provided to the main dining area sometime after 1976 based on photographic evidence. During the design process BPN undertook a fire analysis to see if these could be removed and replaced with the original windows, it was noted that one could be removed and replaced however the other must be kept and in order to keep the symmetry and future proof the building these doors have been retained, proposing a new door matching the original doors used on the front elevation. We have not found evidence of a planning application for this original change.

Roof
It was noted in the feasibility study conducted by Avanti that the, *'asphaltic roof covering has lifted in places and cracked locally where the transverse beams emerge as up stands at the perimeter margin. The run-off arrangements in this area are unsatisfactory and there is a tendency to ponding'.* - Item 5.7.2.2

We believe that the roof has undergone several repairs or replacements over the years and roof assessments will be required as part of any works.

5.5 The Elephant House

Use / Significance / Previous Repairs

Fig 30. Aerial image of the former Elephant House

5.5.1 Introduction

The Elephant House was built not only to house elephants, but camels and Shetland ponies. Constructed in one of the more sensitive locations in the Zoo, just outside the Castle moat and in clear view from the ruins above. It was built into the slope between two terraces, in order to be as unobtrusive as possible. Like the other large animal houses, it had a dual purpose, housing and displaying animals and also cleverly linking the paths and roads at different levels. It was so arranged that the animals can be viewed either from below the canopy or from the gallery above at the same time maximising the South East sun.

The Elephants were not separated from the public by heavy bars as was usual, but by a ditch and a row of spikes, as the Elephant's tenderest part is the sole of his foot, they would avoid hurting themselves on the spikes and is so kept within their enclosure away from the glazing and openings. The ditches have since been filled in to allow the Zoo to use the entire extent of the enclosure space. Originally the floors in this house were covered with rubber and artificial rain was provided from the ceiling as an Elephant's skin has a tendency to become dry in summer but both features have since been removed.

5.5.2 Use

Originally the building housed Elephants but this ceased in 2003 and has since been used as an aviary and store for demonstrations within the Castle. Since its conception in the late 1930s the building has only had one major use change from enclosure to an aviary and store,

The building is no longer fit for purpose and therefore DZC have proposed an alternative use as a monkey enclosure allowing the hillside enclosure to extend into this underutilised building. The building has undergone various alterations since its completion, including changes to its lower-level main elevation.

5.5.3 Significance: Significant

Listed Status

Grade II Listed

Architectural Interest

The Castle ruins were a key consideration in the placement and scale of the Elephant House. This building is so well embedded into the landscape around it that it only presents itself in full elevation on the ground floor level at the exit to the chairlift.

The building is symmetrical with external staircases connecting the forecourt and upper levels. The main enclosure is flanked on each wing by smaller stables which are top lit by two circular cockpits with glass lenses. The main central enclosure consists of two roughly cubic chambers side by side which can be observed from the clerestory windows on the upper floor, viewing the animals from above, while the roof is designed as a terrace on two levels providing vistas out towards the surrounding landscape and up to the Castle ruins. The lower terrace extends in a shallow curve as a white partly cantilevered canopy over the main viewing position at ground floor, the canopy is carried on substantial down stand beams and free standing circular columns either side similar to the former Bird House.

This is the second of the three Elephant houses that Tecton designed in the 1930s, Lubetkin also designed the Elephant House at Whipsnade in 1935 that had similar properties with a semicircular roof line similar to the terrace shape of the Elephant House Gallery, top lit spaces, louvred ventilation, restrictions along the front edge through the use of water, to stop the animals from getting too close to visitors. Building on his experience at Whipsnade, Lubetkin applied similar principles to the Elephant House. The location at Dudley was somewhat altered but the building principles were the same.

The Elephant House is not an outstanding building, but it is of interest as a specific example of Tecton's ingenuity in reconciling a difficult functional brief with a sensitive historic location.

Aesthetic Qualities

Viewing this building along the main facade it seems that it has been extensively altered but the buildings use was kept until around twenty years ago and therefore has gone through little transformation. The original design ideas for the Elephant House do not differ much from the final building, from analysis of the original drawings it seems minor alterations were made such as; removal of central seating on the top terrace, adding painted signage and swapping the pony and camel enclosures and final finishes to the terrace were not as drawn but dividing into sections.

The building feels somewhat grounded because of the extent of the building that is submerged into the landscape. Large staircases book end the building, extending like large buttresses of a cathedral, seemingly supporting the weight and the position that this building holds within the hillside. The over-sailing terrace was intended to provide shelter for those viewing the exhibits, it also reduces the perceived headroom which in the context of such large creatures gives an unfortunate impression of confinement.

There have been some alterations made to the building, whilst the building was still in use for Elephants the two elephant dens were provided with an intercommunicating opening between the two chambers and a further opening was made through the end wall to the left hand side stable to provide access to the long paddock towards children corner on the southern most tip of the upper plateau. The paddock was used as part of the animals exercise area and was separated by dry ditches from the surrounding paths.

Above the right hand side wing a giant tortoise enclosure was built, which covered the glazed cockpit, this is no longer in use and the area is now home to a local badger family. The left hand side has been covered by trees and self seeded saplings, both sides were originally grassed and the cockpits clearly visible.

The balustrade, planters, shuttering, columns all replicate similar techniques and details as the other Tectons, highlighting that this structure is part of the group.

Materiality

The paint analysis has indicated that the Elephant House was unfinished concrete with white finishes internally. The interior surfaces of the Elephant dens are finished with terrazzo wall tiles to mid height with white windows and doors. Similarly to the Bear Ravine the upper balustrade was formed out of fluted concrete, exploiting the use of light and shade through the simplicity of texture.

All windows have been replaced or covered which makes a dramatic effect to the overall appearance of the building,. It is intended that the proposed windows will replicate the original composition and size and shape of the frames that were originally used.

Colours
Original colours: All bare concrete structure; door and window outer frames - black; sliding door - mid red; window casements - white within black frames; light metalwork - black; balustrade supports - aluminium paint, silver

Social Value

The understanding of animal enclosures is adapting overtime and becoming ever more naturalistic with expanses of land attached to the enclosures replicating situations in the wild. All of the Tecton structures have a limited amount of land attached to each enclosure, apart from the Bear Ravine. Originally it was thought that the forecourt at the front of the building would be enough for the animals as the intention was to use the animals for riding for visitors but this eventually came to a stop and the animals had less open space to use, the extent of their enclosure and surrounding open space did not suffice for the size and amount of animals in the enclosure. The proposal to use these enclosures for smaller animals and linking these buildings to adjacent land helps to resolve those issues and allows the animals to roam freely outside the confines of the predetermined space of the Tecton structure.

The conceptual ideas of the Tecton Group in the late 30s represented the beliefs they had in the presentation of animals and this is evident in the Elephant House. These buildings stand as a reminder of an Architectural era.

5.5.4 Previous Repairs & Observations

Below are our observations of the Elephant House, this is supported by observations made in the Feasibility Study produced by Avanti Architects in June 1990 highlighted in italics. There have been multiple repairs to the Elephant House which are noted below:

Concrete repairs:
Spallng cracking and exposed rebars occur in several locations. The clerestory window surround has spalled, and patch repairs to the terrace balustrade (which from below reads as the canopy fascia) are very rough and unmatched to the original corrugations. - Item 5.11.2.1

Local damage to the cantilever beams is visible, and the balustrade rail rebar is nearly totally exposed along the soffit,. Internally there are ceiling cracks and traces of leaks; rebar is exposed. - Item 5.11.2.2.

Some of the observations from Avanti are hard to identify on the current structure due to the extent of paint work therefore once the paint has been removed during the repair works it would be best to examine the original finish, understand whether additional repairs with like for like concrete are required and/or whether a concretal paint finish may need to be applied.

We have identified a large extent of exposed rebar across the majority of the underside of the stairs which needs immediate attention. The building has generally worsened in condition since Avantis observations, one of the original plant/store rooms currently has an internal roof and associated guttering to redirect rainwater coming from an original window. This is a similar case in the plant space which has been overrun with roots and plants creeping in through the opening making the space unusable.

Opening up works have determined that the roof slabs above the original pony and camel enclosures are concrete slabs, it appears that no works have been undertaken to the original concrete. There is concern that the tree roots from the established trees may have had an effect on the integrity of the concrete slab, the top soil will need to be removed to assess the condition and a liquid membrane may need to be applied to these areas.

Once the store and the half round battens have been removed from the main facade, the lead designer can begin to understand the extent of repair works that need to be provided to the openings and concrete profiles.

5.6 The Entrance

Fig 31. Image of the Entrance Gateway, 18th August 2021

5.6.1 Summary

Prior to the repairs, several of the entrance building's five brick Kiosks had been boarded up, the turnstiles had been removed, and each element of the structure had been painted with a variety of colours. The proposal was to strip away all of the added items, reopen all the Kiosks and reinstate the original design. The repairs began in July 2013 and the works were completed in June 2014.

5.6.2 Use

This building is perhaps the most functionally specific of all the remaining Tecton structures. Its use as an entrance is effectively determined by its design and its location. The Zoo arrival has changed since its inception and with the increase of visitors arriving by car this has meant that the Safari Cafe is now used as the main entrance but the building is well placed for visitors coming from the town centre. The Zoo entrance was used to its full potential between 2019-2021 during the Covid pandemic but since has reverted to its use as a secondary entrance.

Once the Metro is completed there will be two stops close to the Zoo, one at the top of Castle Hill and one close to the entrance to the Very Light Rail Innovation Centre. Dudley Zoo and Castle requested that the stop along the Metro is named 'The Zoo' and due to its name it is the believe that most visitors will use this stop for Zoo access therefore reinforcing the use of the Gift Shop as a main entrance, although the Zoo are hopeful that the Castle Hill stop will allow visitors to use the original Zoo entrance.

5.6.3 Significance

Architectural Interest

There was only one possible space for the entrance building, as few areas of the grounds have a street frontage, and so the location of this building was easily decided. It sits on the narrow apron of land at the foot of the hill on which the Castle sits, and as such, the depth of the building was severely limited.

The original entrance building comprised eight pairs of turnstiles, each pair consisting of one entrance for adults and one for children and two exit turnstiles, of which are set out in a series between five brick control cabins, independently roofed below an interlocking row of free standing sinusoidal canopies, a flying edge beam or false fascia sits about 200mm from the roof edges, the over-sailing canopies providing shelter either side. Apart from the overbearing of the control cabins the building had been little altered since it was constructed.

The sloping site meant that the single slab roof which had been employed for the larger buildings within the Zoo site could not be employed here; the dynamic, interlocking S-shaped roof canopies were created as an alternative enable the roof to step downwards, to follow the buildings they cover, and at the same time created an iconic design for this, the public face of the Zoo.

Aesthetic Qualities

The use of curved sections in roofing is a familiar Tecton hallmark, the most similar example being the North Gate Kiosk at Regent's Park, London. At Dudley, however, the falling site gradient has produced a particularly inventive solution giving an appropriately playful and festive gesture of introduction.

Aluminium painted supports, gridded timber structures and flying transoms are all used within this building. The false 'fascia' is another characteristic Tecton detail and is here applied to good effect having a dual function of lightening the effect of the roof, expressing the rhythm of the roof scape and preventing staining of the visible front edge as rain water runs off. This is a feature also used on the entrance building.

Materiality

The Kiosks are the only example of brick used within the Tecton Group at Dudley Zoo. There is a slight difference between the Kiosks with the two outer offices had three brick walls and one reinforced concrete wall whereas the three inner offices had two brick walls and two reinforced walls.

Social Value

Architecturally speaking the Entrance building is a highly characteristic Tecton work. To passers-by and visitors it provides their first impression of the Zoo, and immediately conveys an inviting and distinctive identity. But unless or until the attraction revives, the battery of ticket booths and turnstiles will seem like over-provision.

5.6.4 Schedule of Repairs

Cleaning
Blast cleaning was carried out by Soda Blast, firstly in an inconspicuous portion of the lower concrete base to the Kiosks to assess how the cleaning method would affect the external surface of the concrete and the extent of the paint finish it would remove. Once the right level of steam cleaning was found it was applied to all surfaces. Brickwork and internal surfaces were cleaned using the same cleaning method.

Metalwork
Some of the columns were in a poor condition and in order to repair them the column head and connection were exposed to allow the structural engineer clear understanding of the details. The surrounding canopy was then shuttered and re-cast to a smooth finish and the columns were weld repaired, the material was built up through welding and then ground smooth, this was also used at the base of the column. Gates were repaired and repainted. Existing features such as the label of the gate manufacturers was retained and not painted. Existing turnstiles were left as found, some of the finishes were removed but others that were more stubborn were left so as not to damage the steel.

Woodwork
The Kiosks and trellis required repair works to the woodwork, as much existing timber was retained as possible, where the timber was not salvageable new timber was used to match.

Concrete
Areas of spalling concrete or exposed reinforcement were identified and the affected area cut out. Exposed reinforcement was treated with zinc rich paint to stop corrosion and offer future protection. Repairs were then shuttered and filled. A cement / sand / aggregate mix was preferred to a proprietary repair mortar. The ratio of these and different aggregates were trialled to achieve the best match to the original concrete. The concrete elevations and new repairs to the Kiosk were painted with Keim Concretal Lasur. This is a semi transparent paint that allows the natural imperfection of the concrete to show through whilst providing an even tone to the surface. Floor sections were repaired, only the amount of area necessary was removed.

Paintwork
Columns, lettering, concrete canopy, the underside of the canopy was painted with Keim Soldalit, a solid pigment paint tl

Roof Protection
After much research a roof covering for the canopies was chosen. It needed to be without flashings, have a good life span, be able to bridge the cracks, allow expansion and contraction, be visibly similar to the existing concrete and due to the location, be able to withstand up-draft. The solution was a liquid membrane that had 3mm thickness and could be topped with a resin bound quartz. The quartz was sampled to best match the tone of the existing concrete. A bonding resin was spread onto the surface and onto this, the quartz was spread. Next stage was to apply the liquid membrane with reinforcing fleece, the fleece was not taken all the way to the edges so that the membrane could be taken right to the edge without being visible.

Colours

A Architectural Paint Survey Report was undertaken on the Phase One Tecton structures at Dudley Zoo and Castle to determine if evidence survives of the original or early decorative schemes, this included the Entrance, the Station Cafe, Bear Ravine and Kiosk. The aim of this research was to identify the original paint scheme colours and finishes used on these historic structures on their completion in order to produce specifications that replicate researched colours that can reproduced in modern materials. Paint sample cross sections were set in clear casting resin and the surfaces polished back to reveal the stratigraphy of the accumulated paint layers. Providing useful data to determine the paint make up, this was read in conjunction with the original black and white imagery of the Tecton structures. The report was provided in March 2013, prior to the works and is provided within the appendices.

The table at the end of this section demonstrates the final colours chosen for the Entrance building based on the paint analysis results. The colours are split into three columns, the final colours that were chosen on site, any specific Keim paint references and the natural colour scheme references which refer to Crick Smiths paint analysis report.

Materials

We have provided a table at the end of this building chapter to denote those materials that have been used on site, please refer to the materials table.

5.6.5 Planning

Since the completion of this project a further application was submitted for feature lighting for the canopy and public realm works. The listed building consent for installation of feature lighting to the Tecton entrance structure, planning application reference: P21/0144 was validated in January 2021, granted in March 2021 and the works were completed in August 2021.

The ‘Accelerator Town Fund’ helped to secure public realm improvements infront of the entrance to the Zoo, this included stainless steel anti ram bollards, litter bins, tactile stainless steel studs, sett edging trim 100mm x 100mm tumbled scouter sett edging set within a resin bound gravel. The works were completed in July 2021.

5.6.6 Monitoring

On completion of the Phase One works, Rowan Technology were asked by Historic England to undertake monitoring of the repairs. The sixth annual site visit for the long term monitoring of like-for-like repairs was conducted by Rowan Technologies on the 9th December 2020. The work entailed assessing the visual condition of the repairs and taking corrosion rate measurements on both the Bear Ravine and the Meerkat enclosure. No assessments were taken for the entrance however in August 2022 DZC commissioned Rowan Technologies to undertake a defect assessment of the five repaired structures providing a visual and Non Destructive Testing (NDT) assessment to analysis any defects to the concrete repairs, below is a brief summary of what was identified on site:

Structure
The edges of the RC roof slabs were inspected by ladder and these showed no obvious defects. There were a number of areas where hollowness and sometimes delimitation of the concrete cover was detected, in total there were 7 areas that require repair, 4 of which are on the patches and 3 on the original parent concrete. 1 area showed corrosion of a low covered rebar it is recommended that this be cut out using a grinder to the repairing the concrete and a zinc rich coating be used.

Materials
Although BPN have no formal involvement in the post occupancy evaluation of the Tecton structures we have been involved in Zoo and Castle and through general observation are aware of issues with the Tecton structures.

The entrance is in a good condition however one area that is of concern is the canopy covering, it has been noted on site that this is set in from the flying edge beam and the edges of the main canopy and may require remedial works, we have consulted with Rowan Technologies about our concerns and they believe that the reduction is from shrinkage on the very edge of the membrane. They don't believe it is of any great concern as any moisture that enters into the concrete will readily escape afterwards, they noted that it is only where the moisture can run down into the concrete, get trapped and build up where it could cause concern.

5.6.7 Findings

This building is in relative good condition since the works were completed in 2014 however with the possibility of no use within the Zoo, there is concern that this building will deteriorate at a quicker pace than those used on a daily basis.

The repairs works are fairing well, the entrance was used as a testbed for new material applications and this should be monitored further, in the next phase of works we will look to use a similar product on other exposed canopy surfaces as it seems to have been fairly successful.

5.6.8 Documented

As part of the Phase One HLF requirements the repair of the Tecton structures has been documented and recorded, this information can be found in the following locations:

Repairs:
Dudley Zoological Gardens, Four Tectons, HLF regeneration project 2011-2015, Site Works Photographic Record, Prepared by BPN Architects

Fig 32. Aerial image of the Entrance Gateway, 19th April 2021

Entrance Building - Colours

Item	Feature	Paint Type	Colour (chosen for completed building)	Keim Colours	Natural Colour System (NCS)	Notes
Internal						
	Partitions	Eggshell Paint	Cream - BS-10B15			The separating walls within the Kiosks were painted, the brick walls were left unfinished
External						
	Roof edging to Kiosk	Eggshell Paint	Cream - BS-10B15			
	Trellis	Eggshell Paint	Cream - BS-10B15		Cream - NCS: S 1005-Y30R	
	Lettering	Eggshell Paint	White - BS-00E55 Red - RAL 3003 - Ruby Red		Cream - NCS: S 1005-Y30R Black - NCS: S 9000 - N	Originally the bevelled edge was cream and the centre of the lettering was black oil paint
Roof						
	Underside of Canopy	Keim Soldalit	Pale Blue - RAL - 260 60 25	K6567	Mid Blue - NCS: S 2030-R90B	Originally the sides of the canopies were also painted pale blue
Windows						
	Kiosk	Eggshell Paint	Cream - BS-10B15			Originally a cream enamel paint, created by applying an off cream zinc oil paint with a cream tinted zinc based varnish
Doors						
	Kiosk	Eggshell Paint	Cream - BS-10B15			
Metalwork						
	Gates	Aluminium Paint for Metal	RAL 9006 - White Aluminium			
	Columns / Stanchions	Aluminium Paint for Metal	RAL 9006 - White Aluminium			
Fixtures & Fittings						
	Counter	Eggshell Paint	Cream - BS-10B15			
Other						
	Turnstiles	N/A	Original Finish - Steel			Some stubborn finishes were left so as not to damage the steel

Entrance Building - Materials

Item	Feature	Material	Manufacturer	Notes
Internal				
	Partitions	Existing wood panelled walls		
	Internal Face of External Wall	Blue bricks		
External				
	Concrete	Existing Concrete, localised replacements where necessary		
	Bricks	Blue bricks		
	Trellis	Existing hardwood		
	Lettering	Existing hardwood		
Flooring				
	Floor Finish	Existing Concrete, localised replacements where necessary		
Roof				
	Roof Protection	Liquid Membrane topped with a Resin Bound Quartz	Kemper	
	Roof Membrane	Single Ply membrane		
	Underside of Canopy	Forsoc ST05 - First application of the protective coating, smoothed over with a wet sponge to a smooth finish		
Windows				
	Kiosk	Existing hardwood		
Doors				
	Kiosk	Existing hardwood		
		New Hardwood		
Metalwork				
	Gates	Existing Metal Gates. Galvanised and painted in bright aluminium paint		
	Columns / Stanchions	Existing solid steel sections		
Fixtures & Fittings				
	Counter	Existing hardwood or new well-seasoned solid wood		
Other				
	Rain Water Pipes	Existing Steel		
	Turnstiles	Existing Steel		

5.7 The former Station Cafe

Fig 33. Image of the former Station Cafe

5.7.1 Summary

Of the four buildings. The Station Cafe was the most changed since 1937. Through the years the building had been altered as its use changed to a fish and chip shop, a nightclub, and finally the Zoo's souvenir shop. The original open, windowless pavilion style of the building had been lost amid the changes and clutter, and partitions had been installed enclosing sections of the building for storage, other areas were simply abandoned. The proposal was to remove all of the later additions and reinstate the open layout. In accordance with the wider master plan for the Zoo, the shop was to provide an entrance for visitors from the car park and an interpretation space to explain the history of the Zoo and its buildings. The repairs began in July 2013 and were completed in June 2014.

5.7.2 Use

Originally used as a large volume self-service cafeteria adjacent to the Zoo entrance, planned as a simple rectangle with rear servicing and kitchens. The Station Café was later fully enclosed, by increasing the height of the external walls to reach the roof, and the infilling or glazing the open lattice sections.

The building was split in two in 1965, two thirds of the building became a separate nightclub whilst the remaining third continued to operate as a cafe in the busier summer months. The building was extended shortly after, providing lounge and bar facilities with independent access from outside of the Zoo boundary. Until 1995 part of the building was a fish and chip bar for Zoo use, and the remainder was still operating as a nightclub, which closed in 2002.

In 1996, part of it was converted into a gift shop and alternative entrance, the rest remaining empty. The current use of the building is an exit, entrance and gift shop for the Zoo with a connection to the rear of the building for Zoo staff. The adjacent lavatories are no longer in use.

Dudley Zoo and Castle are currently proposing a new mixed used facility which will provide a new entrance for visitors allowing the Station Cafe to be the exit and gift shop only and continue its current use.

5.7.3 Significance

Listed Status

Grade II Listed

Architectural Interest

The former Station Cafe is better described as efficient rather than outstanding. Its interest lies in the highly modelled and characterful entrance elevation, which provides further evidence of Tecton's ability to conjure an architectural statement out of simple ingredients. Requiring a single large flat floor area its relationship to the gradients of its site is inevitably less successful than the Entrance who's function allows this feature to be positively exploited. Thus, rather than following the slope, the uniform floor level must average it out - producing surplus plinth at one end and a sunken approach at the other.

Similar to the Moat Cafe the building was designed to be partly open to the air, the three sections between the doorways were filled with an unglazed timber lattice frame and the projecting concrete framed entrances were open to the elements. The roof slab was carried by concrete columns and extended beyond the external walls, a gap left between the independent walls and the roof.

Aesthetic Qualities

The Station Cafe is a culmination of the features seen throughout the Tecton structures, separate roof slabs, gridded windows, deep red columns, flying fascias and circular roof lights, some of which extruded down with wire mesh into the space forming aviaries. The circular cockpits are used in many of the Tecton structures and are a common feature used in deep floor plans such as the Queen Mary and Elephant House. This building encompasses the fundamentals of the Tecton structures, formulated by a kit of parts.

It was unrealistic to advocate a return to the original open air concept of the cafe and this was recognised as part of the Phase One works.

Materiality

This building is majority bare faced concrete punctuated with red columns and cream painted gridded window frames. Even though the Station Cafe is built from concrete the overall building feels light due to the large openings and the separation between the walls and upper roof slab.

The internal walls parade the red, white and blue colours that are carried throughout the Tecton structures. An unusual material choice within this space was the use of large flagstones, in other buildings either concrete floors or terrazzo floors were used as a floor finish, using quite a seemingly traditional finish.

Social Value

This structure currently begins and ends a visitors journey to the Zoo, at the start of a visitors journey they are greeted by either the entrance structure or the former Station Cafe highlighting the collective thinking of the buildings at Dudley Zoo and Castle. This immediately provides visitors an insight into architecture at Dudley Zoo and Castle as well as the conservation and animals. This is supported by the interpretation space within the former Station Cafe which provides an insight into the Tecton structures, the history and repair works that we're undertaken to bring them back into a good state of repair.

5.7.4 Schedule of Repairs

Cleaning
The exterior of the building was blast cleaned to strip away any later applied finishes and expose the concrete, this allowed the structural engineers to identify all areas of damage, producing a schedule of repairs. The right level of steam cleaning was found to strip all the existing finishes without damaging the concrete surface.

Metalwork
The later installed steel goalpost frame was removed and columns reinstated. The new steel columns were wrapped with GRP moulds and painted with Keim Soldalit to match the original columns.

Woodwork
The timber windows that were in contact with the cill showed signs of rot and were replaced with like for like timber. as much existing timber was retained as possible. Beading and glazing was removed and all timber was stripped back using a heat torch. where the timber was not salvageable new timber was used to match.

Concrete
Any existing areas of unsuccessful repair were broken out to allow for a new repair. Infilled rooflights were broken out. Large areas of infill brickwork were removed between the lower and upper roofs, this left no damage to the original structure. The concrete soffit was stripped of paint. Areas of spalling concrete or exposed reinforcement were identified and the affected area cut out. Exposed reinforcement was treated with zinc rich paint to stop corrosion and offer future protection. Repairs were then shuttered and filled. Repairs to window cills were recast with a slight fall to aid water run off. A cement / sand / aggregate mix was preferred to a proprietary repair mortar. The ratio of these and different aggregates were trialled to achieve the best match to the original concrete. In some cases steel angles were installed to support concrete edges.

The soffit was in such poor condition it was decided that it was too much work for this project, major repairs were carried out, any exposed reinforcement was treated with zinc rich paint to stop further corrosion and a new ceiling was installed atop. It is anticipated that this will be left for a future project to expose the original ceiling. The new repairs to the surrounding concrete surfaces will be protected with a translucent mineral paint that will show the original texture and pigment of the concrete.

Paintwork
During the works it was revealed that the columns were originally painted red, the walls were red and blue and part of the soffit to the lower roof was blue. Paint samples were applied to an area that was going to be demolished to form a new opening. Through this testing it was confirmed that Keim Soldalit mineral paint was to be used to give a vibrant finish on the internal walls and Keim Concretal Lasur mineral paint was to be applied to the bare concrete surfaces, matching the existing surface tone and creating a even tone across the building.

Roof Protection
Single ply membrane was used across the roof, new rooflights were installed above the circular cockpits, matching the original composition, identified through historic images. The glazing bars were fixed to the existing rectangular concrete upstands.

Rainwater Pipes
The existing rainwater pipes were cast into the concrete and had a very small diameter. To aid water flow from the roof and try to remove potential for failure, new rainwater goods were installed. Holes were cut into the rear of the roof to accommodate these new outlets.

Flooring
Although the original flag paving stones were in good condition, large areas were removed when a dance floor was added to the building. It was decided that a new floor would be laid above the flagstones, a DPM, two layer of timber grid, insulation, underfloor heating, plywood and polyflor expona cool grey concrete flooring was laid throughout. The tiled floor was laid in an offset grid to resemble the original floor pattern.

Glazing
Single paned glazing was installed between the upper and lower roof slabs, due to the uneven nature of the concrete, individual templates were created for each piece of glass. The glass was then sealed into the slim aluminium channels top and bottom.

Counter
The existing counter was reformed to show its original shape, the existing reinforcement was bent back into position and timber formers created to recast the top in concrete. A fairing coat was applied to the surface to unify the existing and new concrete surfaces, the original images showed a sheen to the surface therefore the surface was sanded and applied with a wax seal. The existing timber edge that had survived was sanded down and finished with an oil to bring out its true colour. The original images indicated that the front of the bar was covered in white tiles, but sadly this was discovered following construction and the concrete was painted white.

Signage
The signage to accompany the shop entrance and Zoo exit was set out in the same style and font as the original signage, through photographic analysis of the original black and white images it was determined that the original signage was red match the columns.

Colours
The tables at the end of this section demonstrate the final colours chosen for the former Station Cafe based on the paint analysis results. The colours are split into three columns, the final colours that were chosen on site, any specific Keim paint references and the natural colour scheme references which refer to Crick Smiths paint analysis report.

Materials
We have provided a table at the end of this building chapter to denote those materials that have been used on site, please refer to the materials table.

5.7.5 Planning

Prior to the repair works submitted in February 2012 (application reference: P12/0255) there have been several applications for the former Station Cafe which includes a change of use application and listed building consent in 2010 submitted by BPN Architects (application reference, P10/0024 & P10/0023), a change of use application in 2004 (application reference: P10/0023) and a application for the installation of security in 1995 (application reference: 95/50975)

For more details please refer to 11.2 Tecton Planning Applications within the appendices.

5.7.6 Monitoring

In August 2022, DZC commissioned Rowan Technologies to undertake a defect assessment of the five repaired structures providing a visual and Non Destructive Testing (NDT) assessment to analysis any defects to the concrete repairs, below is a brief summary of what was identified on site:

Structure

Through analysis of each facade it has been noted that exposed corroding bars and delamination is occurring some on repair patches and some on the original concrete. Side D has a section of overhead beam that showed severely cracked concrete which could delaminate and fall at any time and was highlighted as been dealt with as soon as possible as this is a health and safety hazard. The building had 33 defects in total that will all eventually require repair. The report describes the recommended methods, that any small rebars with low cover be ‘cut out’ using a grinder prior to repairing the concrete, then a zinc rich coating is used over the ‘cleaned’ steel rebar before making further concrete repairs.

Materials

During BPN site visits it has been noted that there is dark staining along the flying edge beam/ false fascia, these features were added to the buildings to avoid seeing the water running along the edge of the building.

Keim have been consulted about the staining and have suggested cleaning the surface with Keim Concrete Cleaner, a silicic acid based cleaning concentrate to remove any contamination and mould release agents from the concrete surface. After Keim Lotexan should be applied by low-pressure spray or brush, which is a siloxane based water repellent impregnation which reduces the water absorption of the mineral substrate. This encourages water to bead off the surface to keep the surface cleaner. This will last typically around 10 years before requiring another coat and would need to be part of the maintenance plan.

The single ply roof membrane overlaps the edge of the fascia which takes away from the purity of the form and is a lesson learnt for the other Tecton repairs, finding an appropriate system that sits within the roofline but provides adequate protection from the elements.

Fig 34 & 35. Image of the false fascias on the former Station Cafe, taken on 4th February 2021

5.7.7 Findings

The building is in constant use on a daily basis and is in a good condition, this further supports the idea that a viable use for these buildings encourages maintenance and care of these buildings.

We believe there are some lessons to be learnt from the application of materials such as the roof coverings and the staining along the edge of the flying fascias and how we can reduce the risk of this occurring in the remaining Tectons.

There are also lessons to be learnt about how best to provide interpretation information material to the public about the building and the competing pressures of the commercial nature of the building. When the repairs were first completed there was a strong vision for how the merchandise in the shop should be displayed so it was sympathetic to the architecture of the building and there was on display large life size images of the building in order to illustrate how the building originally appeared internally. Over-time, this strong vision has been eroded, the large life-size images are no longer visible having been covered up with animal images and the public interpretation area used as a storage area. There needs to be a clearer steer provided to the Zoo staff about presentation of this building not only as a shop but also as a visitor centre.

5.7.8 Documented

As part of the Phase One HLF requirements the repair of the Tecton structures has been documented and recorded, this information can be found in the following locations:

Repairs:
Via the website http://Tectons.dudleyZoo.org.uk/repairs/shop-entrance-building/

Detail:
Via the website: http://Tectons.dudleyZoo.org.uk/project-detail/

Former Station Cafe - Colours

Item	Feature	Paint Type	Colour (chosen for completed building)	Keim Colours	Natural Colour System (NCS)	Notes
Internal						
	Coloured Walls	Keim Soldalit	Red Brick	RB029		
	Coloured Walls	Keim Soldalit	Blue			
	Concrete Wall	Keim Concretal Lasur Mineral Paint	Grey			This was used on bare concrete surfaces to match the existing colour and create a even tone across the building
	Columns	Keim Soladit	Red Brick	RB029		Originally a red oil paint
	Ceiling	Dulux Trade Diamond Matt	White - BS 00 E 55			The soffit of the lower roof to the rear was originally blue
	Original Ceiling	Keim Concretal Lasur Mineral Paint	Grey			
	Rooflight up stands	Dulux Trade Diamond Matt	White - BS 00 E 55			
External						
	Walls	Keim Concretal Lasur Mineral Paint	Grey			Originally they would have been unfinished
	Columns	Keim Soldalit	Red Brick	RB029	NCS: S 5040-Y80R	
	Bench Seats	Keim Concretal Lasur Mineral Paint	Grey			Originally was mid blue cementious lime wash
	Bench Seats (between Toilets)	Dulux professional Full Gloss Enamel	Cream - BS 10 B 15			
Roof						
	Fascia	Keim Concretal Lasur Mineral Paint	Grey			Originally was mid blue cementious lime wash
	Flying Fascia	Keim Concretal Lasur Mineral Paint	Grey			
Windows						
	Grid Windows	Dulux professional Full Gloss Enamel	Cream - BS 10 B 15	BS-10 B 15	NCS: S 1005-Y30R	
	Rooflights	Powder Coated	White			
	Glazing between roof slabs	Aluminium Profiles	Original finish			
Doors						
	Surrounds	Keim Concretal Lasur Mineral Paint	Grey			Originally was mid blue cementious lime wash
	Internal	Hardwood veneer	White			
	External	Aluminium	Original Finish			

Former Station Cafe - Colours Continued

Item	Feature	Paint Type	Colour (chosen for completed building)	Keim Colours	Natural Colour System (NCS)	Notes
Other						
	Building Signage	Powder Coating	Red - RAL 3016			
	Concrete Counter Top	Fairing Coat				
	New Counter Top	Dulux professional Full Gloss Enamel	Cream - BS 10 B 15			
	Counter Wall	Dulux professional Full Gloss Enamel	Cream - BS 10 B 15			Originally was white tiles

Former Station Cafe - Materials

Item	Feature	Material	Manufacturer	Notes
Internal				
	Concrete Walls	Existing Concrete		
	Partitions	Blockwork - Plascon Dense Blockwork	Plasmor Limited	
	Partitions	Gypframe Partition Wall 70s 50 C studs with 2 layers of gyproc wallboard with 50mm Isover Insulation	British Gypsum	
	Moveable Partition	Multiwall Glass	Niche Operable Systems Ltd	
	Columns	Existing Concrete / New Steel Columns wrapped in GRP Moulds		
	Ceiling	Suspended MF Plasterboard Ceiling	British Gypsum	Original proposal was to expose the concrete soffit but it was in a poor condition so a suspended ceiling was added
	Original Ceiling	Existing Concrete		
	Rooflight up stands	MF Plasterboard	British Gypsum	
External				
	Walls	Existing Concrete		
	Columns	Existing Concrete		
	Bench Seats	Existing Concrete		
	Bench Seats (between Toilets)	Existing hardwood timber		
Flooring				
	Substrate	Polished screed over existing concrete surface	Skim Coat	
		Cradle and Batten with integrated under floor heating system	Durabella Flooring Solutions	Refer to drawing : 1877.2.2153 - Proposed Flooring
	Entrance Matting	EMS Evergreen debris channell matting	Entrance Matting Systems	
	Finish	polyflor expona cool grey concrete		Gradus S025 site on cove skirting
Roof				
	Roof Finish	Trocal 1.5mm Single Ply Membrane, Type SGK calendared fleece baked PVC Membrane, incorporating a glass fibre inlay.	Sika	
	Fascia	Trocal metal profile flashing	Sika	
Windows				
	Grid Windows	Existing Windows, repaired were necessary.		
	Rooflights	Fixed flush glazed roof light	Natralight	
	Glazing between roof slabs	17mm thick toughened laminated glazing fixed within slim aluminium profile. Glass constructed from 2 x 8mm heat soak toughened panes either side of 1mm interlayer.	Natralight	
	Fixed glass panel to concrete openings	Fixed vertical frameless glass panel	Natralight	

Former Station Cafe - Materials Continued

Item	Feature	Material	Manufacturer	Notes
Doors				
	Internal	Solid core timber construction with harwood veneer. Rutland TS9205 auto closer, A-Spec 19mm Return to door lever - 316 Stainless Steel, Chubb kick plate		All ironmongery to be confirmed on site.
	Architrave	Painted timber square profile 50mm wide		
	External	ES200 Microprocessor controlled, modular designed automatic sliding door operator	Dorma	
Other				
	Rainwater Pipes	Steel		
	Signage	Powder Coated Aluminium		
	Counter Top & Edge	Painted hardwood on Metal Frame		
	Lighting	Various	Phi Lighting	Refer to drawing : 1877.2.2222 - Proposed Lighting

5.8 The Bear Ravine

Fig 36. Image of the Bear Ravine

5.8.1 Summary

The Bear Ravine and Kiosk were the most unchanged due to the fact they had been left unused for many years. This neglect meant that the Bear Ravine in particular was in very poor condition, with large sections of concrete missing and exposed reinforcement, The approach for these two structures followed the principle of reinstating the original design, although the enclosure will not be used to house brown bears again. The repairs began in June 2014 and were completed in August 2015.

5.8.2 Use

The Bear Ravine is a piece of sculptural infrastructure, originally housing brown bears, the enclosure had a large rocky ravine and small pool with much of the building acting as a retaining structure to the hillside at the rear. Wire netting enclosures contained monkeys in a square cage at the rear of the platform and birds or squirrels in a circular cage wrapped around the extreme right column supporting the upper promenade. Once an enclosure for multiple species, the enclosure is now used by Emus.

The Zoo are proposing to have a smaller specie of bear within the enclosure and provide alternative dens. The Zoo are not intending to use the original animal accommodation as they are no longer fit for purpose. A planning application was submitted to DMBC for a new hut in October 2019 and accepted in April 2020, please refer to planning section of this chapter and the appendices section 11.2 for more details.

5.8.3 Significance

Listed Status

Grade II* Listed

Architectural Interest

When works began on the Tecton structures and the Zoo it was known that underground workings existing but their exact extent and location were uncertain and there was neither time nor resources for a comprehensive survey. This meant that any subterranean unknowns had to be dealt with onsite as the work was conducted, the structural strategy of pile foundations and column structures enabled groundwork investigations to be localised and the safer option to explore the site.

The location for the Bear Ravine was located within a deep ravine on the edge of a 165 metre long cavern, Mud Hole Cavern. The original proposal was much larger but on locating the cavern, the structure was shortened and modified to include the natural cavern wall. The Bear Ravine holds the illusion that it forms the caverns edge, the concrete folding into the sheer rock edge forming a dramatic backdrop for the landscape laid out in-front.

Due to the multiple levels, the form allowed visitors to view animals from above and from the cantilevered terrace, projecting out over the ravine like a prow of a ship, this was a method used on the Sea Lion enclosure, Elephant House and former Bird House.

This structure epitomises Lubetkins philosophy of a discovered abstract intervention in untamed surroundings, emphasising his ideal of contrived contrast between manmade and natural order.

Aesthetic Qualities

The matching of individual buildings to the detailed circumstances of their setting is acutely sensitive, and in some cases, such as the Bear Ravine, due to the precipitous gradients involved and set within the existing cavern. This exploitation of indigenous features made the most of Dudley's unique advantage over more conventional Zoos, where the 'natural' scenic effects are constructed artificially.

In several key buildings, Polar Bear Pit, Bear Ravine, Elephant House and Aviary, the buildings sit over several levels due to their locations within ravines and outcrops. The original intention of these buildings was to connect successive tiers of the orbital route system to allow visitors to encircle the enclosures and climb up through the Zoo however this is no longer possible and the majority of routes are no longer accessible.

The upper terrace behind this parapet is supported at 20-foot intervals on centrally-placed columns with mushroom capitals, a feature used only on the Bear Ravine and Polar Bear Pit.

Curving arabesque retaining walls line the lower half of the enclosure, originally surrounding a pool, a theme used throughout the aquatic enclosures, connecting features between the Bear Ravine, the original Penguin Pool and the Sea Lion Pool.

It seems that the severity of the site constraints prevented a greater formality in the buildings' interrelation than the Architect might have wished. This meant that the sense of unity is almost wholly dependent on the stylistic consistency of 'family kinship' of the building themselves.

Materiality

The paint analysis report states that a mid blue lime wash was used to all of the structure generally further emphasising the contrast between man made and nature through block colour. In the repair process it was chosen to remove all paint and provide a bare concrete finish.

Social Value

Adapting these buildings to suit new ways of animal welfare and the display of animals can be restrictive based on the extent of the enclosure and its attached paddock however the Bear Ravine has the ability to adapt because of the attached land. Further adaptation may be required in the future as Zoos adapt to evolving mindsets about suitable animal enclosures.

The structure has an architecturally significant value as Lubetkin creates sculptural settings for the animals and a striking ravine for the bears around a natural cavern. Animals served to animate his mathematically precise volumes connected by harmonies curves of concrete, a substance her mastered to perfection.

5.8.4 Schedule of Repairs

Cleaning
Due to the corrugated surface a more delicate approach was required than the shop or entrance, a specialist subcontractor carried out various tests on a sample to ascertain the least evasive way to clean the surfaces. It was established that a thermatech system of high pressure steam was to be used to remove vegetation and any soft paints. This left behind tougher cementitious based paints which were removed with soda blasting. The low pressure nozzle was first angled at one side of each length of corrugation and then turned to hit the other side. This slow process was required as direct blows were damaging the surface. After the process, the small amounts of green paint remained. To remove these would have been detrimental to the concrete surface and so they were left.

Metalwork
Steel grids were produced to infill the open section behind the upper deck, this was based on the remaining section that was found. Various methods for repairs to the handrail supports were trialled. The agreed repair method involved blast cleaning the uprights to remove any loose material or rust, the metal was repaired with a metal filler, these were cleaned, filled and sanded back to match the original form. The steelwork was galvanised prior to painting, the woven mesh of the stair rails was saved but the majority of the steel bar was new.

Preventive measures were added to the Bear Ravine to stop the bears from climbing onto the balcony, Large spikes beams were mounted within a rolling bracket making it even more difficult to climb. The piece was removed and sent away for stripping and refinishing.

Concrete
When the structure cleaning was complete, the team started to experiment with repair techniques. Different mixes and aggregate were trialled to suit the varying surface textures found on the structure. Different methods of application to create the corrugated surface were explored through the provision of wooden corrugated application tools. In order to add the corrugated detail, the material was added, proud of the surface to allow the corrugated texture to be applied, the surrounding existing areas were used as a guide to line the tools up to maintain the rhythm of the texture.

Areas of spalling concrete or exposed reinforcement were identified and the affected area cut out. Exposed reinforcement was cleaned using wire brushes to remove any surface corrosion and was treated with zinc rich paint to stop corrosion and offer future protection. Repairs were then shuttered and filled, the Bear Ravine had both smooth and corrugated finishes.

Large areas of the handrail had to be broken out and repaired, a special jig has to be built to re-cast the handrail. It had an inbuilt drip detail on the underside that was re-instated. Though the corrosive nature of rainwater, the originally smooth handrail had been warn away until the aggregate within had been exposed and the surface took on a rough texture. This surface inhibits the run off of water and promotes absorption resulting in a lot of damage to the underside of the handrail. To reduce the effects of this in the future a skim of concrete was applied to the top to smooth out the surface and avoid damage to the steel supports beneath.

Fibreglass reinforcement was installed on the cantilever. Fibrwrap Construction Ltd were used to complete structural repairs to the flexing cantilevered platform. They added strips of resin bound fibre glass sheeting to the top surface. At a thickness of 3mm it does not add any thickness to the top surface but dramatically increases the strength.The balcony beam to the underside of the cantilevered balcony was to be structurally repaired by wrapping it in fibreglass reinforcement. Part of this it had to be repaired to create a suitable surface for the sheeting to bond.

Similar to the entrance, the underside of the upper balcony was repaired with a polymer modified render, this allowed a thin layer to bond to the existing concrete without the need for mass removal. The thin layer also provided the same protection as a much thicker layer of natural cement.

Existing drainage holes to the upper platform were increased in size to aid the removal of water from the surface, the Kemper system was used to line the outlets, this was a water applied membrane used throughout the external floors of the Bear Ravine.

A cement / sand / aggregate mix was preferred to a proprietary repair mortar. The ratio of these and different aggregates were trialled to achieve the best match to the original concrete. Deeper repairs were packed in by hand to fill the area this was roughed up and allowed to set before the second layer was applied. The new repairs were protected with a translucent mineral paint that shows the original texture and pigment of the concrete. Floor sections were repaired, only the amount of area necessary was removed. It was agreed that the original unfinished concrete state would be put back due to the varying condition of the surface and the various finishes present, different opacities were trialled to ascertain the appropriate mix, the ratio mix of 2:1 was chosen to provide the best coverage without being too solid.

Paintwork
Keim Lasur was applied using a spray gun to achieve a uniform coating, it was imperative to keep a wet edge when applying the paint, as it it dried when applied atop it would darken, as with watercolour paints.

Floor Protection
A water applied membrane from Kemper was used to create a waterproof covering to the floor of the entire structure. Permeability of the floor was identified as a major concern, so needed to be addressed. It would later be topped with a resin bound aggregate to match the surrounding concrete.

Rainwater Pipes and Gullies
Existing drainage was through cast in lead pipes. These were constantly blocking up with leaves and new larger outlets need to be provided, these were accompanied with larger grilled floor gullies. The design was chosen for its classic style and as it matched other original gullies found on site.

Removal of vegetation
Large trees to the rear of the upper balcony were not only causing problems due to leaf fall but were also growing into the concrete structure, these were removed to safeguard the Bear Ravine.

Colours

The tables at the end of this section demonstrate the final colours chosen for the Bear Ravine based on the paint analysis results. The colours are split into three columns, the final colours that were chosen on site, any specific Keim paint references and the natural colour scheme references which refer to Crick Smiths paint analysis report.

Materials

We have provided a table at the end of this building chapter to denote those materials that have been used on site, please refer to the materials table.

5.8.5 Planning

Following the repair works submitted in 2011 there has been a full and listed building consent submitted for the Bear Ravine (application reference: P19/1479 and P19/1459) for the erection of a new bear house and enclosure to sit within the grounds of the Tecton structure, this was to extend into the woodlands however has been kept within the enclosure grounds. This was granted in April 2020.

For more details please refer to 11.2 Tecton Planning Applications within the appendices.

Fig 37. Image of the Bear Ravine taken on 22nd July 2021

5.8.6 Monitoring

The seventh annual visit was made to Dudley Zoo on the 4th August 2022. The Covid pandemic in the years 2020 to 2022 had resulted in the annual monitoring inspection for 2021 being missed out. The previous monitoring inspection was in December 2020. The inspection work entailed assessing the visual condition of the repairs and taking corrosion rate measurements on the Bear Ravine, Kiosk and the Meerkat enclosure. Inspections of the other Phase One structures was not undertaken and the focus of this monitoring has only been for these three structures.

A visual assessment assessed any changes had occurred to the structure, this was followed by Corrosion Rate Measurements and Hammer Surveys and is detailed in the Rowan Technologies Report, this is concluded in the structures chapter below:

Structure

It is stated in the report that generally the Bear Ravine looked in good condition form a distance but issues noted in 2020 when repairs were examined in detail seem to have worsened over time. Shrinkage and sometimes moss growth was noted in a few areas of the top balustrade rail on the 1st floor, to the areas of the repair on the balustrade on the ground floor and to the circular columns, all of which were identified in 2017 and have since worsened. Additional cracks were noted to the central areas of the parapet walls to the prow of the Bear Ravine, the fluted sections of the ground and first floor parapet, these were identified in 2020 but the cracks now appear to be increasing in width and becoming more extensive.

The defects assessment report also notes that on the day of assessment where cracks were becoming evident moss was becoming established within them. On the day of inspection DZC had a team of cleaners to remove all debris and scrape off the moss which was becoming established in the cracks. Most of the defects were noted in the fluted parapet walls and the balustrade above. The destructive testing on some sections of the walls in July 2022 showed that the cracking was mainly due to ongoing corrosion of the embedded steel rebars and also the thicker steel posts which support the balustrade, many of the cracks were emanating out from these central locations. At the moment (for both the downstairs and 1st floor) there is approximately 3m of fluted wall and also around 5m of balustrade which are showing cracking within the concrete.

The report goes onto state that, the parapet walls are only 125mm thick and it would have been almost impossible in 2014 to break out behind the central steel rebars (and also the steel support posts) and fully clean them up prior to repair. In retrospect, it may have been better to have completely recast these walls and balustrades using fully cleaned up (grit blasted or replacement) steel reinforcements. Rowan Technology therefore recommend that when future repairs are carried out to the fluted parapet walls and balustrade they be completely recast and with all embedded steel being grit blasted clean and a zinc rich coating applied.

The visual assessment found that columns had a signs of hollowness and fine cracks on the parent concrete suggesting that there might be ongoing corrosion of the rebars beneath but the cracks on the original concrete which appear to be associated with casting defects when the Teuton structure had first been cast.

Hollowness and also areas of delamination were noted in the repair patches to the ceilings above the stairwells. These would have used the proprietary repair mortars when the patches had been placed. Most of the other areas of RC to the Bear Ravine showed no ongoing damage, possibly because the steel reinforcements had thicker cover. Repairs will be required to the ceilings above the stairwells if public access is allowed.

From the results of the corrosion rate measurements it was noted that the results are significantly lower than those taken in 2016 and it is likely that the cleaned embedded steel rebars have now established a protective oxide film on the rebar surfaces through the application of zinc painted layers being applied during the repair works. There does not appear to be any indication of ‘increased corrosion activity’ of the original concrete adjacent to the repairs, indicating that the ‘incipient anode effect’ is not affecting these repaired areas of concrete.

The hammer surveys were carried out on five typical repairs to the Bear Ravine, it was concluded that the surface strength of the both the parent and patch concretes was a low average strength, the average surface strength were 36N/mm2 whereas those of the adjacent parent concretes were 41N/mm2. It is important that when concrete is repaired that the concrete has a similar strength to the parent concrete.

Materials

Kemper was used for the terrace floor and has not sustained the full amount of foot fall that it could have had due to the Covid pandemic and so the monitoring of this product as a floor material hasn't been truly explored but the current condition seems satisfactory.

Although the original concrete face has been cleaned BPNs observations note that the repairs and parent concrete can be identified even underneath the translucent Keim Concretal Lasur paint finish. For future projects the ratio may need to be reconsidered.

The entire structure is suffering from algae and moss growth, due its location at the edge of the woodland this condition is intensified and therefore requires a consistent cleaning and maintenance regime to reduce the risk of the moss affecting the structure as it has been previously noted that the moss can take root in the cracks that form along the concrete face and worsen the materials condition.

5.8.7 Findings

Since the completion of the repairs in 2015 the Bear Ravine structure has not been in use and the majority of the time is gated and shut off from visitors. As shown in the image taken in 2021 the cantilever has been restricted from general access. The grounds beneath the enclosure are used but not the structure itself. This has left the structure isolated and not maintained as often as the other structures such as the Entrance and former Station Cafe due to its lack of use.

We believe through the introduction of the smaller bears and interactive features within the grounds this will encourage visitors to use the building to get a closer view of the animals and in turn will be maintained more often. How visitors are using the space will need to be monitored and further exploration into encouraging visitors to walk the further extents of the Bear Ravine should be considered.

5.8.8 Documented:

As part of the Phase One HLF requirements the repair of the Tecton structures has been documented and recorded, this information can be found in the following locations:

Repairs:
Via the website: http://Tectons.dudleyZoo.org.uk/repairs/bear-ravine/

Detail:
Via the website: http://Tectons.dudleyZoo.org.uk/project-detail/

Bear Ravine - Colours

Item	Feature	Paint Type	Colour (chosen for completed building)	Natural Colour System (NCS)	Notes
Internal					
	Walls	Keim Lasur Mineral Paint	Grey		This was used on bare concrete surfaces to match the existing colour and create a even tone across the building
	Columns	Keim Lasur Mineral Paint	Grey		
	Ceiling		White		
External					
	Walls	Surface of concrete floor coated with Keim Silan Primer then Lasur Mineral Paint			The paint analysis report states that the pale blue lime wash was applied to all of the structure generally but there is no evidence of mid blue on the roof structure. NCS: S 2020-B10G
	Columns	Keim Lasur Mineral Paint	Grey		
	Balustrades	Keim Lasur Mineral Paint	Grey		
	Floors				
Terrace					
	Fascia	Keim Lasur Mineral Paint	Grey		
	Underside	Keim Lasur Mineral Paint	Grey		
Doors					
	Internal				
	External				
Metalwork					
	Balustrade Supports	Aluminium Paint for Metal	RAL 9006 - White Aluminium		
	Steel Grids	Aluminium Paint for Metal	RAL 9006 - White Aluminium		Galvanised prior to painting
	Steel Bar (stairs)	Aluminium Paint for Metal	RAL 9006 - White Aluminium		
	Steel Mesh (stairs)	Aluminium Paint for Metal	RAL 9006 - White Aluminium		
	Spike Beams	Aluminium Paint for Metal	RAL 9006 - White Aluminium		
	Grilled Floor Gullies		Black		

Bear Ravine - Materials

Item	Feature	Material	Manufacturer	Notes
Internal				
	Walls	Existing Concrete		
	Columns	Existing Concrete		
	Ceiling	Existing Concrete		
External				
	Walls	Existing Concrete		
	Columns	Existing Concrete		
	Balustrades	Existing Concrete with steel supports		
	Floors	First applied with Kempertec EP-5 Primer, then Kemperol 2K-PUR/165 water proofing system then finished with Kemperdur TC with quartz aggregate	Kemper	
Terrace				
	Fascia	Existing Concrete		
	Underside	Existing Concrete		
Doors				
	Internal	Existing metalwork, galvanised and painted		
	External			
Metalwork				
	Balustrade Supports	Existing metalwork, galvanised and painted		
	Steel Grids	New and Existing metalwork, galvanised and painted		
	Steel Bar (stairs)	Existing metalwork, galvanised and painted		
	Steel Mesh (stairs)	Existing metalwork, galvanised and painted		
	Spike Beams	Existing metalwork, galvanised and painted		
	Grilled Floor Gullies	Cast Iron circular grating with cast iron pipework - Grating: 155mm diameter, product code: K2103 CI.	Wade International Ltd	
	Steel Grates	Existing metalwork, galvanised and painted		
Other				
	Rainwater Pipes	Cast Iron Pipework		

5.9 The Kiosk

Fig 38. Image of the Kiosk adjacent to the Bear Ravine

5.9.1 Summary

Both Kiosks are of the same design, elliptical structures with steel supports designed around Lubetkins 'diametry' or diagonal symmetry. The Kiosk was in a poor condition and the approach for this structure was to follow the principle of reinstating the original design. The repairs began in June 2014 and were completed in August 2015.

5.9.2 Use

Two small oval enclosures roofed independently with generously overhanging canopies, providing an open counter and a secure storage cabin, regarded as free standing decorative sculpture and placed next to large structures to provide refreshments, originally serving chocolate and cigarettes. The locations were chosen as they were points furthest from the restaurants and cafes.

These structures have been unused for many years and act as follies in the landscape rather than serving their original purpose.

5.9.3 Significance

Listed Status

Grade II Listed

Architectural Interest

Considering their minute size, the Kiosk projects have an extraordinarily forceful architectural personality. They could be regarded as free standing decorative sculpture and sum up the spirit of the Zoo - a contrived mixture of the disciplined and the lyrical.

The design has strong constructivist associations and is a reminder of Lubetkin's early encounters with Rodchenko, Lissitsky and Melnikov. Both structures are placed next to much larger structures to provide a playful foil and highly characteristic Tecton signature.

Aesthetic Qualities

Although these Kiosks are the same design, this Kiosk has gone through various amendments to the dividing wall that zig zags through the building. This Kiosk only has one dwarf wall and we believe the other was removed shortly after the Zoo opened or just before as images taken in 1937 show it removed, we believe this was demolished to allow easy access to the Bear Ravine.

The Kiosks are on separate sides of Castle Hill however they sit along the same orientation and in the same direction.

Materiality

The original dwarf wall had a timber grid set within the wall however this was altered to a balustrade during the Phase One repair works. Due to the analysis and repair works undertaken on the Bear Ravine Kiosk, we believe that the process, repair works, colour choices will be streamlined for the remaining Kiosk.

Social Value

It is unique situation where there is a pair of near identical structures but which were adapted from the original design in order to support the larger structures around them. These decisions were made by the Architect on site showing that this was a learning process whilst on site and removing aspects of the structures where necessary to adapt to the movement of visitors, the approach and views to the structures.

5.9.4 Schedule of Repairs

Cleaning
At the start of the works some loose paint was chipped away to reveal the words, 'DUDLEY ZOO ROCK', further research uncovered that in its past, the Kiosk sold Greys Rock. When the internal walls of the Kiosk were cleaned they revealed the ghost lines of the original layout of the shelving that would have displayed snacks and drinks. These lines were left and not painted over. Following blast cleaning and some chemical removal the lettering to the Kiosk was removed leaving a smooth concrete surface.

Metalwork
Unlike the solid columns to the entrance, the Kiosks columns were hollow. The bottom of the columns where they were cast into the concrete had corroded and eaten into the steel due to the opening up of the columns at the Entrance the structural engineer had a good understanding of the connections and details. The Kiosk column joints with the counter were broken out to fully expose the steel base, the degradation was reviewed by the structural engineer and the column remained, the holes being ground back and welded. The concrete base was then recast and the base painted with a primer and a final finish. The Kiosk column however needed extensive repairs as the base of the column had completely disappeared, the solution that required the least intervention was to sleeve the bottom of the column and create a new connection to the slab.

Rather than providing a wooden lattice work to the dwarf wall as per the original designs the client chose to add a tubular steel section and mesh similar to that in the Bear Ravine. The proposed drawings produced by BPN showed a new latticework as indicated in the repair book on page 160.

Concrete
Areas of spalling concrete or exposed reinforcement were identified and the affected area cut out, the reinforcement was scrubbed clean with a combination of wire brushes and a mechanical tools such as a scabbler. Exposed reinforcement was treated with zinc rich paint to stop corrosion and offer future protection. Repairs were then shuttered and filled. The edge of the Kiosk roof had diminished over time and was rebuilt to return the roof to its original form, once the profile was built up, the edge of the roof was repaired.

The Kiosk counter surface had been over coated in the past with a tough cementious based system. This system was difficult to remove and so a new concrete coating was applied over the top. This was later ground back to expose the aggregate and better match the surface of the original concrete. A cement / sand / aggregate mix was preferred to a proprietary repair mortar. The ratio of these and different aggregates were trialled to achieve the best match to the original concrete. Floor sections were repaired, only the amount of area necessary was removed. The concrete elevations to the Kiosk were painted with Keim Lasur, this is a semi transparent paint that allows the natural imperfection of the concrete to show through whilst providing an even tone to the surface.

Paintwork
The Kiosk columns were painted in a bright silver paint, the concrete surfaces were finished in the Keim Lasur, the wall below the counter was painted red and the underside of the roof was painted blue in Keim Soldalit.

Roof Protection
The Kemper applied to the membrane was also used to seal the top of the Kiosk roof.

Colours

The tables at the end of this section demonstrate the final colours chosen for the Kiosk based on the paint analysis results. The colours are split into three columns, the final colours that were chosen on site, any specific Keim paint references and the natural colour scheme references which refer to Crick Smiths paint analysis report.

Materials

We have provided a table at the end of this building chapter to denote those materials that have been used on site, please refer to the materials table.

5.9.5 Planning

From DMBC records we understand that there have been no planning applications submitted for the Kiosk.

5.9.6 Monitoring

Rowan Technologies, the concrete specialist undertook a visual and defects assessment in August 2022 and concluded that the repairs were in excellent condition and no significant cracking or delamination was noted in any of the repaired areas, There was a fine crack on the top counter to the Kiosk leading out from a steel column which had been first noticed in 2019 but it didn't appear to have increased in width. It is thought that this could be due to differential expansion and contraction between the steel pillar and the concrete or it could be ongoing corrosion of the steel where it is embedded in the concrete counter. In retrospect, it may have been better to have opened up this area, fully cleaned down the corroded steel surface and given it a protective (barrier) coating to prevent this occurring again.

The defects assessment goes on to state that there was some iron staining to the bottom section of the front wall to the Kiosk. This is not causing any damage to the wall at the moment and could be due to abandoned steel fixing (from advertising boards or similar) having been left in the concrete surface. Alternatively, it could be low-lying rebar which may need to be cut out.

The conclusion is that there is only one specific defect noted to the Kiosk and this does not require further repair for many years.

5.9.7 Findings

The repair works on the whole were generally successful with the only exception being the counter as noted in the monitoring. This is reassuring that the steel repairs were successful and the right approach was taken.

There has been noticeable algae growth on this structure similar to the Bear Ravine, especially on the fascia of the roof slab and this may be resolved using the Keim Lotexan, similar to the entrance building in combination with consistent maintenance and management.

We believe that if the Kiosks are provided with a viable use these issues would be dealt with more frequently. Our understanding is that this structure has not undergone a deep clean within the assigned maintenance times as noted in the maintenance action plan.

5.9.8 Documented

As part of the Phase One HLF requirements the repair of the Tecton structures has been documented and recorded, this information can be found in the following locations:

Repairs:
Via the website: http://Tectons.dudleyZoo.org.uk/repairs/bear-ravine/

Detail:
Via the website: http://Tectons.dudleyZoo.org.uk/project-detail/

Kiosk - Colours

Item	Feature	Paint Type	Colour (chosen for completed building)	Keim	Natural Colour System (NCS)	Notes
Internal						
	Walls	Keim Concretal Lasur Mineral Paint	Grey			
	Ceiling	Keim Concretal Lasur Mineral Paint	Grey			
External						
	Coloured Walls	Keim Soladit	Red Brick	RB029	NCS: S 5040-Y80R	The original substrate was a tinted concrete, soon after it was painted red
	Concrete Walls	Keim Concretal Lasur Mineral Paint	Grey			
Roof						
	Underside of Canopy	Keim Soldalit	Blue		NCS: S 2030-R90B	No saline to be applied to the underside of the roof
Windows						
	Grid Windows	Dulux Professional Eggshell Enamel	Cream - BS 10 B 15			
Doors						
	External	Dulux Professional Eggshell Enamel	Cream - BS 10 B 15			
Metalwork						
	Columns / Stanchions	Aluminium Paint for Metal	RAL 9006 - White Aluminium			
Fixtures & Fittings						
	Shelving	Eggshell Paint	Cream - BS-10B15		NCS: S 1005-Y30R	Originally was a cream zinc enamel
Other						
	Counter Top & Edge	Primer and Final Finish				

Kiosk - Materials

Item	Feature	Material	Manufacturer	Notes
Internal				
	Walls	Existing Concrete		
	Ceiling	Existing Concrete		
External				
	Walls	Existing Concrete		
Roof				
	Canopy	Existing Concrete		
Windows				
	Grid Windows	Existing Windows, repaired were necessary.		
Doors				
	External	Solid core timber door		
Metalwork				
	Columns	Existing solid steel sections		
Other				
	Counter Top & Edge	Existing Concrete		
	Shelving	N/A		Existing hardwood shelving no longer exists in the Kiosks

5.10 Sea Lion Pools

Use / Significance / Repairs / Planning / Monitoring / Findings / Documented

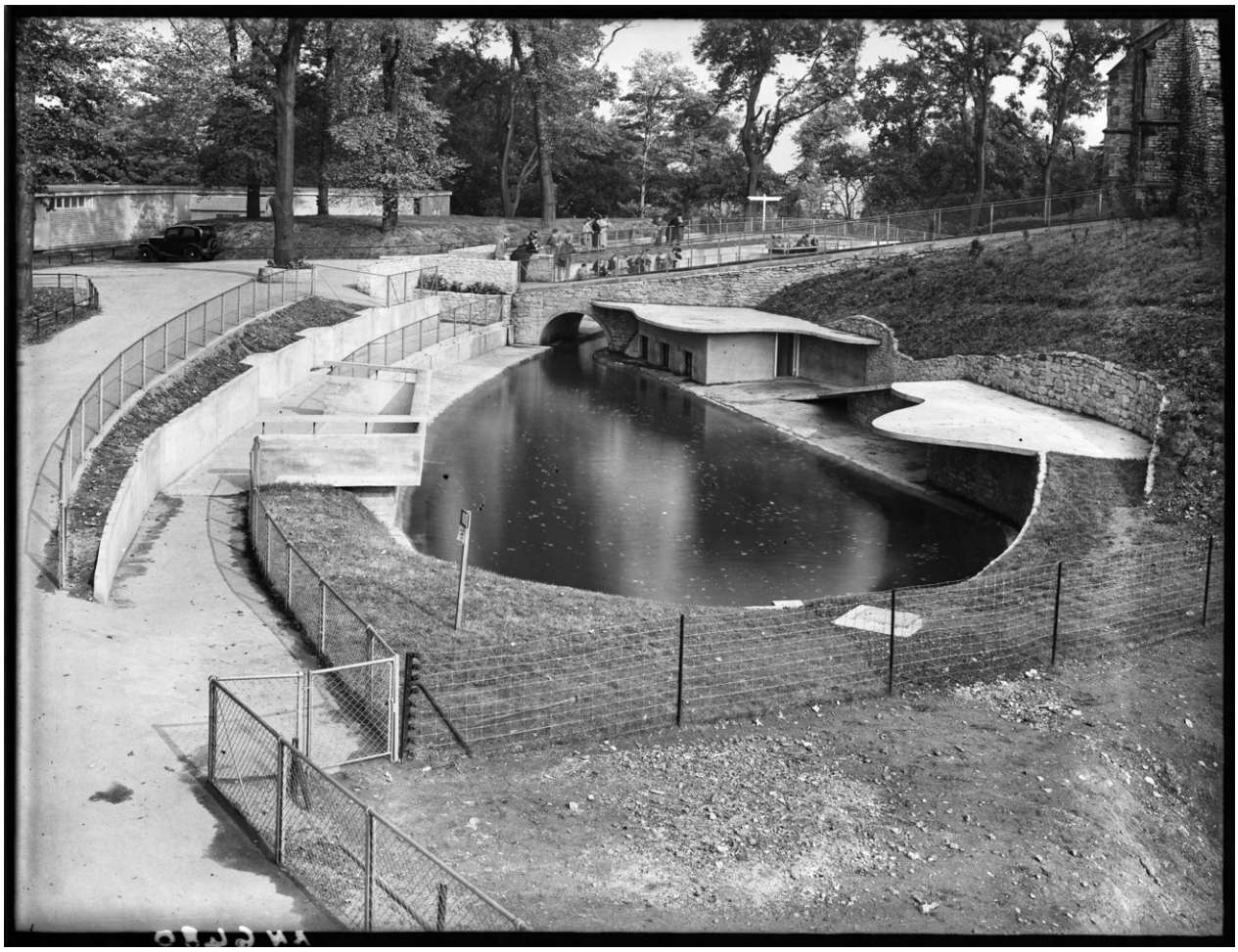

Fig 39. Image of the Sea Lion Pool, General view of the Sea Lion Pool,1937

5.10.1 Summary

The Sea Lion Pool, along with the Meerkat Enclosure, were two additional projects that were on the 'possible' list for repair as part of the Phase One works. It was hoped that they could be tackled if repair work on the core group of buildings and structures that the project was committed too was completed under budget, this proved to be the case. During the works the Sea Lion Pool had to remain operational and the works were phased between pools to allow the then 26 year old Patagonian sea lion, Cleo to remain in the pools. The works were carried out in January 2015 and were completed March 2015

5.10.2 Use

Since it's completion the intention for the pools were always to house Sea Lions but in 1971 Dudley introduced 'Cuddles' the killer whale and bottlenose dolphins into the pools. In order to house the mammals the walls of the pools were extended to create deeper pools, but their plans fell foul of the local planning laws and the Zoo was ordered to return the pools to their original state. Sadly for Cuddles this didn't last long as he died three years later in 1974, when the pool was returned to its original design and handed back to the Sea Lions. Since then the enclosure has retained its use as a Sea Lion Pool.

5.10.3 Significance

Listed Status

Grade II Listed

Architectural Interest

The building is essentially a landscape feature located in the Castle moat, the design intent for this structure derives from the geometric vigorous of the plan outline and its axial relationship through the gate to the Castle arena on the south and to the arrowhead Queen Mary on the north. It Is highly characteristic that Lubetkin and Tecton should seek to establish such a formal relationship.

There is no doubt that the sight and sound of the sea lions energetic activity in the water was intended to dramatise the experience of approaching or leaving the Castle gate.

Aesthetic Qualities

On the Castle side are placed the animal dens beneath arabesque shaped basking platforms with further ramped platforms supported on roughly coursed stone walling. At the time the arabesque shaped platforms mimicked those in the penguin pool.

Originally on the public side of the enclosure, a concrete walkway bordered each pool giving access to visitors via a rectangular viewing balconies that cantilevered over the water. These had a long low profile over the pools and the associated structures were intended to be inconspicuous, providing a large area for viewing the animals without compromising the view of the Castle. These are now no longer accessible and the paths and balconies sit within the enclosure barriers like relics of a past era. The original stairs either side of the Castle access still remain but have a fence at the base to stop visitors entering the enclosure. This means that visitors are at a higher vantage point further away from the animals than originally intended. Only one viewing platform survives from the original design, the other has been removed, presumably during the 70s when the pool walls were increased and platform seating was provided around the edge of the pool.

The vegetation along the Castle walls was originally just a grass embankment with a few sparsely planted shrubs that was part of the enclosure. This area has slowly been taken over by vegetation and restricts the view towards the Castle walls. Although this does not align with the original design intent the area is regularly managed by the Zoo and provides solar shading to the enclosure.

Originally the enclosure extended up to the Castle walls, allowing the sea lions up the embankment and close to the cantilevered viewing platforms. From the image you can see the balustrade separating the visitors from the mammals which provides minimal protection. The Zoo currently has two lines of security for the enclosure with a higher balustrade and an electric fence, this is also implemented along the edges of the enclosure to ensure the sea lions do not access the embankment reducing the overall size of the enclosure.

Materiality

In order to provide a visual link with the Castle and avoid too greater a clash between the old and the new, the retaining walls to the rear of the sea lion pools, and the bridge passing between the two pools to allow access to the Castle ruins, were constructed in local rubble stone.

The walls adjacent to the Castle that lined the stairs and the lower section at the base of the stairs that steps outwards were originally planters but have been infilled with concrete and are no longer used.

The concrete walls that form the edge of the enclosure do not seem original, these walls have been extended and the splayed indents have been infilled, a thick layer of concrete sits on top of the retaining wall providing an edge to the tarmac walkway at high level. It is also noted that the waterfall at the far end of the pools and the mounted speaker above the central den are later additions.

Social Value

The Sea Lion Pool is the only structure that has remained as an animal enclosure for the mammals it was originally intended for.

The surrounding landscape around the enclosure has changed dramatically since its inception, the concentration is less on the Castle walls and more on the biodiversity that surrounds it. The Zoo is always striving for a balance between the conservation of historic buildings and the arboriculture.

5.10.4 Repairs

The repair works listed below are those that were undertaken in 2015, other than the alterations in the early 70s to increase the size of the pools it is unknown whether any other repairs were conducted.

Cleaning
Specialist steam cleaning was used to remove algae and spores in the reinforced concrete in readiness for reparation.

Metalwork
Specially made galvanised steel gates replaced the former wooden barrier.

Concrete
Concrete repairs were undertaken on the den, ramp and diving platform using original shuttering techniques. The pools contain saltwater which had effects on both Penguin Pools at London and Dudley Zoo. Rowan Technology note in their report that the incipient anode effect is noted where concrete has been contaminated with chloride salts found in marine environments where this can increase the corrosion activity. If future monitoring is undertaken for the Sea Lion Pools it would be important to explore this to understand whether the water is effecting the state of the concrete pools.

Colours
No paint analysis has been undertaken for the colours at the Sea Lion Pool but it is believed that the pool was generally bare concrete with the pool and its rim painted white. From the images it is noted that the doors to the dens, (assumed white) are a different shade to the den walls and believe these were either bare concrete or coloured. The platforms above the dens also seem a shade lighter and could possibly be white however this would need to be confirmed through further analysis.

Materials

The majority of the enclosure is reinforced concrete, with rubble stone for the retaining walls to the rear of the enclosure and the bridge passing over the junction between the two pools. Balustrades and viewing platforms are bare faced concrete with steel supports as used throughout the structures.

5.10.5 Planning

Apart from the known alterations made to the pools in the early 1970s there is no record of any planning changes to the Sea Lion Pools.

5.10.6 Monitoring

Structure
No formal monitoring has been undertaken for the Sea Lion Pool, observations may have been taken prior to repairs however these have not been noted or recorded.

Materials
From general observations the pools, platforms and dens are maintained by the Zoo staff regularly and look in relatively good condition.

5.10.7 Findings

The pools are well used which has ensured a constant level of maintenance is provided. The pool repairs in 2015 are seemingly successful however no formal monitoring has occurred to confirm this. The skills and knowledge were still present within the staff on the completion of the pool repairs and it would have been great to keep the momentum and make further improvements to this structure to recreate the original design intent, especially understanding the colours and removing the mounted speaker.

The view to the Castle and the Gateway has been lost and we believe further management of the immediate landscape within this area would help to reveal the original views and design intentions whilst finding a balance between the conservation and arboriculture.

5.10.8 Documented

The works undertaken in the Sea Lion Pools were not heavily documented but they are noted in the evaluation report produced by Dudley Zoological Gardens, see link below:

https://www.dudleyZoo.org.uk/wp-content/uploads/L143-Tectons-Project-Evaluation-Final-Report-For-Publication-2017.pdf

5.11 Meerkat Enclosure former Reptiliary

Use / Significance / Repairs / Planning / Monitoring / Findings / Documented

Fig 40. Image of the Reptilliary, View of the Reptiliary showing visitors leaning over the concrete wall, 1937

5.11.1 Summary

Built on the slopes of the Castle it was originally used as a vivarium, but the snakes were transferred to a more suitable home in the nearby Reptile House and the building has become home to a group of meerkats.

The enclosure underwent repair works in 2015 conducted by Carlo Diponio, the construction supervisor for Dudley Zoo and his apprentice Nathan Beaman with guidance from Rowan Technology.

5.11.2 Use

The building was originally intended for reptiles but was changed to meerkats we believe around 20 years ago. The Meerkat Enclosure is suitable for a small display of non-dangerous territorial animals that can be viewed safely at close quarters and has lent itself well to its current use. The meerkats are an extremely engaging exhibit. Our understanding is that the enclosure has only had one major change during its current lifespan adapting to another species.

5.11.3 Significance

Listed Status

Grade II Listed

Architectural Interest

A mounded rockery within a tapered oval moat contained by a broad topped concrete wall, designed to allow observers to lean over but not touch the animals.

This is a low unobtrusive form that respects its surroundings and does not obstruct views to the Castle keep sat atop a large mound, creating a dramatic background for this seemingly simple enclosure.

Aesthetic Qualities

There is concrete ditch around the internal perimeter of the enclosure to prevent the animals from getting too close to surrounding walls, the original design intention was to fill the ditch with water which is clearly denoted in the original drawn sections. From the original photo we believe this was used however this is no longer seen within the exhibit or used as a prohibitive for the animals.

The original design intent was to allow visitors to have full access around the entire enclosure and on the Castle keep side of the enclosure a small section of the surrounding wall drops down and is infilled with a tubular steel bar to provide better views for children however visitors can no longer gain access to this as the area the rear and side is gated off from the general public.

This is one enclosure that does not contain shelter or cages within the exhibit itself. During its conception it was the belief that the reptiles would house themselves within the rocky outcrops. Since then a new animal has been allocated within the structure and additional enclosures adjacent to the structure have been provided for the meerkats accessed via a wooden tunnel that sits on top of the wall to the south edge of the enclosure.

Materiality

This is the site's only Tecton structure retaining its original finish and has not had any paintwork applied to the structure. There is a noticeable change to the facing techniques used on the periphery wall, the concrete lid is a smooth finish whilst the walls are shuttered. During the repair works, due to the rate of weathering the aggregate was more exposed, to ensure the repairs were seamless a similar aesthetic was applied to the top of the wall.

Social Value

This enclosure has been truly successful since its inception, although it contains a different species this is one of the most engaging exhibits at the Zoo, truly a Zoo with no barriers.

5.11.4 Repairs

Concrete
Large sections of concrete were removed and replaced using wooden shuttering to provide the formwork for the concrete, this was made on site to ensure it aligned with the curved shape of the walls, then the textured finish was applied.

Colours
No paint analysis has been undertaken for the colours at the Reptiliary but it is believed that the structure was bare concrete, the light metalwork was black and the balustrade supports were grey/silver.

Materials
There are only a couple of elements and features to this building and so the material palette is limited to concrete and galvanised tubular rails and supports.

5.11.5 Planning

There is no record of any applications being submitted for the Meerkat Enclosure

5.11.6 Monitoring

A visual and defects assessment was undertaken in August 2022 assessing what changes had occurred to the structure, this was followed by Corrosion Rate Measurements and Hammer Surveys and is detailed in the Rowan Technologies Report, this is concluded in the structures chapter below:

Structure

The visual assessment of the enclosure showed no sign of any significant deterioration to any of the repairs. There were some insignificant shrinking cracks to the fluted finish to the low level walls. Crack widths were measured as between 0.2 to 0.3mm. This cracking is due to the repair concrete being allowed to dry out too fast; wet blankets should have been placed over the repairs to slow down the rate of setting.

It is noted that these repair works were completed in 2015 and the Dudley Zoo repair team had improved their repair methods and application processes for this Tecton. The images in the report demonstrate that the repairs have now fully blended with with parent concretes following seven years of weathering.

As part of the works a large area of the top counter was replaced and the top surface had been pre weathered. In order to apply this effect the top surface had been pre-weathered (reportedly by scattering round aggregate onto the soft mortar surface prior to setting), this method is shown in the image below. In 2015 when completed the surface exactly matched the adjacent parents concrete but in 2022 the small stone pebbles are starting to become loose. The surface area contact between the round pebbles and the mortar appeared to be insufficient to achieve long-term bonding. This should of been broken out early and brushed to remove some of the cementitious layer to reveal the aggregate rather than scattered to ensure it bonded. Other areas of the counter which were replaced in 2015 were not as aggressively pre-weathered and now provide a good colour and texture match with the parent.

Corrosion Rate Measurements were lower than those measured in all previous visits, this is believed to be due to the steel having developed a protective oxide film on its surface. There was no indication of ‘increased corrosion activity’ of the original concrete adjacent to the repairs, indicating that the ‘incipient anode effect’ is unlikely to be affecting these repaired areas.

The Hammer Surveys were carried out on five typical repairs, it was concluded that the surface strength of the both the parent and patch concretes was a poor strength

Fig 41. Image of the repair works to the Meerkat Enclosure.

5.11.7 Findings

As with the other Tectons, the enclosure size is limiting and are difficult to extend easily. In order to overcome this an additional enclosure has been built to the side of the Meerkat Enclosure and a tunnel formed between the two, this currently leans on the broad topped concrete wall. There is a concern that this area may weather differently to the rest of the wall however we feel this can be dealt with continued maintenance and management.

5.11.8 Documented

The works undertaken in the Meerkat enclosure were not heavily documented but they are noted in the evaluation report produced by Dudley Zoological Gardens, see link below:

https://www.dudleyZoo.org.uk/wp-content/uploads/L143-Tectons-Project-Evaluation-Final-Report-For-Publication-2017.pdf

5.12 Polar Bear Pit and Lion and Tiger Ravines

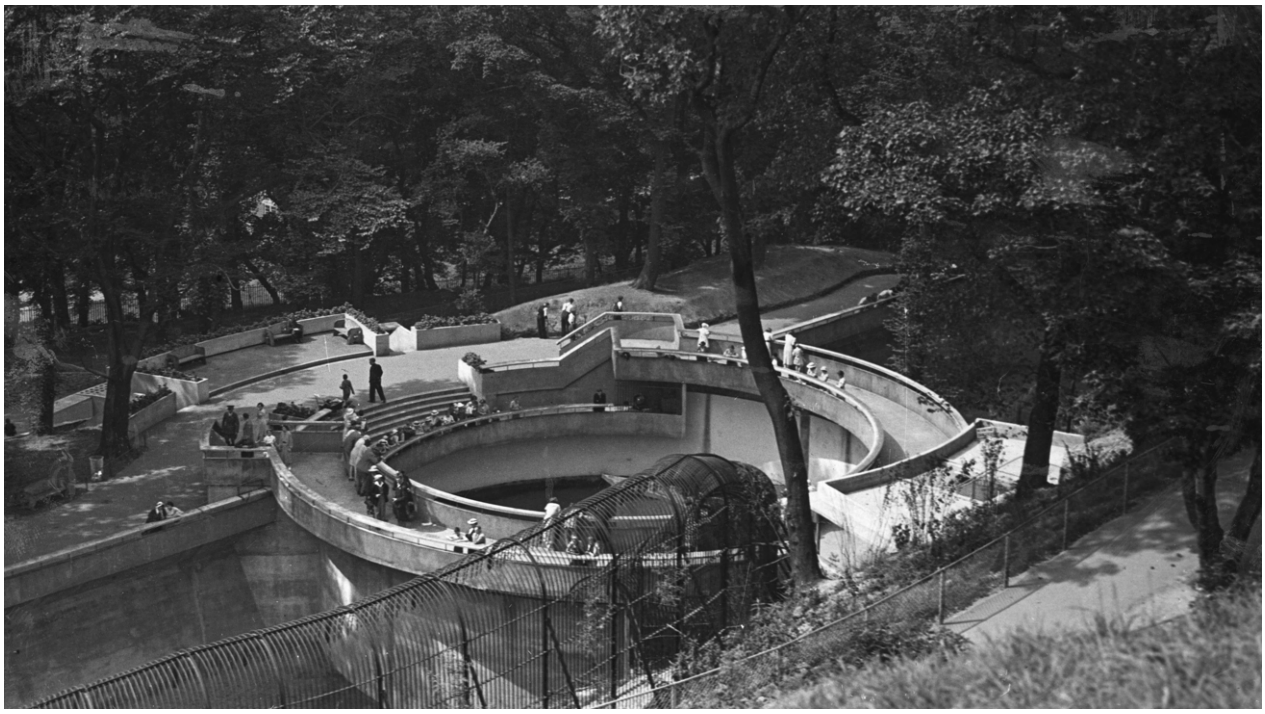

Fig 42. Image of the Polar Bear Pit and Lion and Tiger Ravine, Visitors leaning on the balustrade of the upper terrace of the Polar Bear Pit looking into the Tiger Pit and a view of the geometry of the structure,1938

5.12.1 Summary

This is the largest and perhaps most complex of the Tecton structures comprising the central circular polar bear pit and two part-walled, part fenced sunken animal enclosures disposed symmetrically either side of it, originally housing lions and tigers. The central pit contains a sculptural 'iceberg' feature and deep swimming tank; the side areas have shaped 'basking' platforms designed as outgrowths of the rear slope, and all three exhibits are equipped with animal dens at the rear of the aquatic pit, and at each end of the landscaped areas respectively. The polar bear pit is flanked by ravines for lions on one side and tigers on the other.

The structure was built into an old quarried area or ravine on the southern side of the hill. The complex is in a sense more infrastructure than architecture. Much of the complex is retaining structures and the viewing arrangement is entirely uncovered consisting essentially of looking down onto, as distinct from looking across at the animals.

5.12.2 Use

The Polar Bear Pit and Lion and Tiger Ravines held polar bears until 1989, the enclosure was then used for asiatic black bears. Artic foxes currently reside in the central polar bear pit with Sumatran tigers and wolverines in the enclosures either side.

The key issue with the use of this building is the depth of the pits. The original Zoo belief of looking down on the enclosures and the animals within is now outdated and the current fit out has tried to redress the balance and has provided height within the enclosures so that the animals could be at height or above the terrace levels if they chose to be. This has also been observed within the tiger pit were viewing levels are located at ground floor to far side of the enclosure.

Previous suggestions that have been explored for an alternative use provided by Avanti Architects were that the central pit could be used for penguins, increasing the water level by 600-800mm, forming landscaped areas through the introduction of planting and stone, decorate the retaining walls to reduce glare and provide nesting boxes. Although this makes use of the existing enclosure and its features we don't believe this is an appropriate animal for this space. There is a fundamental issue that the walls are so high it creates a telescopic view for animals. The central pit is so restrictive that it suits a smaller animal that can meander along multiple levels.

5.12.3 Significance

Listed Status

Grade II* Listed

Architectural Interest

Its architectural drama derives from its setting against the Castle mound above, and from the energy of its plan. This is of historical interest in bearing a strong geometrical resemblance to Lubetkin's prize-winning (unbuilt) entry for the international Palace of Soviets competition (1931), where the central circle and symmetrical splays motif is applied to a huge auditorium and flanking secretariat blocks.

Aesthetic Qualities

The geometric form used for the enclosure sharply contrasts against the natural background of the hillside, set in a deep ravine, built into a historic quarry, the Polar Bear Pit was further excavated to ensure the appropriate depth was achieved.

The steeply-sloping nature of the site meant that, like the other larger animal enclosures in the Zoo, the design of the buildings was able to facilitate the movement of visitors from one level to another within the grounds without an obvious steep climb. Access is no longer provided to any of the surrounding terraces or the rear, only allowing visitors to experience the enclosures from the front elevation.

The increased public safety requirement of the Zoo Licensing Act resulted in the need for an additional post and wire barrier bolted to the parapet walls. The justification for this solution is that it clearly differentiates original from subsequent design changes and is possible to remove at a later date. But inevitably introduces an element of visual complication that detracts from the original outlines of the building.

Materiality

The whole building is currently painted in a cream paint which was a clear alteration from the original design intent, many of the structures that had repair works undertaken in the early 00s have a similar finish. The current paint finish is inappropriate and harms the significance of the structure and should be changed.

Similarly to the Bear Ravine the bare concrete finish emphasised the man made from the natural order. The grouping features of the Tecton structure, the mushroom capitals, the balustrade, the shuttering effect and the concrete planters identify this building as one of the original structures.

Social Value

Similarly to the Elephant House and Bear Ravine this is a structure that is no longer fit for its original purpose and no longer sits within the current ideology that Zoos have now. Due to the nature of animals that are within the enclosure extensive visual changes have been made, there is a fine balance to be sought from this structure, between the architectural experience and using it as a functional enclosure for a suitable species.

This is undoubtedly a significant piece of architecture which is reflected in its status as a Grade II* listed structure. Historic Englands listing description states that, 'the structure is of more than special interest for its unflinchingly geometric forms, and complex levels of viewing platforms and circulation elements which demonstrate a high degree of design and engineering interest.'

5.12.4 Repairs

Repair works were undertaken by Dudley Metropolitan Borough and English Heritage in the 80s, the complex gives a first impression of having been totally refurbished however renovation techniques were less sensitive than we believe appropriate today. The renovation was clearly been conscientiously executed, but there are now several significant departures from the original design.

The replacement of the original rear fencing, and its replacement (on the right hand enclosure) by a rendered blockwork retaining wall, which both destroys the symmetry of the concept and prevents the rear bank from merging into the Castle hill as was originally intended.

The retaining wall to the left-hand (north) enclosure and the toilet block element received only protective coatings, but not the full concrete and rebar repair specification applied elsewhere.

The renovation exercise involved considerable work to recreate the characteristic pattern of corrugation employed by Tecton as a weathering control device, and the result is authentic and consistent. However, as it entailed the application of profiling mortar to all areas where it occurs (irrespective of whether an original area was defective locally or not) it follows now that none of the visible surface is actually original Tecton work. Although this method is seemingly destructive, on reflection, the Bear Pit repairs were a lighter touch only addressing those areas that required repair allowing the original concrete to be retained and on show. Rowan Technologies report notes that cracks are showing along the repaired parapet walls and a better solution would have been to rebuild these walls retaining the original reinforcement bar similar to the repair methods used on the Polar Bear Pit and Lion and Tiger Ravines.

During these repair works the standardised parapet handrail was also entirely replaced - inclusive of oval section supporting metal posts,

The complex was applied with a protective coating in two shades of white, this was a clear alteration from the original design intent.

Further repair works were undertaken in 2005 but it is unclear what works were undertaken.

Colours
No paint analysis has been undertaken for the colours at the polar bear complex but it is believed that the colours were as follows:

Balustrade walls - bare concrete
Wall to inside of centre pit - white
Wall below waterline - possibly dark grey or blue
Other walls - bare concrete
Metalwork grilles - black
Parapet rail standards - grey.

Materials

The building is made up of a limited palette of materials, bare concrete and metal grilles and supports, its original use expressed through the paint and sculptural diving ramps in the main enclosure. The interest for this building comes from the multiple levels and geometric forms. Balustrades were shuttered, similarly to the Elephant House and Bear Ravine.

5.12.5 Planning

There is no record of any applications being submitted for the Polar Bear Pit and Lion and Tiger Ravines however there are applications for the neighbouring lion enclosure, now used for tigers, please refer to section 11.2 in the appendices.

5.12.6 Monitoring

No monitoring has been undertaken for this structure, as noted the most recent repairs were undertaken in 2005. The structure seems generally in good condition, but there is limited access to the whole structure.

5.12.7 Findings

This building has been adapted since its inception for safety reasons with the implementation of the surrounding block walls, the safety bars and the restriction of access to the top level and subsequently the rear stairs and canopy, leading to the former Moat Cafe have been cut off from public use. Future efforts should be made to bring the viewing platform area back into use.

These changes and additions detract from the geometric forms and original design intent. We believe the removal of these additions would enhance the architectural experience of this building but are also aware that there is a balance to be had between conservation and the functionality of these buildings.

5.12.8 Documented

The repair works in 2005 were not documented and there is no online information.

Dudley Zoo have a brief overview of the structure, see link below:

http://Tectons.dudleyZoo.org.uk/collection/polar-bear-pit/

5.13 The Kiosk 2

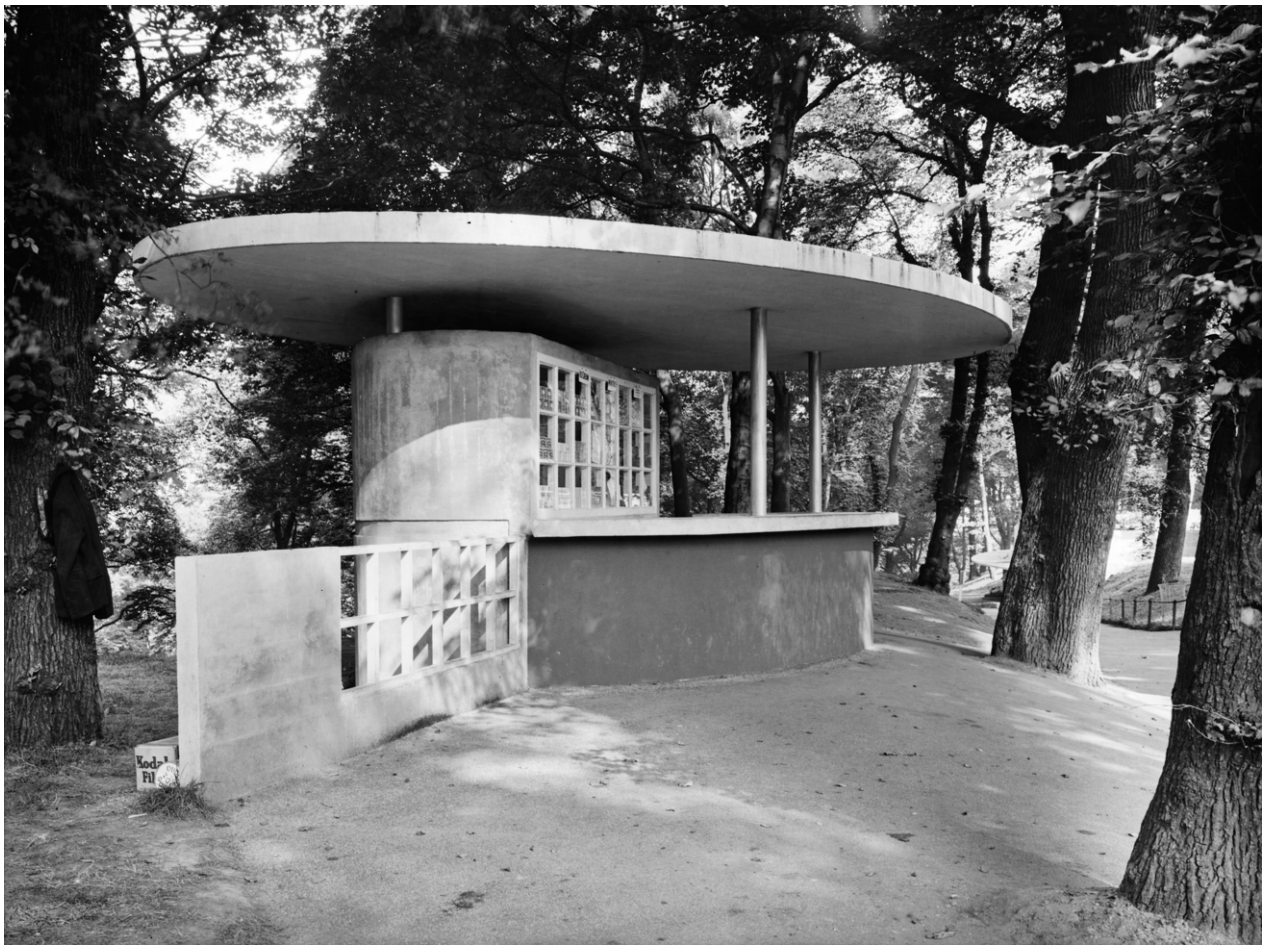

Fig 43. Image of the Kiosk, View of the kiosk looking in the direction of the Polar Bear Pit and Lion and Tiger Ravine, 1937

5.13.1 Summary

Two small oval enclosures roofed independently with generously overhanging canopies threaded through the structure which is cut zig-zag in plan on the oblique to provide an open counter area and a secure storage cabin. The oblique line is extended beyond the oval by two balustrade walls infilled with open lattice grilles to provide a counterpoint to the window frame infill of the cabin.

5.13.2 Use

This Kiosk is a copy of the Kiosk close to the Bear Ravine, originally used to provide refreshments. These structures have been unused for many years and act as follies in the landscape rather than serving their original purpose.

Proposed uses noted in the feasibility study undertaken by Avanti Architects suggested that these structures could be used as vending or information points so they become self reliant and don't require permanent staffing.

5.13.3 Significance

Listed Status

Grade II Listed

Architectural Interest

Considering their minute size, the Kiosk projects have an extraordinarily forceful architectural personality. They could be regarding as free standing decorative sculpture and sum up the spirit of the Zoo - a contrived mixture of the disciplined and the lyrical.

The design has strong constructivist associations and is a reminder of Lubetkin's early encounters with Rodchenko, Lissitsky and Melnikov. Both structures are placed next to much larger structures to provide a playful foil and highly characteristic Tecton signature.

Aesthetic Qualities

Unlike the other Kiosk this is true to the original design intent having two low dwarf walls spanning outwards from the main building however the timber grid set within the walls has been removed.

The Kiosks are on separate sides of Castle Hill however they sit along the same orientation and in the same direction.

Materiality

The whole structure has been painted cream included the canopy fascias, the columns a deep brown and the original window frames have been painted black so it is difficult to see the original materiality and its condition but the structure would have largely been bare and painted concrete with timber grid infills, replicating that of the gridded windows. The main canopy supported by three steel columns originally illuminated in aluminium paint. The current paint finish is inappropriate and harms the significance of the structure and should be changed.

Social Value

It is unique situation where there is a pair of near identical structures but interesting to see how these structures were adapted from the original design in order to sit within their location. This Kiosk in particular only seen from the front and side facades, the rear facing away from the main concourse.

5.13.4 Repairs

We believe repair works are being undertaken when required by the DZC maintenance team but this structure has largely been left untouched apart from the overall paint finishes that have been applied.

Colours
Based on the paint analysis of the Kiosk closest to the Bear Ravine we have a good understanding of the original colours however an additional Paint Analysis study should be undertaken to confirm that the colours are the same.

Materials

When repair works are conducted on the Kiosk, we believe this can be streamlined because of the analysis and repair works undertaken on the Bear Ravine Kiosk.

The repair works on the other Kiosk were very successful, but areas likely to be reconsidered during the repair works on this Kiosk would be the fascias and countertop. A fine crack has formed from the central column after the repair works were completed and moss build up has been identified along the fascia, If there is concern that this could occur again the area can be opened up, fully cleaned down the corroded steel surface and given it a protective (barrier) coating to prevent this occurring. The moss build up can be dealt with through application of Lotexan, a siloxane based water repellent impregnation.

This Kiosk is set within a very covered, green area of the Zoo so particular attention will need to be taken with constant maintenance to ensure the build up of moss does not exploit the structure.

5.13.5 Planning

From DMBC records we understand that there have been no planning applications submitted for the Kiosk.

5.13.6 Monitoring

No monitoring has been undertaken for this structure however the structure seems generally in good condition.

Consideration should be made to the surrounding landscape to cut back vegetation and allow the full extent of the dwarf walls to be exposed.

5.13.7 Findings

There is noticeable algae growth on the top and fascia of the roof slab. We believe that if the Kiosks are provided with a viable use these issues would be dealt with more frequently. Our understanding is that this structure has not undergone a deep clean within the assigned maintenance times as noted in the maintenance action plan due to a lack of use.

5.13.8 Documented

Dudley Zoo have a brief overview of the structure, see link below:

http://Tectons.dudleyZoo.org.uk/collection/Kiosk/

6 Issues & Opportunities

6.0 Issues & Opportunities

The repaired Tecton structures provided Dudley Zoo and Castle with a vital learning tool and a opportunity to understand how best to work with existing structures, finding alternative uses and learning from the care, maintenance and repair of these historic buildings. This has proved helpful in the preparing for the next phase of works for the other Tecton structures.

Through funding from the Heritage Lottery Fund, the Getty Foundation and Historic England we have been able to explore repair methods and how to ensure these are conducted in the most appropriate way to ensure further harm and possibly irreversible damage does not come to the original fabric. This knowledge has been accumulated through decades of work conducted on the Tecton structures, learning from the initial repair works conducted by Dudley Metropolitan Council and Historic England in the 1980s, Avanti Architects in the 1990s and our own repair works in mid 2010s. By producing this document we hope to provide some insight to secure the future of these buildings and sustain and lengthen their life expectancy through careful conservation. Through providing extensive detail about each Tecton we believe this will support future works and provide a roadmap.

After completing the Phase One works we have found appropriate methods of repair for the Tectons and have an opportunity to improve previous concrete repair methods based on continued monitored evidence produced by Rowan technology from the past 7 years and the further investigation conducted by Getty Conservation Institute, Historic England and Historical Monuments Research Laboratory (LRMH) in 2022.

6.1 Existing Building Conditions and Monitoring[11]

Originally the general condition of some of the reinforced concrete structures was poor and little maintenance or repair had been carried out since the late 1980s. In 2006, DZC commissioned Halcrow Group to undertake a condition report of the Tecton buildings. The report showed that extensive repairs were required to all twelve buildings concluding that concrete repairs to the Tecton buildings will be an ongoing project and that further monitoring and maintenance will be required during their lives.

In the late 1980s, Makers Industrial Ltd carried out major refurbishments on a few of the concrete structures. They reportedly used modern (polymer modified) concrete materials to repair the historic reinforced concrete. These repairs are now starting to fail. The use of different materials for repairing historic listed structures is not encouraged by the conservation industry unless it is the only way to save a structure from demolition.[12]

Repairs carried out using traditional materials (like-for-like) and traditional techniques have always been encouraged for historic structures but this has been difficult for reinforced concrete, as methods had not previously been developed for this purpose. However, over the past fifteen years or so Historic England have been pioneering the use of traditional concrete materials (using standard cements, sands and aggregates to match the original) and application techniques for repairing historic concrete structures.

To help develop the understanding of best practice a programme of concrete monitoring and testing was established in 2015 following the completion of the Phase One repair works in conjunction with Historic England to gauge the effectiveness of the recent works. This includes a photographic assessment at 1, 3, 5, and 10 year intervals and corrosion rate mapping pre and post repair to assess changes in the corrosion rates of the adjacent reinforcement. Concrete hardness tests using a Schmidt hammer are undertaken on repaired and surrounding concrete, and samples are tested to assess changes in the alkalinity at various depths across the depth of the concrete and at distances away from the repair.

Rowan Technologies have undertaken this role of monitoring on three of the Phase One Tectons, the Kiosk, Bear Ravine and Meerkat Enclosure and further testing has been undertaken in 2022 by Historic England in conjunction with the Getty Foundation and LRMH.

As part of the Phase Two works, Stand Consulting have provided external observations of the former Bird House, Elephant House, Moat Cafe and the Queen Mary to support the full and listed planning applications providing us with an understanding of the existing condition of the Tectons. The monitoring of the more recent repair works will assist in understanding whether these methods are an appropriate way to address the repairs for the Phase Two Tectons. The remaining Tectons, the Polar Bear Pit and Lion and Tiger Ravines and Kiosk are not frequently observed and these are the structures that received the majority of repair works in the 1980s.

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[11] Rowan Technologies Tecton BUILDINGS, DUDLEY Zoo plus Appendices A, B and C
Traditional Repair Schemes for Reinforced Concrete Structures Report 2011 prepared by David Farrell.

[12] 11.2 How to Repair Concrete AJ 19 November 2008 Catherine Croft

Originally all but one of the Tecton buildings have been overcoated, in full or parts, using various layers of paints, with the exception of the Meerkat enclosure which has remained uncoated. The Bear Ravine has additionally been provided with some form of fairing coating, prior to the paint coatings. The paint coatings have provided a physical barrier, which was presumably intended to prevent deterioration of the concrete over their 75 year lives in addition to brightening up the concrete for visitors. However, these coatings have not entirely prevented the chemical reaction between the environment and the alkaline constituents of the concrete, which has contributed to their deterioration. Note – paint coatings can also trap moisture within the concrete and stop it drying out.

A few individual areas of some of the buildings have been left uncoated and the degree of weathering over their lives was noticeable. The weathering of the uncoated curved roofs of the entrance structure may be compared to the unweathered surface of the underlying adjacent roof curve.

6.2 Repair Issues

During the Phase One works like-for-like concrete repairs were used on the structures and after 7 years on monitoring Rowan Technology have concluded in their report that, ‘The corrosion rates of the repaired concretes for both Tecton structures have now decreased significantly from those that were measured soon after the repairs had been completed.’ And that the, ‘Visual assessments of the repairs have shown that there is now some cracking and shrinkage problems associated with the Bear Ravine; the other two Tecton structures (Kiosk and Meerkat Enclosure) appear to be almost free of all defects.’, and that, ‘The corrosion rate monitoring of the repaired areas showed that all rates are now low and the data gave no indication that the incipient anode, or halo effect, was occurring.’ Their conclusions and findings have been fully documented in their monitoring documents, see appendix 11.5 onwards.

The Phase One repairs, methods and materials were documented in the Four Tectons book produced by BPN Architects as part of the HLF funding to support future use in the conservation of historic concrete structures. Monitoring of the like-for-like concrete repairs is vital for the future of the remaining Tectons to ensure the right methods are being applied to these structures so the issues of the past are not repeated.

6.3 Structural Issues

One such structure that has suffered from the use of different materials is the former Bird House, we have established through analysing historic drawings, photographs and drawings that the structure had significant alterations to the central inverted roof cone this was undertaken by Avanti Architects lead by Alan Powell, this is evidenced through planning drawings provided by DMBC. Some building work went beyond the repair of the structure and in finding a new use altered the structures fundamental principles. Sometime in the 1960s we believe four rooflights were carved out of the central roof to provide additional light in the centre of the space this altered the structural strategy for this building and additional measures had to be put in place to work with the new proposals as a 'Tropical House’ providing additional support beneath the central roof light. The images below show the original design intent, the 1960s alterations and it current state.

Fig 44, 45 & 46. Internal images of the former Bird House, 1938, 1976 and 2021 respectively.

6.4 Design Issues

In order to make these buildings fit for purpose there are a number of alterations that need to occur to each of the Tecton buildings. When undertaking any work to these structures they require Listed Building Consent, some of these buildings are within the scheduled ancient monument for the limestone workings or the Castle and this also needs to be considered. There is an established dialogue with Dudley Conservation & Planning officers, Historic England and the Twentieth Century Society, when any proposals are put forward they are consulted prior to the application being submitted.

Any proposals put forward should align with the original design intent where possible, in order to justify internal and external changes. As part of the Phase Two planning submissions BPN produced a series of drawings to delineate

where any new interventions had been introduced into the Tecton structures. This gave all external consultants a clear understanding of the extent of original fabric that would be harmed or removed in the proposals.
The architectural language for any new additions to each of the structures should be carefully considered with an emphasis on repair and re-engagement along with future sustainability.

6.5 Equality and Inclusion Issues

The Equality Act 2010 imposes a legal requirement to make all reasonable efforts to facilitate access into public buildings. Whilst the buildings are mostly single storey with level access generally possible at entry points, the site is on raised ground and poses a number of challenges to provide dignified access for those using wheelchairs and for the semi-ambulant. There is a need to increase visitor numbers and this will necessitate some considered design proposals.

6.6 Managing the Heritage

Dudley & West Midlands Zoological Society occupies an extraordinary site encompassing a medieval Castle (Scheduled Ancient Monument), historic woodland setting, twelve Tecton structures (Grade II and II* Listed), uncoursed limestone Lodge (Grade II Listed) and restored chairlift. The management team, have gained considerable experience of dealing with such important heritage assets on a day to day basis with very limited funding. As custodians of so many listed and nationally important structures they have a close working relationship with the local authority conservation officers and English Heritage.

In 2010 the World Monuments Fund Watchlist highlighted international attention towards the Tecton structures at DZC. At the time several were considered to be at risk and this led to significant funding being provided by the Heritage Lottery Fund to assist with the restoration of four of the iconic structures. A further four structures were in need of attention, with aid from the Getty Foundation funding the research to develop these remaining structures up to planning stage as part of their ‘Keeping It Modern 2020’ initiative.

6.7 Use

Conservation may involve a degree of compromise to keep a building in viable use, particularly where adaptations are required to meet current day needs and expectations. It is important that any use is viable, not just for the owner, but also the future conservation of the asset. It is obviously desirable to avoid successive harmful changes carried out in the interests of repeated speculative and failed uses. It is important to understand what is historically significant so that any changes can be designed to have minimum negative impact on the heritage value. There are a number of opportunities to preserve and interpret for a wider audience the heritage significance of the site.

7 Policy Aims and Objectives

7.0 Policy Aims and Objectives

The plan sets out a number of principles for the future development and management of the DZC site which take into account practical requirements for use as well as the retention of significance.

The principal policies

Policy 1	*continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage*
Policy 2	*the continued use of the existing buildings/ structures through sympathetic and viable uses*
Policy 3	*to perpetuate concrete repair/ maintenance skills on the wider DZC site*
Policy 4	*maximise the range of visitors to the site through audience development*
Policy 5	*retain or complement the character and quality of the existing structures when planning repairs, adaptations or development*
Policy 6	*improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric*
Policy 7	*emphasise the need to include conservation advice within the decision-making process for future developments*
Policy 8	*maintenance and repair should be based upon sound knowledge of the building and its materials gained through regular inspections*
Policy 9	*the possibility of the existence of important below-ground archaeological evidence will be considered when planning any development or maintenance work, and appropriate action will be taken to mitigate the impact of any such work*
Policy 10	*engage in public consultation on local planning policy for the Dudley Zoo & Castle which could affect the continued significance of the site*
Policy 11	*an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys*
Policy 12	*ensure every change is an opportunity for a wider holistic vision for landscape to be explored and implemented in terms of sense of place, historical context and original intention*
Policy 13	*seek opportunities to improve future biodiversity and experiential atmospheric landscape design with regard to international, national and local aspirations.*

7.1 Use

Issue: The use to which a building is put, places particular demands and pressures on the building and can either complement or detract from the building's significance.

Discussion: Changes in use, or the modernisation of the original, or a long-standing use of a building place new demands which may suggest removal or concealment of elements of the original structure with consequent loss of significance. There is usually a tension between a building's use and its conservation/ preservation and it is important to keep use under review in case a particular form of use becomes so demanding that it jeopardises the future or the significance of the building.

Policy 1	continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage
Policy 2	the continued use of the existing buildings through sympathetic and viable uses
Policy 3	to perpetuate concrete repair/ maintenance skills on the wider DZC site
Policy 4	maximise the range of visitors to the site through audience development
Policy 5	retain or complement the character and quality of the existing structures when planning repairs, adaptations or development
Policy 6	improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric
Policy 7	emphasise the need to include conservation advice within the decision-making process for future developments
Policy 10	engage in public consultation on local planning policy for the Dudley Zoo & Castle which could affect the continued significance of the site
Policy 11	an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys
Policy 12	ensure every change is an opportunity for a wider holistic vision for landscape to be explored and implemented in terms of sense of place, historical context and original intention
Policy 13	seek opportunities to improve future biodiversity and experiential atmospheric landscape design with regard to international, national and local aspirations.

7.2 Conservation

Issue: General repair, maintenance and restoration work to building and fittings can be unintentionally highly destructive.

Discussion: Properly managed and specified conservation, maintenance and repair are essential to prevent gradual erosion of a buildings significance and interest. Well meaning, but inappropriate works can cause serious damage, ether directly through removal of features of significance or indirectly through decay or damage that results from the use of inappropriate materials for repairs. The following general policies should be reflected in the conservation and repair work programmes to the buildings, and in procedures which are drawn up.

Policy 2	the continued use of the existing buildings through sympathetic and viable uses
Policy 5	retain or complement the character and quality of the existing structures when planning repairs, adaptations or development
Policy 6	improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric
Policy 7	emphasise the need to include conservation advice within the decision-making process for future developments
Policy 8	maintenance and repair should be based upon sound knowledge of the building and its materials gained through regular inspections
Policy 9	the possibility of the existence of important below-ground archaeological evidence will be considered when planning any development or maintenance work, and appropriate action will be taken to mitigate the impact of any such work
Policy 11	an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys
Policy 12	ensure every change is an opportunity for a wider holistic vision for landscape to be explored and implemented in terms of sense of place, historical context and original intention

7.3 Development and Restoration

Issue: Areas of the building have been subject to poor quality modifications over time and there is a desire to improve these areas.

Discussion: Most historic buildings have had modifications that are now considered to detract from the significance of the original design. It is important to understand what might remain of the original structure before planning restoration, as well as researching evidence of the original design and assessing the significance of any later modifications.

The following three principles are of value in the consideration of the removal of any modifications etc:

- Changes and visual discontinuities within a building can constitute or reflect important aspects of the history of the structure, and of how it has been used;
- Changes to the original design should be retained if they contribute positively to the significance of the building; and
- Changes which remove intrusive alterations should be encouraged.

Policy 1	continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage
Policy 2	the continued use of the existing buildings through sympathetic and viable uses
Policy 5	retain or complement the character and quality of the existing structures when planning repairs, adaptations or development
Policy 7	emphasise the need to include conservation advice within the decision-making process for future developments
Policy 11	an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys
Policy 12	

7.4 Access

Issue: Requirements to increase physical and intellectual access to a building can suggest damaging changes to buildings but they can also benefit the building by making it more useful and more important to the community.

Discussion: Equality Act 2010 has provided the impetus for many physical changes to historic buildings, most usually to provide for wheelchair access to and within the building. These changes can be very destructive but the worst consequences can frequently be avoided by thorough review of the options available for improving access, including consideration of changes of use of areas within the building. It is important to consider the incidental effect of denying

important public spaces to visitors – loss of public access can result in lack of interest and subsequent lack of care for these spaces.

Increased presence as a visitor and cultural facility will come through the site development proposals, but must be linked to both 'hard' improvements to signage, gateways and physical presence, as well as 'soft' aspects such as links into local cultural, retail and tourism focused promotion. Then, the heritage aspects of the site can be communicated as part of the awareness raising.

Consider how buildings can be inclusive. Note about the changing places and how the equality act 2021 introduces the public sector equality duty, this duty eliminates discrimination and advances equality of opportunity between people from different groups.

Policy 4 maximise the range of visitors to the site through audience development
Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development
Policy 6 improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric
Policy 7 emphasise the need to include conservation advice within the decision-making process for future developments

7.5 Building Research and Recording

Issue: Research into building fabric, surface finishes etc can provide important information to help preserve or enhance the significance of the buildings.

Discussion: An understanding of the history of the principal spaces and an inventory recording original or significant fixtures, fittings, and features are invaluable tools to guide and inform future conservation and restoration. In considering proposals for redecoration of external features or of the principal spaces, past decorative schemes can help demonstrate the character of the original building and help reveal significance. Where original fixtures or features are no longer required, it can frequently be beneficial to leave them in situ rather than remove them to storage where they are at risk of losing their context.

Policy 1 continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage
Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development
Policy 11 an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys

7.6 Effects on the Environment

Issue: how to reduce effects on the environment

Discussion: There may be a degree of compromise to keep a building in viable use, particularly where adaptations are required to meet current day needs and expectations.

There is already an established waste management and recycling initiative on site.

Considerate Constructors Scheme. Be aware of the environmental impact of sites and minimise as far as possible the effects of noise, light and air pollution. Efforts should be made to select and use local resources wherever possible. Attention should be paid to waste management and materials should be reused and recycled where possible.

Public transport

Travel Plans are integrated packages of measures designed to promote more sustainable transport choices for staff, visitors and suppliers. Encouraging visitors to arrive by and use public transport can help both the environment and the community. The visual intrusion and noise of vehicles can also detract from visitor's enjoyment. Furthermore, increased visitor use and demand for services can improve the frequency and viability of services for local people. Carefully presented information on using alternative public transport and the benefits to the local environment and community will be important.

Policy 2 the continued use of the existing buildings through sympathetic and viable uses

Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development

Policy 8 maintenance and repair should be based upon sound knowledge of the building and its materials gained through regular inspections

7.7 Maintenance

Issue: Programme of Planned Maintenance

Issue: Poor and infrequent maintenance, Neglect of small items of repair – such as regular cleaning of gutters and down-pipes – can result in small defects growing rapidly into major problems such as dry rot outbreaks which may then require the removal of original fabric.

Discussion: Regular, prompt and efficient maintenance has been proven to be a successful and prudent method of preserving the national heritage of historic buildings. Particular attention should be paid to keeping all rainwater goods such as gutters, downpipes, gullies in good working order and free from debris and leaves. Inspections of the rainwater system should take place by the maintenance team a minimum of twice a year at the beginning and end of autumn.

Organic growths should be treated and removed on a regular basis as part of a maintenance programme.
Provision for safe access to maintain buildings is essential and will facilitate the work being undertaken more thoroughly and regularly.

Regular documentation by reports supplemented by photography is of great value as the maintenance personnel responsible for looking after the building will change.

Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development

Policy 8 maintenance and repair should be based upon sound knowledge of the building and its materials gained through regular inspections

Policy 11 an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys

7.8 Management

Issue: Building greater product interest and awareness for potential visitors

Discussion: The objective, of maximising the range of visitors, needs to be considered and developed within the context of the site location, multiple functions taking place across a complex site and the HLF focus on the historic skills and building resource content. The approach takes into account the size and characteristics of the local community and visitors to the town and the surrounding area.

Policy 1 continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage

Policy 3 to perpetuate concrete repair/ maintenance skills on the wider DZC site

Policy 4 maximise the range of visitors to the site through audience development

Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development

Policy 6 improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric

Policy 10 engage in public consultation on local planning policy for the Dudley Zoo & Castle which could affect the continued significance of the site

Policy 11 an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys

7.9 Site archive

Issue: The need for an archive, detailing information currently available on the site, to be updated on a regular basis.

Discussion: Over the coming years it may be necessary to revisit and reassess certain historical information, and future research may disclose archive and other sources not previously reviewed. A site archive would ensure that copies or extracts of relevant data were available at one point for those needing information. The archive should continue to be augmented with further investigation and survey work, together with details of repair and maintenance.

Policy 11 an accessible site archive should be established and kept up to date with the regular addition of records of works, investigations and surveys

7.10 Landscape & Setting

Issue: The need for a holistic landscape strategy, providing a responsive landscape that suits both the Tectons, the welfare for the animals and a wider landscape strategy

Discussion: Over the years the landscape at Dudley Zoo and Castle has significantly changed and no longer resembles the original design intent. Works across the site work in isolation and any future changes to the Zoo should consider the landscape in the wider context.

Policy 1 continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage

Policy 4 maximise the range of visitors to the site through audience development

Policy 6 improvements in access to the site and buildings should attempt to make the most of the experience for all users with minimum intervention in the historic fabric

Policy 9 the possibility of the existence of important below-ground archaeological evidence will be considered when planning any development or maintenance work, and appropriate action will be taken to mitigate the impact of any such work

Policy 12 ensure every change is an opportunity for a wider holistic vision for landscape to be explored and implemented in terms of sense of place, historical context and original intention

Policy 13 seek opportunities to improve future biodiversity and experiential atmospheric landscape design with regard to international, national and local aspirations.

7.11 Embodied and Operational Carbon & the Circular Economy

Issue: Is it possible to respond to climate change and improve the energy efficiency of older buildings without destroying their distinctive character and value.

Discussions: Historic England advocates how historic buildings have a place in the climate change issues. The re-use and recycling of older buildings is sustainable and can help to provide a source of embodied carbon that can be built with. Historic England are aware that some parts of the historic environment will be lost as a result of climate change. Some will need to be adapted to avoid permanent damage. The continued concrete research will help us to understand how we can repair, conserve and adapt these buildings in the face of such change. The involvement of M&E consultants will also help to identify how we can reduce the operational carbon through the use of natural ventilation, alternative energy sources and materials.

Policy 1 continue to pioneer an innovative approach to education within the context of practical skills, centered around the Tecton heritage

Policy 5 retain or complement the character and quality of the existing structures when planning repairs, adaptations or development

Policy 7 emphasise the need to include conservation advice within the decision-making process for future developments

Policy 8 maintenance and repair should be based upon sound knowledge of the building and its materials gained through regular inspections

Policy 10 engage in public consultation on local planning policy for the Dudley Zoo & Castle which could affect the continued significance of the site

8 Action Plan and Costs

DZC Current Maintenance Costs for 2021 and 2022

Action	*Description*	*2021 Budget*	*2022 Budget*
Cleaning Services	*Servicing of our washrooms and Window Cleaning*	£30,000	£32,000
Equipment Hire	*Clearing of Drains and road cleaning.*	£1,800	£1,800
Waste Disposal	*Disposal of General waste, recyclable cardboard and Skip waste*	£20,000	£16,000
Plants & Shrubs	*Purchase of Plants to maintain the Gardens*	£4,500	£5,000
Repairs and Maintenance	*includes* *Repairs to Castle steps - £2.5k* *Patching Repairs to roads - £8k* *Tractor Hire for site - £2k* *Gas Certificates (to comply with regulations) - £6k*	£65,000	£60,000
Castle Maintenance	*Annual Maintenance of Fire Safety Systems etc.*	£8,000	£8,000
Site Consumables	*Refuse sacks, Toilet rolls etc*	£25,000	£28,000
Health & Safety	*From Tree work to servicing of washrooms* *Essential treework to keep the site safe can cost approx. £10k p.a.*	£22,750	£46,000
IT & Communication Costs	*Landline Telephone maintenance.*	£3,500	£3,000
<u>Staff Costs</u>			
Maintenance Team	*Maintenance Team including the Painter.* *They undertake repairs on buildings and animal enclosures.*	£155,684	£160,081
Site maintenance	*Gardening and general site cleaning*	£142,511	£151,603
Total		**£478,745**	**£511,484**

8.0 Action Plan & Costs

The following section highlights the maintenance and management actions and costs associated with the development of the proposed project and the heritage items within this.

8.1 Management and Maintenance Team

Prior to the Phase One works, DZC dealt with any Tecton issues internally, the maintenance team had undertaken repairs to a number of the structures. This included work to keep the roof of the former Station Cafe in good order (expenditure of some £30k), painting, minor concrete repairs, repairs to the roof of the former Moat Cafe and some £40k of upgrading to the Queen Mary.

When the application was lodged with the HLF in 2011 it was the intention that the management and maintenance of the Tecton structures would be taken on by DZC following the repair works using local apprentices, the HLF application stated that:

'The Tecton structures will continue to be managed and maintained by the Zoo's maintenance team after the renovation works are complete, under the supervision of its shortly to be appointed Operations Manager. This is in accordance with the adopted conservation strategy and management plan for the Tectons. The future maintenance will be carried out initially by the Tecton repair programme apprentices who are to be taken on for a two year period as part of this project. During this period the apprentices will develop good practice guidelines and techniques that can be adopted by the maintenance team as a whole to inform ongoing maintenance work to the Tectons after this project is complete.

The maintenance regime to be employed will be developed by the appointed specialist concrete repair contractor in conjunction with the Architect to the works and set out in the maintenance and management plan. This will provide the guidance for the subsequent maintenance work undertaken by the appointed Tectons repair apprentice programme. The apprentice's supervisor will be appointed prior to the works starting on site and will thereby gain the necessary experience to oversee the subsequent work by the apprentices.'

In 2016, following his role in the restoration work that were undertaken at DZC, Construction Supervisor, Carlo Diponio won the award for 'outstanding contribution to heritage', from Historic England Angel Awards

Dudley Zoo and Castle produced a Evaluation Report in 2017, it describes in detail what happened during the works and states the following, 'When the projects went live it was the intention that the grant from the HLF included the cost of a Repair Programme Supervisor and two apprentices who would study part-time and gain practical experience by working alongside the contractor. The longer-term aim was for the apprentices to remain at the Zoo to deal with on-going repairs and maintenance to the other structures. But finding a clerk of works proved to be more difficult than envisaged and although candidates were interviewed, no one suitable had been found by the time the work started on site.

Unfortunately, the performance and general level of management by the contractor who had carried out the concrete repairs to the entrance and shop had deteriorated during the works. One consequence of this was that during the works one of their foremen applied for the position of clerk of works. The expertise in concrete and stone repair held by this person and obvious enthusiasm for the project presented a new possibility of employing someone who could be much more than just clerk of works. Subsequently hired by the Zoo to lead the concrete repairs, with one assistant and two apprentices, the Zoo now had direct control over the costs and quality of work. The same general contractor who had worked on the Station Cafe and Entrance was used to provide the site mobilisation and scaffold. The concrete cleaning, painting and waterproofing were procured as a separate package through the main contractor.

Then CEO Peter Suddock explained that: "Lessons learned during Entrance/Shop Phase One eased production for the second part of the programme. During the early work we were totally reliant on contractors' skills and quickly realised that this is a truly unique project and that skillset simply does not exist, workers were literally learning on the job, at DZG's expense. By appointing our own in-house Construction Supervisor and setting up an apprenticeship scheme, with local students, in concrete repair we are not only controlling costs and timescale, but also providing on-going maintenance for the remaining eight Tecton structures to give them a future for generations to come to enjoy.

Expert feedback suggests that now DZG has the expertise in house to undertake further routine repair work it will have much less reliance on contractors than it would otherwise have needed to do'

The Evaluation Report also states that, 'Following the completion of the Phase One works the two apprentices that worked on the Tecton structures joined local building firms. DZC then recruited two more maintenance staff in 2015/16 and a further two more in 2017. Prior to the end of his contract, Supervisor Carlo Diponio was tasked with ensuring the skills and techniques learnt during the programme have been passed onto the others within the team. DZG now has the knowledge and expertise to confidently undertake routine Tecton repairs 'in house' and the evidence base and knowledge to develop a plan for repairs to the remaining Tecton structures.

8.2 Budgets

Budgets within the organisation are maintained and reviewed on an annual basis and set out for the forthcoming and subsequent years. The following breakdown describes the overall budget for maintenance for the entire site and shows how this has been allocated. The figures included are budgets for materials, specialist subcontract and hire of equipment only.

8.3 Maintenance and Management tables

The following tables set out procedures DZC have in place for the maintenance of all of the Tecton structures. The procedures that are set out in the action plan are to ensure the long term sustainability of the buildings.

The current restoration initiative needs to be combined with the ongoing maintenance policy. The idea of introducing a Log Book for each building has previously been recommended during the Phase One works. This would contain essential information on each of the buildings i.e. original design, record of subsequent alterations, criteria for restoration, original colours, restoration techniques etc. The logbook would also record any subsequent holding measures and interim surveys as part of the maintenance regime. The majority of the maintenance action plan is undertaken as prescribed though it is not recorded in a log book for each building.

The figures compiled have come through direct consultation with the Client along with specific advice from Consultants, Contractors and Subcontractors. The costs include any specific items identified by involvement of outside consultants or equipment hire. Work to be completed by the salaried members of the Maintenance teams or by the Management Staff will be worked into the existing programme of works and time allocated.

General maintenance items will come from staff resources with costs of materials and repairs coming from within an overall Maintenance budget.

Maintenance Action Plan - Tectons

Item	Action	When	Who	Resources - Annually
Buildings/ structures				
Gutters / Roofing	*Inspection / monitoring cleaning / repair if required.*	*Annual*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Drainage Holes	*Inspection / monitoring cleaning / repair if required.*	*Weekly / As required*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Valley Gutters	*Internal Valley Gutters to be inspected and cleaned. Hire of Specialist Equipment required.*	*6 Monthly*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Window Cleaning	*Specialist Subcontractor for external windows / rooflights and high level internal glazing.*	*Monthly*	*Head of Maintenance to instruct a specialist subcontractor – Monitored by CEO*	*Within Maintenance budget*

Item	Action	When	Who	Resources - Annually
Concrete & masonry - visual inspection	*External visual inspection to monitor condition and weathering*	*3 years*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
External painting/ decoration	*Visual inspection to monitor condition and weathering*	*5 years*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Steelwork guarding/ handrails/ columns	*Visual inspection to monitor condition and weathering*	*Annual*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Debris	*Inspection / monitoring cleaning / repair if required.*	*Weekly / As required*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Structural Integrity	*Inspection / monitoring*	*Weekly / As required*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
General Cleanliness	*Inspection / monitoring cleaning / repair if required.*	*Weekly / As required*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Landscaping / external features				
Landscaping maintenance	General maintenance of landscape areas.	Weekly / As Required	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Access Roads and pathways	General maintenance	Yearly	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Terraces	General cleaning of floors and removal of debris			
Internal Public Spaces				
New Interpretation panels.	General inspection to include feature lighting. Ensure Information is visible and boards are clean.	Weekly / As required	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget £5000*

Item	Action	When	Who	Resources - Annually
Cleaning common areas.	General cleaning of floors walls and surfaces within common areas.	Daily	Carried out by DZC Cleaning team.	*Within Maintenance budget*
Walls / Floors	General Maintenance - Check condition of surface finishes – Clean / repaint where required.	Weekly	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Common areas / Public spaces - lighting	Inspect lighting and replace lamps where required. Feature lighting to be included.	Weekly	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Internal Painting / decoration	Full internal decoration of all Internal spaces.	Every 2-3 Years	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Health and Safety items. Fire alarm, Extinguishers, Emergency lighting	*Specialist servicing of equipment*	*Annual*	*Head of Maintenance to instruct a specialist subcontractor – Monitored by CEO*	*Within Maintenance budget*
Electrical Items monitoring	*Inspection*	*Annual*	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Heating / Ventilation	*Inspection/ service*	*Annual*	*Head of Maintenance to instruct a specialist subcontractor – Monitored by CEO*	*Within Maintenance budget*
IT equipment check	General inspection of IT equipment including Audio Visual Display if connected to common network.	Monthly	Undertaken by IT manager	*Within Maintenance budget*
Internal non Commercial Spaces				
Lighting	Lighting in all non – commercial spaces to be checked and defective lamps replaced. Stores / Offices / Plant rooms etc.	Weekly / As required	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Walls / Floors	General Maintenance - Check condition of surface finishes – Clean / repaint where required.	3 months	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*
Cleaning common areas.	General cleaning of floors walls and surfaces within common areas.	Daily	Carried out by DZC Cleaning team.	*Within Maintenance budget*
Internal Painting / decoration	Full internal decoration of all Internal spaces.	Every 2-3 Years	*Head of Maintenance – Monitored byCEO*	*Within Maintenance budget*

Management Action Plan

Item	Action	When	Who	Resources
Building Maintenance Briefing	*Work through maintenance plans for the forthcoming year setting actions dates and responsibility*	*Annual*	*Operations Manager Directed by the CEO*	*Time allocated within Staff resources.*
Update Health and Safety Plan	*Following the preparation of the maintenance schedule. Each item will need to be assessed for Risks to staff, students public and operatives.*	*Completed as required to comply with maintenance schedule and risks associated with maintenance items*	*Directed by Operations Manager - monitored by CEO*	*Time allocated within Staff resources.*
Site Maintenance training	*Train staff/ volunteers in landscape maintenance relating to the refurbished building.*	*As required*	*Operations Manager to direct and organise training sessions*	*Time allocated within Staff resources.*
Cleaning of visual displays / notices	*Train staff in cleaning and maintenance of site information boards and signage.*	*As required*	*Operations Manager to direct and organise training sessions*	*Time allocated within Staff resources.*
Interpretive displays	*Monitor displays usage and set a programme for updating visual material. Train staff in relaying information and responding to visitor enquiries.*	*Annual*	*DZC Marketing Directed by the CEO*	*Time allocated within Staff resources.*

8.4 Maintenance Failings and Impacts

It is known that the Tecton structures have a weekly checklist that is dealt with by the gardening and grounds maintenance team, these checks include drainage holes, debris, structural integrity and general cleanliness.

The former Bird House, Bear Ravine and Kiosks do not currently have a sustainable use and are feeling the impact of having infrequent maintenance visits. The failings we have observed for these particular buildings are emptying drains, gutters and gullies, regular cleaning of the terraces and management of surrounding landscapes, trees and shrubs. Having a sustained daily use allows the need for the structures to be more frequently maintained for the safety and security of the public and the animals.

9 Adoption and Review

9.0 Adoption & Review

9.1 Adoption

It is intended that the conservation management plan be formally adopted by DZC (as the leaseholder of the site/ buildings) and Dudley MBC (as the freeholder of the site/buildings) and provide a guide for all future works related to the Tectons.

Derek Grove, the CEO for Dudley Zoo & Castle will be responsible for monitoring and reviewing the plan with overall responsibility will revert to the DZC Board.

The plan will be described on DZC website, hard copies available to view at DZC offices and held on the Getty Foundations Website.

9.2 Review

Below is an overview of the lessons learnt from the Phase One works, this chapter is split into multiple subtitles; maintenance, design decisions, products / materials, reporting, monitoring, conclusions, use and workbook. The aim of this review is to reflect on the works that were undertaken and analyse whether the theories that were embedded into the original Historic England bid were successful.

9.3 Lessons Learnt

9.3.1 Maintenance

Following the Phase One works it was intended that the skills learnt from the concrete repair would be kept within the Zoos staff and they would be able to undertake their own repairs of the Tectons. In 2022, 5 years on from the evaluation report being submitted we believe that the skills learnt during the works have been lost due to the changing of maintenance staff, and therefore any concrete repairs that need to be undertaken cannot be carried out within the staff as they no longer possess the appropriate skills. For the works that are required for the Phase Two works these again will need to outsourced which will be a larger financial burden on the Zoo than if the skills had been retained within the Zoo as was originally intended.

Understandably, within the Zoo the priority is given to the animals and their wellbeing first and foremost and so we believe a different approach to the upkeep of these heritage assets is required within the Zoo or a stricter management of the Tectons needs to be undertaken.

The maintenance and management action plan within this report has been partly adopted within the Zoo's routine maintenance and the original Phase One Tectons that are not in regular use have suffered from lack of routine cleaning and care. The Bear Ravine in particular has excessive streaking and is greening due to plant growth, its location to the edge of a woodland and lack of cleaning is accelerating this.

As per the original application an Operations Manager role was to be provided to ensure that routine care and maintenance was given to the structures and we believe that this role has not been provided and the management of these buildings is included within the site as a whole rather than as a specific task within the Zoo’s operations.

There is no doubt that the Covid pandemic has had an effect on the Zoo and its budget between 2019 and 2021. Subsequently the maintenance of these structures has suffered which must be taken into account when assessing the maintenance at the Zoo over the past few years.

9.3.2 Design Decisions

As part of the works conducted on the Kiosk closest to the Bear Ravine it has been noted that there was a deviation from the original design intent. As per the BPN drawings it was intended that the original lattice work would be reinstated but the client chose an alternative solution. If any changes are made to the structures following planning determination conversations between DMBC and the Architect/Client need to be recorded to ensure this has been accepted by the relevant parties.

9.3.3 Products / Materials

Below is an evaluation of the products, materials and techniques that were used as part of the Phase One works. This section aims to provide information on successful and unsuccessful materials used for each Tecton. See Section 5 for a list of materials used for each Tecton. Making the structures more integral to the Zoo’s daily activities is key to ensuring the protection and maintenance of the Tectons as seen in the more successful buildings in Phase One.

Roof Coatings

Liquid Membranes
The main areas of existing concrete that were found to be uncoated on the Phase One Tectons are the roof structures of both the Kiosk and the Entrance Structure and the floor on the Bear Ravine. Identified concrete damage has resulted from failure to coat the roofs and this is considered to be a design fault. Through careful analysis and various discussions with the local conservation officer and Historic England, it was agreed that a permanent solution was best to safeguard the future maintenance of the structure whilst providing little visual impact. The solution was a liquid applied membrane that once dry formed a single covering fully adhered to the concrete surface. This system allowed us to paint right up to the edges, leaving only a 3mm visible surface. The resulting surface accommodates any thermal movement experienced by the curved concrete surfaces. To marry the surface colour and texture back to the existing concrete a resin set quartz was applied to the top. The aggregate for the quartz was sourced from a local quarry to best match the tone and consistency of the concrete. At the time of completion the resulting view from the chair lift was five seemingly untreated concrete canopies. In 2022 it was noted that the roof covering has had signs of shrinkage and deterioration along the edges. Subsequently this has been discussed with Rowan Technology and they do not believe this is of any great concern and therefore would be a product to consider for future repair works. We will however need to assess whether the new coating has helped to slow the process of decay to determine whether this is an appropriate method to be used on the remaining Tectons such as the former Bird House, Kiosk and Sea Lion Pools.

Roof Membranes
Similar to the Entrance / Gift Shop, the former Moat Cafe and Queen Mary may have considerable layers of roof coatings that need to be removed before a new roof is applied. The former Moat Cafe originally had a red fascia along the edge of the serpentine curve roof and therefore we would like to expose this edge and remove the need for an edging strip overlapping the entire fascia. Further technical discussions need to be had when discussing the treatment of these edges as it could have a detrimental effect on the overall building. The Entrance / Gift Shop has a flying fascia infront of the main roof edge and so this detail is hidden but does take away from the simplicity of the intended design intent. Through consideration of these details we can return these projects to their former concepts whilst protecting the structure from further damage.

Paint

Removal
As part of the Phase One work initially all structures were cleaned of plant growth, then various methods of removing the paint were explored and the most effective method was a two stage process. First a thermatech super heated steam system would be used to remove all organic contaminants and modern paints without affecting the surface finish or texture, this process cleaned the majority of the the structure back to concrete but left some mineral paints and slurry coats. Some areas were treated with chemical strippers and removed by hand. Areas that did not react to this treatment were cleaned using a very light blasting program utilising both wet and dry blasting. These processes were carried out by SW Sodablast Ltd to a very high degree of quality. The cleaning process was very successful with all organic contaminants and the majority of modern paints removed.

Reapplication
As part of the Phase One works paint samples were tried and tested on the Entrance / Gift Shop walls to confirm the dilution ratios of each chosen colour. Internally, a Keim Soldalit (sold paint) was used to create the vibrant blue and red colours. Those surfaces that were left fair faced were treated with the Keim Lasur. Current analysis of this paint work has held its Keim concretal vibrancy internally and externally as the pigments penetrates the surface of the concrete. The use of Keim's mineral paints has worked well with the Tecton structures and would recommend this is used on future projects.

It was noted on the proposed drawings that a all external surfaces were to be treated with a breathable silane prior to colour being applied, this was to provide a water resistant surface whilst allowing moisture to escape from within the structure but it is understood that this was not applied during construction and the consequence is that the building has streaks along the majority of its vertical fascias. After discussions with Keim they recommend this be applied on the Phase Two Tectons to stop this from occurring.

Concrete Tools
Due to the corrugated finish of the surfaces, different techniques were implemented to best match the texture. A collection of tools have been made to help recreate the waved surface. We are unsure whether DZC still have the tools that were used to replicate this technique or if these will need to be remade for the next phase of works.

Metalwork
Any metalwork that was easy to remove was taken off site to chemically cleaned to understand its true condition, an assessment made as to which parts to be kept and which to be rebuilt with the aim to keep as much original steel as possible. This was the best way to deal with moveable metal elements.

Balustrade
It is noted in the concrete monitoring that the balustrades at the Bear Ravine are suffering from shrinkage. Rowan Technology suggest that application methods are assessed and like-for-like concrete mixes and water content are carefully monitored to ensure this is made as per the recommendations to avoid these issues from happening again. This includes minimising the water / cement ratio, roughening the back of the breakout, dovetailing the sides of all repairs using an undercut of 2 and 3mm and providing additional stainless steel cramps to some areas where steel reinforcements are absent.

Through the works conducted on the Bear Ravine it is understood that the supports to the balustrade are metal sleeves that have been slid over reinforcing bars from the lower concrete balustrade up stand and have subsequently filled with concrete during the casting of the upper horizontal concrete handrail. Metal sleeves were produced by a blacksmith to wrap around the vertical supports and this was a successful way of addressing the supports.

Due to the excessive cracking, in the future it is proposed that the parapet walls that support the upper balustrade are to be completely recast. These walls and balustrades using fully cleaned up (grit blasted or replacement) steel reinforcements. Rowan Technology therefore recommend that when future repairs are carried out to the fluted parapet walls and balustrade they be completely recast and with all embedded steel being grit blasted clean and a zinc rich coating applied.

Windows
It states within the maintenance action plan that the painting for the windows will be undertaken every 5 years and on observation this was not undertaken until 2022, 3 years after it should have. Without regular maintenance the windows will deteriorate quickly. It has been suggested by DZC to use aluminium powder coated windows for the next phase of works to reduce the maintenance required for the windows to the Tecton structures.

Interpretation Boards
We are aware that the interpretation boards are being regularly cleaned however the powder coating of the supports is failing and the paint is slowly flaking away which is due to a failure in the product rather than any fault of the Zoo. This should be of consideration when providing new interpretation boards across the site.

9.3.4 Reporting

Paint Analysis
All Tecton structures have received various layers of paint, a paint analysis report has been conducted so far for the Entrance, the former Station Cafe, the Bear Ravine, the Kiosk, the former Moat Cafe, the Elephant House, the former Bird House and the Queen Mary. The paint analysis report has assisted in the conservation process to determine the original colour swatches for the Tectons but it also demonstrates the layers of paint that have been used on each of the Tectons. This was vital to the conservation of these structures and as part of any Tecton works this process should be undertaken.

9.4 Monitoring

9.4.1 Concrete Repairs

Rowan Technologies have been undergoing annual monitoring of the Tectons in order to monitor the long term performance of the like-for-like concrete repairs. This was undertaken using non destructive testing techniques, mainly visual analysis although drill samples which were taken in 2014. The back catalogue of images has helped to monitor the Tectons over the years and inform future repairs and techniques.

22nd August 2022 was the sixth annual visit made by Rowan Technologies whom assessed the visual condition of the repairs and taking corrosion rate measurements on the Bear Ravine, Kiosk and Meerkat Enclosure. One note to all buildings was that the concrete surfaces (parent and patch) showed significant moss growth.

RTL conduct their surveys on the Kiosk, Bear Ravine and Meerkat Enclosure only but undertook a defects assessment of all the Phase One Teutons to assist with the Conservation Management Plan.

All descriptions for the Tecton structures is written under monitoring in each sub section and all reports are included within the appendices from Section 11.5 onwards.

9.4.2 Conclusions

Rowan Technologies conclude that the corrosion rates of the repaired concretes for both Tecton structures have now decreased to a very low level, the hardness values of the concrete in the repaired areas shows that both the parent and patch concretes are similar and have surface strength values in the average to low range.

Visual assessments of the repairs have shown that there are some cracking and shrinkage problems associated with the Bear Ravine; the other Tectons appear to be free of such defects. These defects may have been due to application problems when they were originally repaired. Repairs carried out later on for the Meerkat Enclosure showed no similar problems. It is possible that the water ratio of the repair mix was too high when the work was first started, leading to shrinkage. Although the author gave outline recommendations for these repairs in 2013, it is not clear if these were closely carried out. These defects will need ongoing monitoring to check that the underlying steel reinforcements do not start to corrode.

It is concluded that the corrosion rate monitoring of the repaired areas did not give any indication that the incipient anode, or halo effect, was occurring, the like-for-like concrete seems to be the preferred material for repairs and blends well with the parent concretes following five years of weathering and the zinc paint to corroded rebar is working. For further information please refer to appendices from Section 11.5 onwards.

9.5 Use

From analysis of the buildings we have seen first hand that those buildings that have a use are maintained more often than those that do not. The Entrance and former Station Cafe are in far better condition than the Bear Ravine and the Kiosk of which have deteriorated at a faster pace. We are conscious that without consistent care and attention these buildings will fall into a bad state of disrepair quicker than expected. To ensure a future for these buildings it is vital to provide them with a viable use that is part of the Zoo experience, so routine cleaning and maintenance is provided, otherwise they will stand as monuments in the landscape.

We are concerned that the knowledge gained from the Phase One works has not been utilised and knowledge has been lost as maintenance staff have changed over the years. Without a dedicated knowledgable team within the Zoo it will be difficult to care for these buildings in the considered manner they require.

We appreciate that during the Covid pandemic that there were limited staff on site, those that were present on site prioritised the care of the animals first before the upkeep of the Tecton structures which has accelerated the worsening condition of some of the Tecton structures.

9.6 Workbook

It was suggested by John Allen in the Tecton Buildings at Dudley Zoo that a workbook should be produced for each building containing essential information. We believe this is still necessary but we think that the conservation management plan has began the process of undertaking this, compiling information for each Tecton but a workbook would provide another level of detail along side a maintenance regime for the buildings.

10 Bibliography

10.1 Books

John Allan – The Tecton Buildings at Dudley Zoo – *A Feasibility Study for restoration and Re-use*
Avanti Architects 1990

Report on Condition of Tectons
Halcrow 2006

Tecton at Dudley Zoo 1937 – 1987
Dudley MBC

Halcrow Conservation Statement 2004
prepared for St Modwen Developments

Dudley Zoo Tour Notes August 2011
Twentieth Century Society

Conservation Statement Dudley Zoo Tectons 2011
Catherine Croft & Jon Allen

The Tecton Structures at Dudley Zoo c. 1935 – 1969
A catalogue of sources researched and compiled by Natasha Fitzgerald and Catherine Gregg

M. Reading, P. Coe, *Lubetkin and Tecton: An Architectural Study,*
*MI.*Triangle Architectural Publications, 1992

Susan MacDonald (ed), *Modern matters principles and practice in conserving recent Architecture*

Donhead Publications, 1996 - David Heath *Tecton Buildings - Dudley Zoo,*
English Heritage

Dudley Zoo Worcs II Architects: Tecton *Architecture and Building News* Vol 152 12/11/37 pp 201-7

Hitchman, J, Towers and Tectons at DZG - a view from the hill, 2009

http://benflatman.com/Richard%20Billingham/Richard%20Billingham.html

Picaresque picturesque Dudley Zoo by Tecton and Berthold Lubetkin Karolina Szynalska May 2010

10.2 Archives

Birmingham Archives
Dudley Archives
Dudley Museum & Gallery
Kier
National Archives
National Monument Record
Royal Institute of British Architects
University of St Andrews

10.3 Illustrations

The sources are listed as they appear in this document followed by figure numbers and where known, names of photographers/originators and copyright holders in brackets. The author and published made every effort to contact copyright holders; they will be happy to correct in subsequent editions any errors or omissions which are brought to their attention.

BPN Architects - 26,28,29,30,31,32,33,34,35,36,37,38,46.

Dudley Zoo & Castle - 41.

Google - 2,7

National Monument Records - 1,3,4,5,6,39,43,44, 47, 49, 50, 51, 53, 56, 57, 58, 59, 61, 64, 66, 67, 68, 69, 70, 72, 75, 77, 80, 81, 82, 84, 85, 86, 87, 89, 91,97,99,111,112, 113.

Promap - 8,9 & 10.

RIBAPix - 27,40,42,45, 52, 55, 60, 65, 73, 74, 78, 79, 88. 92, 93, 94, 95, 96,101,102,103,104,106,107,109,110,111.

RIBA Library Photographs Collection - 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 48, 54, 62, 63, 71,76, 83, 90, 98, 100,105,107,108,114.

11 Appendices

11.1 Listing Descriptions

11.1.1 Tropical Bird House former Bird House

11.1.2 Discovery Centre former Moat Cafe

11.1.3 Queen Mary former Castle Restaurant

11.1.4 Elephant House

11.1.5 Entrance

11.1.6 Entrance / Exit / Gift Shop former Station Cafe

11.1.7 The Bear Ravine

11.1.8 The Kiosk (next to Polar Bear Complex)

11.1.9 The Sea Lion Pools

11.1.10 Meerkat Enclosure former Reptilliary

11.1.11 Polar Bear Pit and Lion and Tiger Ravines

11.2 Tecton Planning Applications

11.3 Berthold Lubetkin Biography

11.4 Ove Arup

11.5 Rowan Technologies Annual Report 2016

11.6 Rowan Technologies Annual Report 2017

11.7 Rowan Technologies Annual Report 2018

11.8 Rowan Technologies Annual Report 2018

11.9 Rowan Technologies Annual Report 2020

11.10 Rowan Technologies Annual Report 2022

11.11 Rowan Technologies Defects Report 2022

11.12 Architectural Historic Paint Research and Analysis Report - Phase One

11.13 Architectural Historic Paint Research and Analysis Report - Phase Two

11.14 Getty Conservation Institute Concrete Research

11.1 Listing Descriptions

11.1.1 Tropical Bird House former Bird House

Listed Building Description

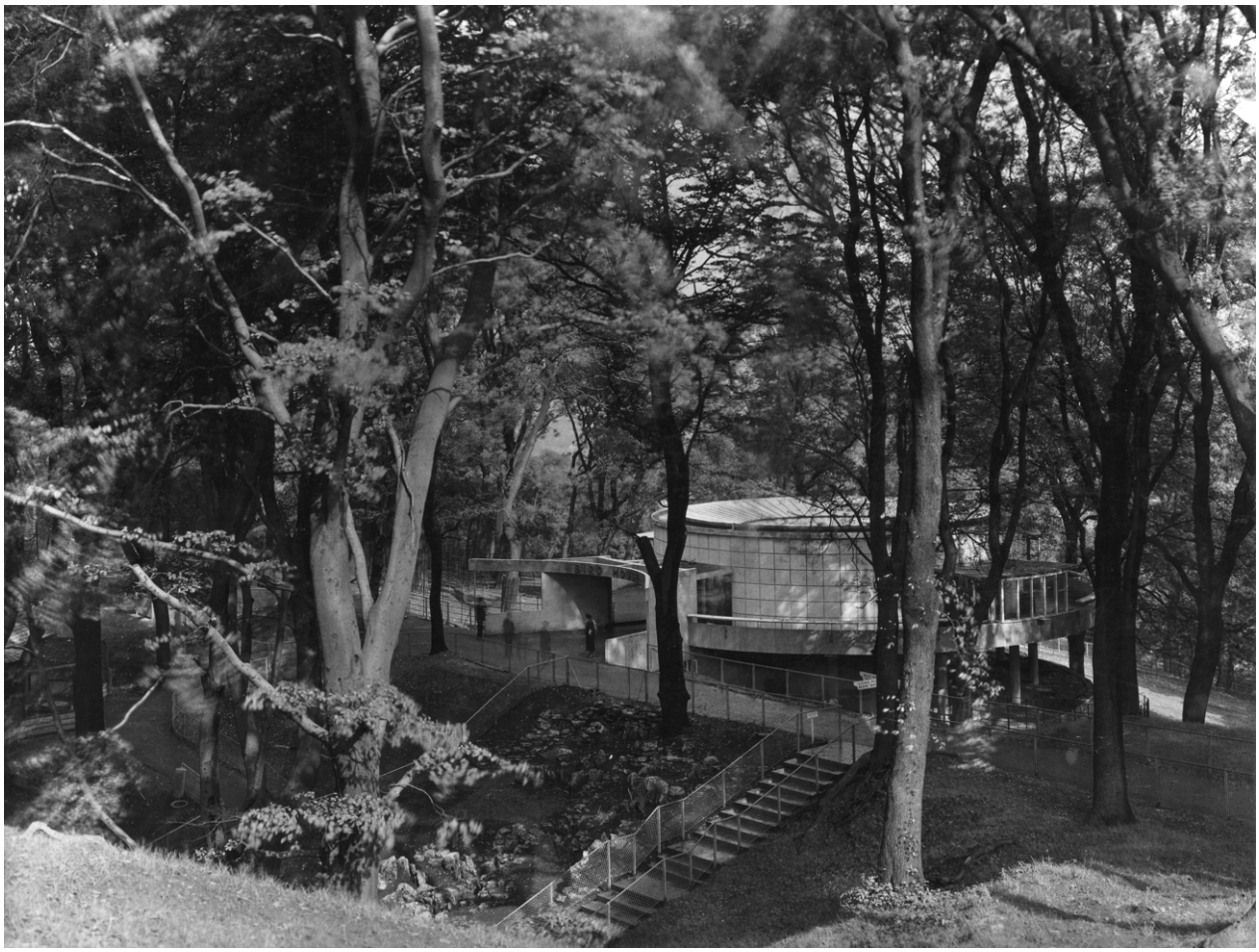


Fig 47. Image of the former Bird House, Elevated view of the Bird House seen through woodland with visitors at entrance, 1937

Tropical Bird House AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II*
List Entry Number: 1227761
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011 Location Description: Castle Hill, Dudley.

Summary

Former Tropical Bird House, designed by Lubetkin and Tecton, and built 1935-7.

Reasons for Designation

The Tropical Bird House at Dudley Zoo, is designated at Grade II*, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building if of more than special interest for it's form, with its deeply cantilevered balcony over an animal paddock, surmounted by a drum enclosure with a separate glass roof, demonstrating significant architectural and engineering sophistication; * Group value: the enclosure demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the enclosure is designed to sit on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

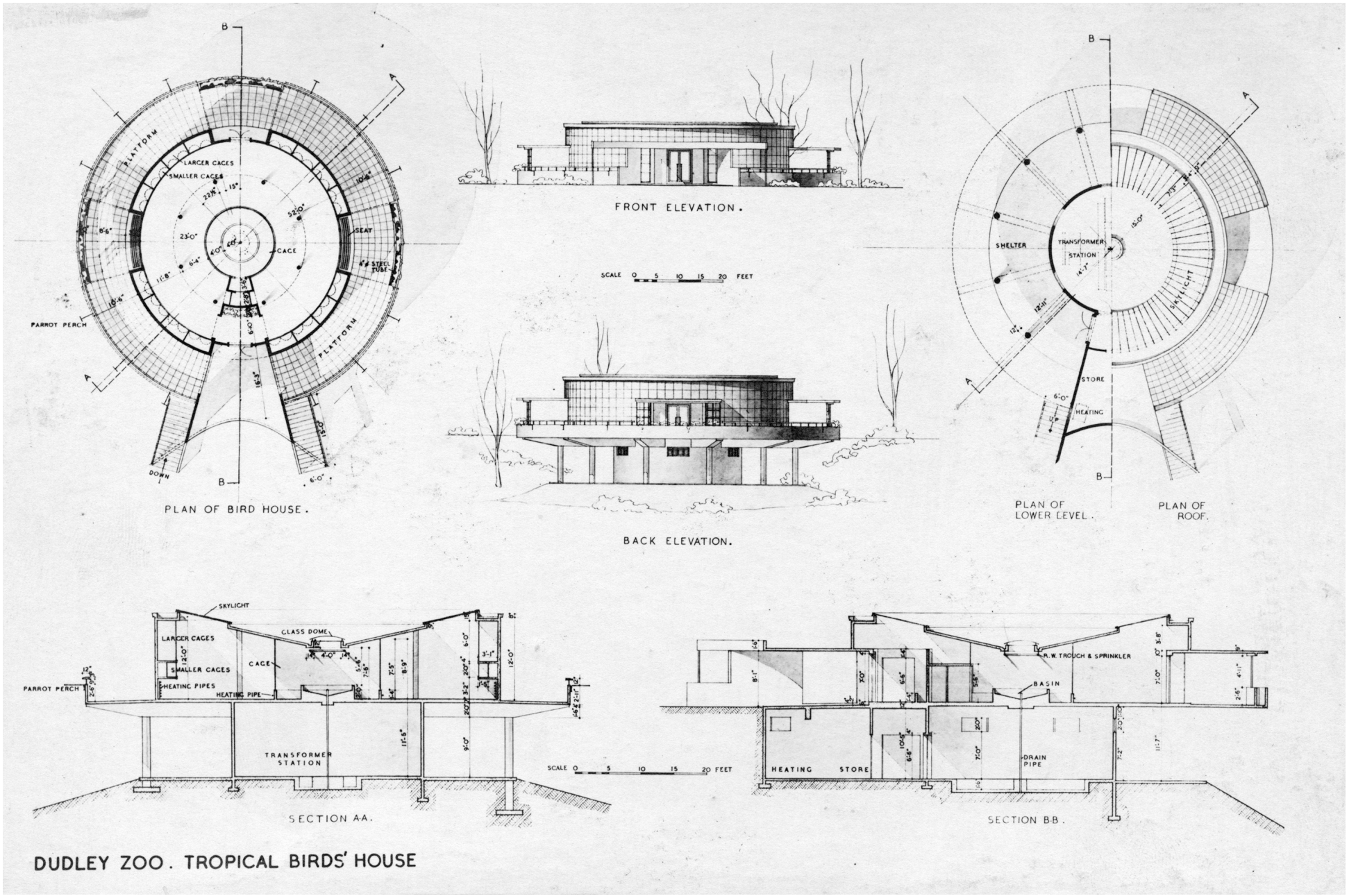


Fig 48. Drawing of the former Bird House

Listed Building Description

Details

MATERIALS
Reinforced concrete, with extensive glazing to the roof.

PLAN
The plan is based on two concentric circles, the smaller describing the external wall of the former bird house, the larger the balcony which surrounds it. An apron for the entrance extends to the west, flanked by flights of steps giving access to the lower level.

EXTERIOR
The circular building is of two storeys, the higher at ground level when approached from the south, and consists of an upper drum-shaped structure, finished with a moulded grid pattern, with a surrounding cantilevered balcony which has three shelters created from floating slab roofs, under which is a smaller drum. The upper drum, which formerly housed semi-tropical birds, and the balcony, are accessed via a bridge, under a roof slab with a deeply convex front edge, which extends to either side as a beam. The double entrance doorway is set back slightly within the entrance. The reinforced concrete roof, in the form of a partial inverted flat cone carried on plain columns, is structurally separate from the circular external wall, and the two are united only by the double-glazed roof light which bridges the gap in an unbroken circle.

The balcony has the common parapet used for all the larger buildings designed by Tecton for the site; the low wall has its coping raised on elliptical-section steel struts, giving adults a raised surface on which to lean, and allowing children to view the animals without being lifted up.

Under the balcony, a smaller central drum below the bird house formerly housed the transformer station and heating plant. The whole sits on a circular platform with an external wall faced in rubble stone.

INTERIOR
The interior is no longer used for the keeping of birds. The enclosures which lined the circular wall of the building have been removed, as has the wire-mesh aviary which formed the central enclosure, though the structural elements which supported them, and hid the heating pipes from view, are still in situ.

Words taken from Historic England Website, 19th July 2022, for full official list entry please refer to: : https://historicengland.org.uk/listing/the-list/list-entry/1227761?section=official-list-entry

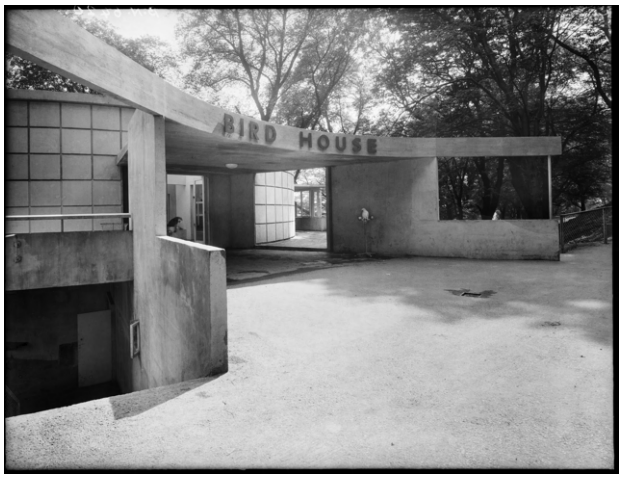


Fig 49. Image of the former Bird House, View of the Bird House entrance,1937

Fig 50. Image of the former Bird House, Interior view of the Bird House showing circular plan form, arrangement of the cages and inverted roof light, 1937

Fig 51. Image of the former Bird House, Interior view of the Bird House showing the arrangement of cages and inverted roof light, 1937

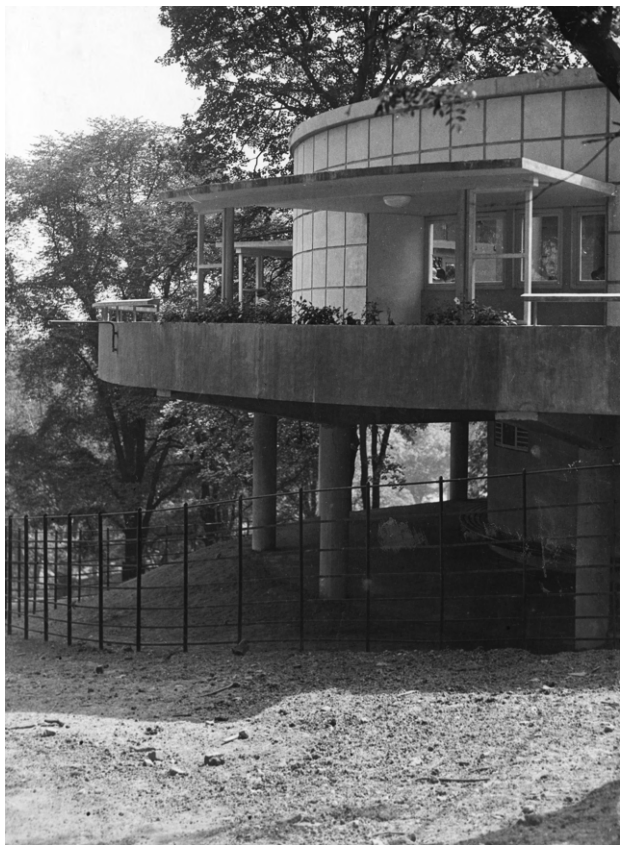


Fig 52. Image of the former Bird House, External view of the balcony, 1937

11.1.2 Discovery Centre former Moat Cafe

Listed Building Description

Fig 53. Image of the former Moat Cafe, Showing the length of the colonnaded façade, serpentine roofline and canopied entrance,1937

ZOO EDUCATION DEPARTMENT AND VISITOR SHELTER AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II
List Entry Number: 1227873
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011 Location Description: Castle Hill, Dudley.

Summary

Former Moat Café, now Education Centre and visitor shelter, designed by Lubetkin and Tecton, and built 1935-7.

Reasons for Designation

The Education Centre, formerly the Moat Café, at Dudley Zoo, is designated at Grade II, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building's curving profile, its discreet height and massing in a sensitive location, and the engineering involved in its construction are all impressive, and legible despite later alterations; * Group value: the enclosure demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the enclosure is designed to sit on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

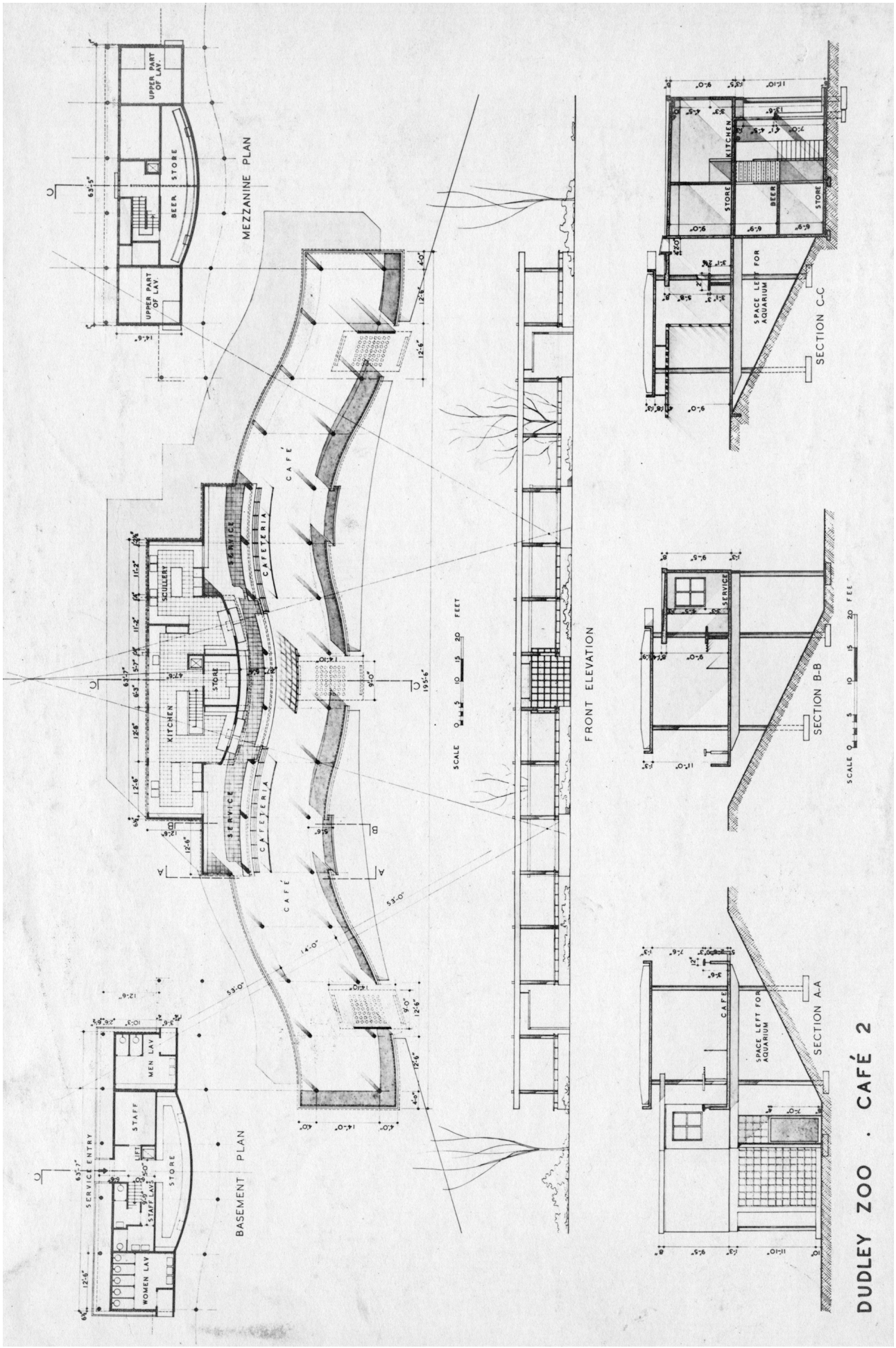


Fig 54. Drawing of the former Moat Cafe

Listed Building Description

Details

PLAN
The building is serpentine on plan, with a rectangular block to the rear.

MATERIALS
Reinforced concrete.

EXTERIOR
The building is set at the top of a steep slope, meaning that it is a single-storey range to the main (east) elevation, and two storeys to the rear. The serpentine front elevation is an unbroken series of curves, alternating convex and concave, with a low wall converted from the parapet used for all the larger buildings designed by Tecton for the site; the low wall originally had its coping raised on elliptical-section steel struts, giving adults a raised surface on which to lean, and allowing children to view the animals without being lifted up. Above this the formerly open elevation is now glazed, the sections to either end with small-paned mullioned and transomed timber windows, the central section with metal-framed mullioned windows with some small opening panes. The central entrance has a recessed double-doorway; there are two alternative entrances spaced regularly along the range, echoing the original openings into the building. The rear elevation is of two storeys, the basement storey slightly recessed, and the upper floor supported on columns; both storeys have small-paned mullioned and transomed windows in strongly horizontal openings.

INTERIOR
The construction is expressed internally in the use of 9-inch diameter columns carrying, by the use of external and invisible beams, a flat roof slab which is flush with the underside of the beams, creating a fully-flush ceiling between the columns.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1227873?section=official-list-entry

Original photographs & drawing shown overleaf

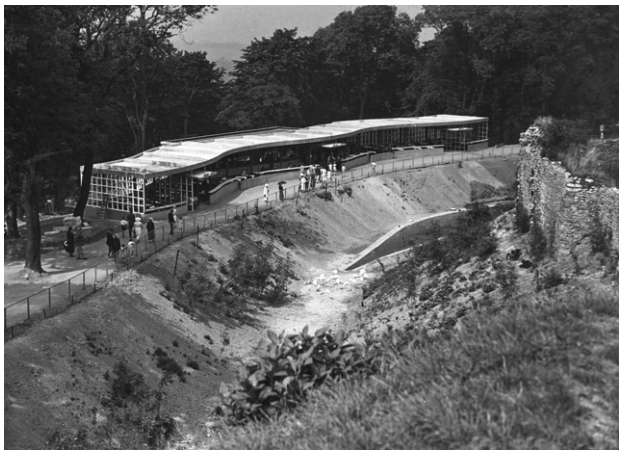


Fig 55. Image of the former Moat Cafe, Elevated view of the Moat Café seen from across the moat,1937

Fig 56. Image of the former Moat Cafe, Showing the length of the colonnaded façade, serpentine roofline and canopied entrance, 1937

Fig 57. Image of the former Moat Cafe, Interior view of the terraced seating area and service counter showing the serpentine roofline, 1937

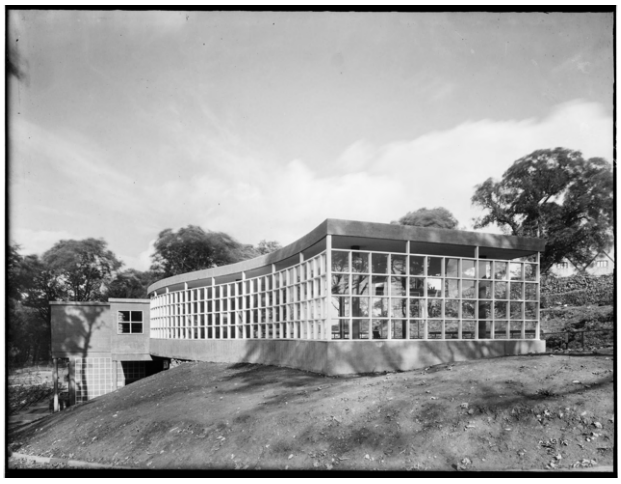


Fig 58. Image of the former Moat Cafe, The trellis screen wall of the rear and side facade, 1937

Fig 59. Image of the former Moat Cafe, Interior view showing the canopied entrance, 1937

Fig 60. Image of the former Moat Cafe, View of the Moat Café seen from across the moat, 1937

11.1.3 Queen Mary former Castle Restaurant

Listed Building Description

Fig 61. Image of the former Castle Restaurant, Detail view of the canopied entrance, 1937

CASTLE RESTAURANT AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II
List Entry Number: 1076025
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011 Location Description: Castle Hill, Dudley.

Summary

The Castle Restaurant, a zoo restaurant designed by Lubetkin and Tecton and built in 1935-7.

Reasons for Designation

The Castle Restaurant at Dudley Zoo is designated at Grade II, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building's strongly geometric form is designed to sit neatly on the outcrop which it crowns, and to give dramatic views to the north over the wooded Castle Hill; * Group value: the restaurant demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the restaurant is designed to sit within the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created; it has an important axial relationship with the access to the castle over the moat.

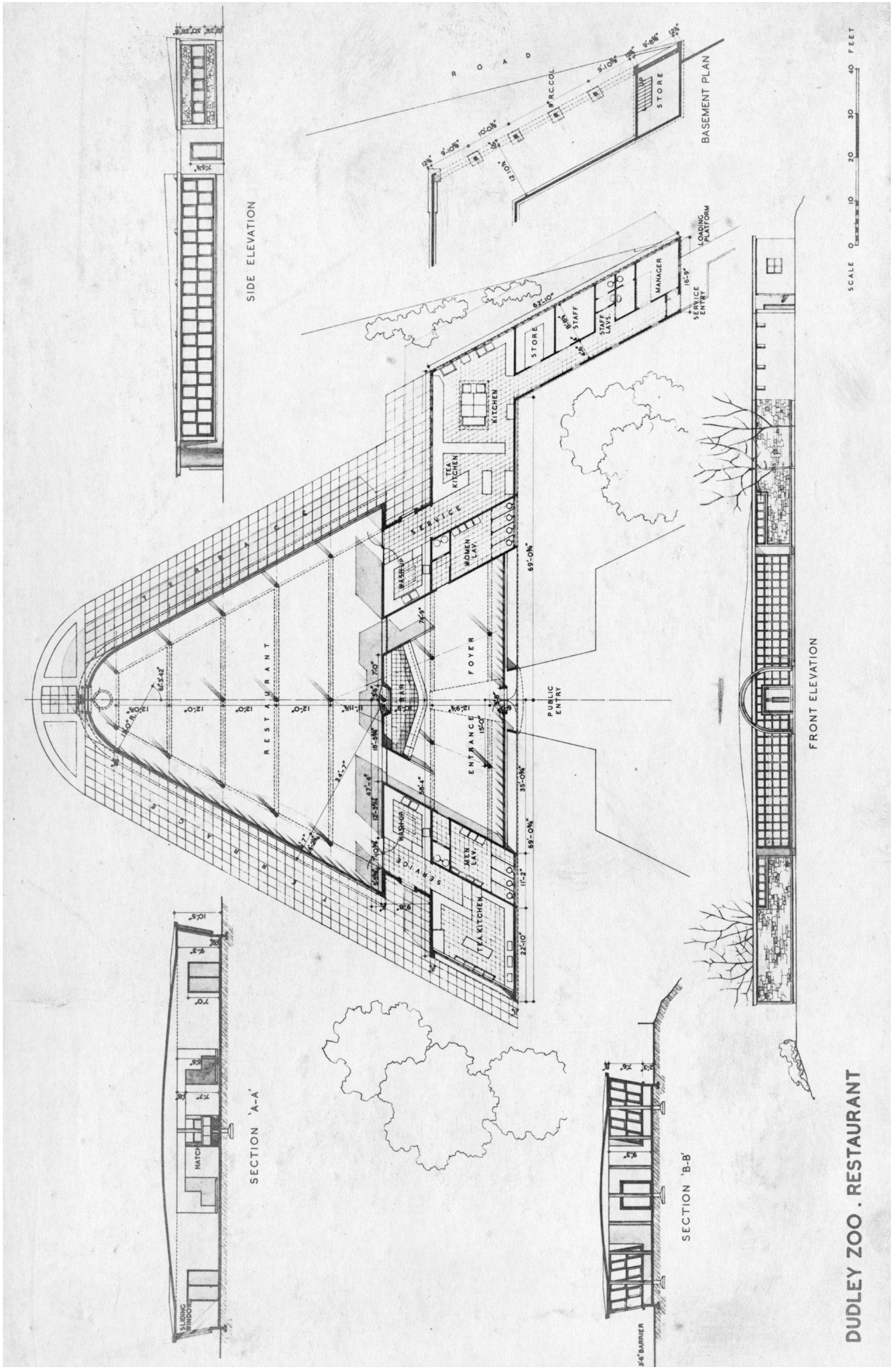


Fig 62. Drawing of the former Castle Restaurant

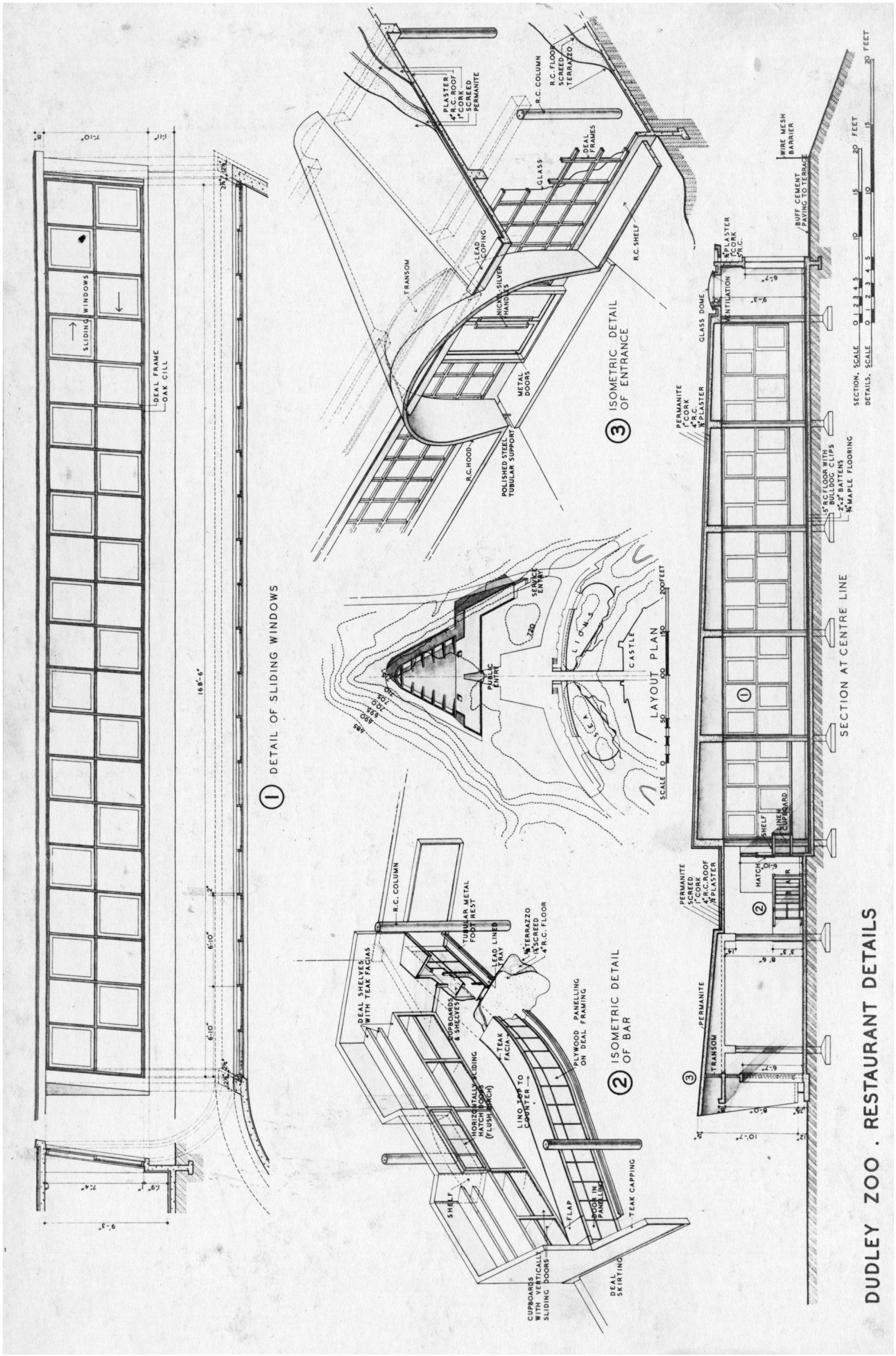


Fig 63. Drawing of the former Castle Restaurant

Listed Building Description

Details

MATERIALS
Reinforced concrete, some stone rubble walling, and timber windows to the long, glazed elevations.

PLAN
The main building is triangular on plan, with an elongated front range to the south. A basement-level range housing ancillary functions runs south-eastwards from the south-east corner of the building.

EXTERIOR
The building is a low, wide single storey to its main elevation, which faces south and is aligned on a bridge over the sea lion pools, which leads into the castle at the top of the mound beyond. The south elevation has a central entrance under round concrete arch, which continues towards the rear of the building as a barrel vault. The elevation is largely glazed, with square-framed timber windows extending floor to ceiling from under the arch to the final bay of the elevation on each side. The end bays, which house kitchens and service functions, each have a row of small, square windows above walls of rubble stone, matching the castle which the building faces. The side elevations, visible from the lower slopes, are floor-to-ceiling multi-paned windows which are inclined outwards, akin to an ocean liner. The opening lights have sliding mechanisms.

INTERIOR
The building is divided into two main spaces: the entrance lounge, now housing the service counter; and the seating area of the restaurant to the rear. The building's structure is visible in both sections: concrete beams are carried on plain columns, and the roof slab, which is raised in a conic form, presents an arched appearance, increasing the sense of height inside the building without adding to the apparent external height. The original terrazzo floor covering has been concealed by later vinyl flooring, and the bar, which was designed by the architects to allow it to serve both the lounge and the restaurant, has been replaced with modern fittings.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1227873?section=official-list-entry

Original photographs & drawing shown overleaf

Fig 64. Image of the former Castle Restaurant, View of the entrance façade, 1937

Fig 65. Image of the former Castle Restaurant, View of the entrance façade with chairs and tables on the grass in the foreground, 1937

Fig 66. Image of the former Castle Restaurant, Interior view of the entrance seen from the bar counter, 1937

Fig 67. Image of the former Castle Restaurant, Interior view of the restaurant area showing Mollo and Egan photo murals of zoo animals, 1937

Fig 68. Image of the former Castle Restaurant, Interior view of the restaurant area showing the slanted angle of the windows, 1937

Fig 69. Image of the former Castle Restaurant, Interior view of the foyer and bar area, 1937

11.1.4 Elephant House

Listed Building Description

Fig 70. Image of the former Elephant House, Exterior view of the Elephant House showing cantilevered terrace and saddles for rides, 1937

Elephant House AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II
List Entry Number: 1076028
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

An Elephant House, designed by Lubetkin and Tecton, built 1935-7, with later alterations.

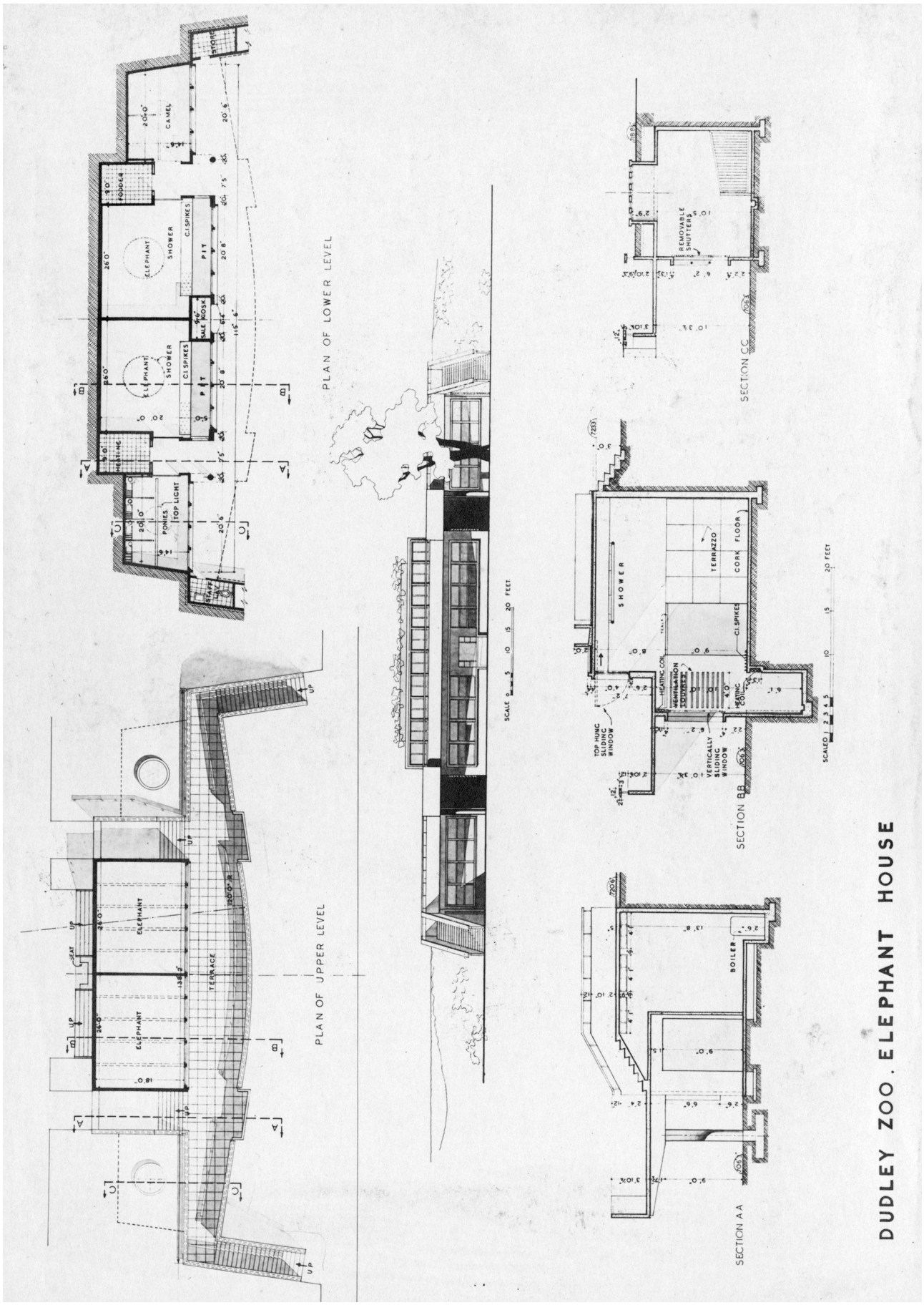


Fig 71. Drawing of the former Castle Restaurant

Listed Building Description

Details

MATERIALS
Reinforced concrete.

PLAN
The main section is rectangular on plan, with a narrow, gently convex range to the south-east, longer than the rectangular section. At either end, a flanking staircase rises from the lower level to the upper terrace.

DESCRIPTION
The structure is built into the slope between two terraces, a single-storey range, with a gently curving glazed front (clad in split-pale timber at the time of inspection in 2011), set under a deeply-overhanging roof plate with projecting balconies. The parapet with raised coping used for all the Tecton animal houses around the zoo - the low wall has its coping raised on elliptical-section steel struts, giving adults a raised surface on which to lean, and allowing children to view the animals without being lifted up - is here employed as a balustrade and handrail to the flanking staircases, which allows access to the viewing area on the upper level, and continues as a wall around the roof terrace above the animal house. A clerestory with obscure-glazed square timber windows rises through the roof terrace, lighting the indoor areas, and forming the only part of the building visible from the castle.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1227873?section=official-list-entry

Original photographs & drawing shown overleaf

Fig 72. Image of the former Elephant House, Exterior view of the Elephant House showing cantilevered terrace with corrugated finish on facing concrete and saddles for elephant rides, 1937

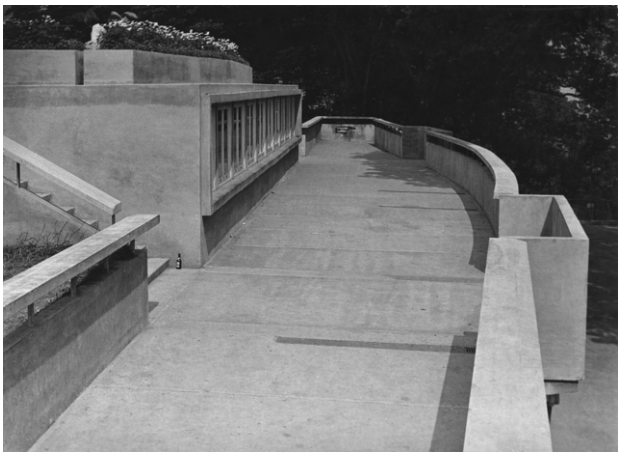


Fig 73. Image of the former Elephant House, View of the upper terrace, 1937

Fig 74. Image of the former Elephant House, Elevated view from the Castle ruins towards the upper terrace of the Elephant House showing the integration of the building with the site, 1937

11.1.5 Entrance

Listed Building Description

Fig 75. Image of the former Entrance Gateway, View of the canopied entrance kiosks and wooded hill behind, 1937

Entrance Gateway AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II*
List Entry Number: 1216535
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

Zoo entrance building, designed by Lubetkin and Tecton, and built 1935-7.

Reasons for Designation

The Entrance Building at Dudley Zoo, is designated at Grade II*, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building is of more than special interest for it's strongly geometric form and its innovative interlocking S-shaped canopy roof demonstrating clear architectural and engineering interest; * Group value: the building demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the building is designed to sit on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

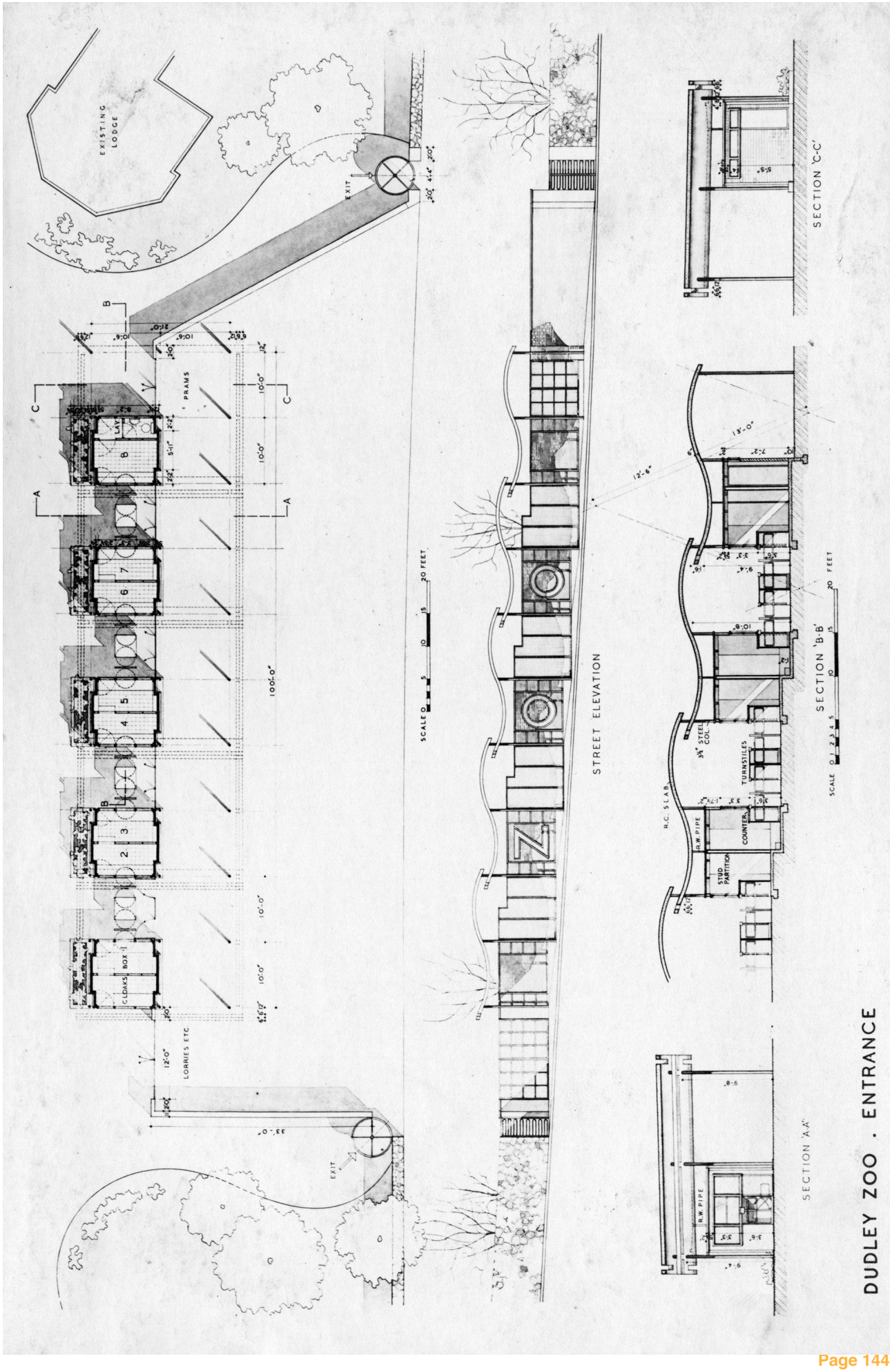


Fig 76. Drawing of the Entrance Gateway

Listed Building Description

Details

MATERIALS
Reinforced concrete, with blue brick to the front and rear walls, and timber fittings to the kiosks.

PLAN
Rectangular plan, the long main elevation facing Castle Hill, and set well back from the road to provide a deep apron, allowing visitors to wait for entrance away from the edge of the pavement.

EXTERIOR
The building is a single storey, set on the slope of Castle Hill, and therefore steps downwards from west to east, following the slope of the ground. The range has five equally-spaced kiosks, separated by openings for the turnstiles, which are of equal width to the kiosks. The Kiosks allow eight openings for the sale of tickets, each back-to-back within the booths, apart from those at the ends, each of which has one ticket window and another area for staff facilities. The walls are faced in blue brick; the central three bays each carry a concrete letter, spelling Z O O. The roof, carried on round steel columns, is formed from interlocking, shallow S-shaped concrete canopies, enabling the roof to step elegantly down the slope. The projecting roof elements, which also form a shelter for queuing visitors, each have a slot set just back from the front, to allow water to run off without staining the front edge. Each ticket window is half-glazed, adjacent to an entrance doorway; the ticket positions retain their glazed timber windows, with a small counter for transactions. The rear is similar to the main elevation. The blind returns are constructed from blue brick.

INTERIOR The kiosks have matchboarding to the interior, with a dado-height partition clad in matchboard separating the two ticket positions

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1216535?section=official-list-entry

Original photographs & drawing shown overleaf

Fig 77. Image of the Entrance Gateway, View of the canopied entrance with Clarion signage,1937

Fig 78. Image of the Entrance Gateway, Detail view of the roofline showing the overlapping concrete canopies, 1937

Fig 79. Image of the Entrance Gateway, View of the canopied entrance with Clarion signage, 1937

Fig 80. Image of the Entrance Gateway, View of the entrance kiosks shielded by overlapping concrete canopies, 1937

Fig 81. Image of the Entrance Gateway, View of the canopied entrance kiosks and wooded hill behind, 1937

11.1.6 Entrance / Exit / Gift Shop former Station Cafe

Listed Building Description

Fig 82. Image of the former Station Cafe, Exterior view of the Station Café, 1937

Former Station Cafe, now Safari Building, AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II*
List Entry Number: 1076023
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

Former Station Café, now the Safari Shop and winter entrance building, designed by Lubetkin and Tecton, and built 1935-7.

Reasons for Designation

The Safari Building, formerly the Station Café, at Dudley Zoo, is designated at Grade II, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building's strongly geometric form and use of a floating roof slab above unglazed lattice walls created a transparency which reflected the Moat Café elsewhere in the zoo grounds, and created an accessible building used both by zoo visitors and the public from outside; * Group value: the building demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the enclosure is designed to sit on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

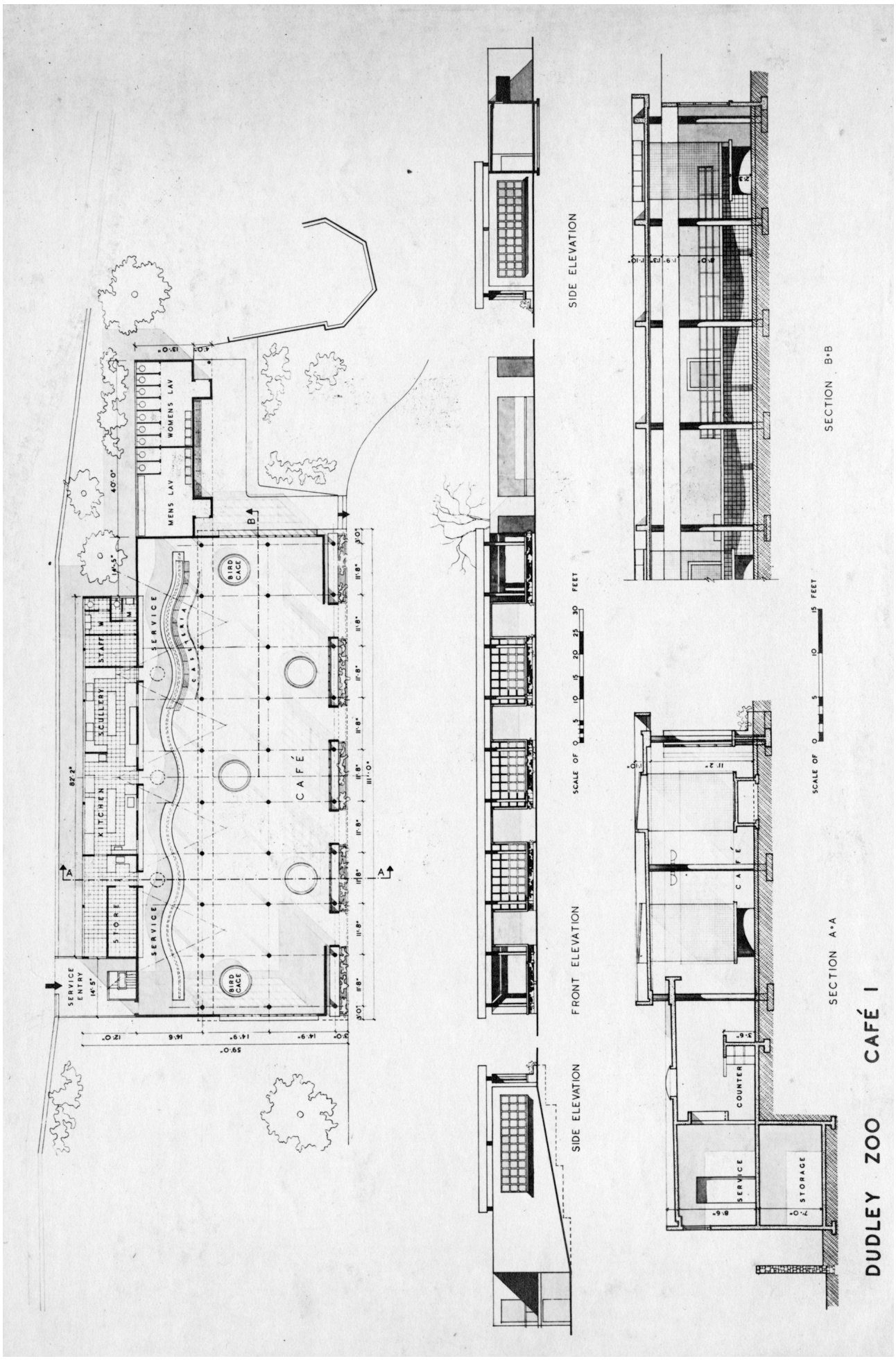


Fig 83. Drawing of the former Station Cafe

Listed Building Description

Details

MATERIALS
Reinforced concrete.

PLAN
A rectangular plan, with a small adjacent block to the south-west corner.

EXTERIOR
The main elevation is of five bays, set between four evenly-spaced entrances; of these entrances, only two are now open, the others having been filled in. Those in use house late-C20 double doors. The overhanging roof slab is supported externally on 9-inch columns, two to each bay between the doorways, around which are built concrete benches. One of the bays retains its timber lattice, now glazed; the others are all filled in. The south end wall has similar glazed lattice, and the opposite end wall is filled in.

INTERIOR
The roof slab is carried on 9 inch diameter columns, which support concrete beams, with
which the main roof slab is set flush. There are regular circular roof lights.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1076023?section=official-list-entry

Original photographs & drawing shown overleaf

Fig 84. Image of the former Station Cafe, Exterior view of the Station Café with visitors on pathway, 1937

Fig 85. Image of the former Station Cafe, Interior view of the station café showing pilotis, cylindrical birdcage and circular skylights, 1937

Fig 86. Image of the former Station Cafe, Interior view of the Station Café showing pilotis, serpentine bar and two cylindrical bird cages below circular skylights, 1937

Fig 87. Image of the former Station Cafe, Exterior view of the Station Café, 1937

Fig 88. Image of the former Station Cafe, Exterior view of the Station Café, 1937

11.1.7 The Bear Ravine

Listed Building Description

Fig 89. Image of the former Bear Ravine, View of the Bear Ravine taken from the arabesque wall enclosing the pool, showing kiosk to the right and Bird House just visible through trees above, 1937

Brown Bear Ravine AT DUDLEY ZOO (including all associated structures)

Heritage Category: Listed Building
Grade: II*
List Entry Number: 1227748
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

Former brown bear ravine, with associated features including elevated viewing platforms on several levels, enclosure walls, steps, and ramps and platforms within the enclosure, designed by Lubetkin and Tecton, and built 1935-7.

Reason for Designations

The former brown bear ravine and associated structures at Dudley Zoo, is designated at Grade II*, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building is of more than special interest for it's strongly geometric forms, and multi-level arrangement of viewing platforms, with sinuous perimeter walls demonstrating significant sophistication in its design and engineering; * Group value: the enclosure demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo;

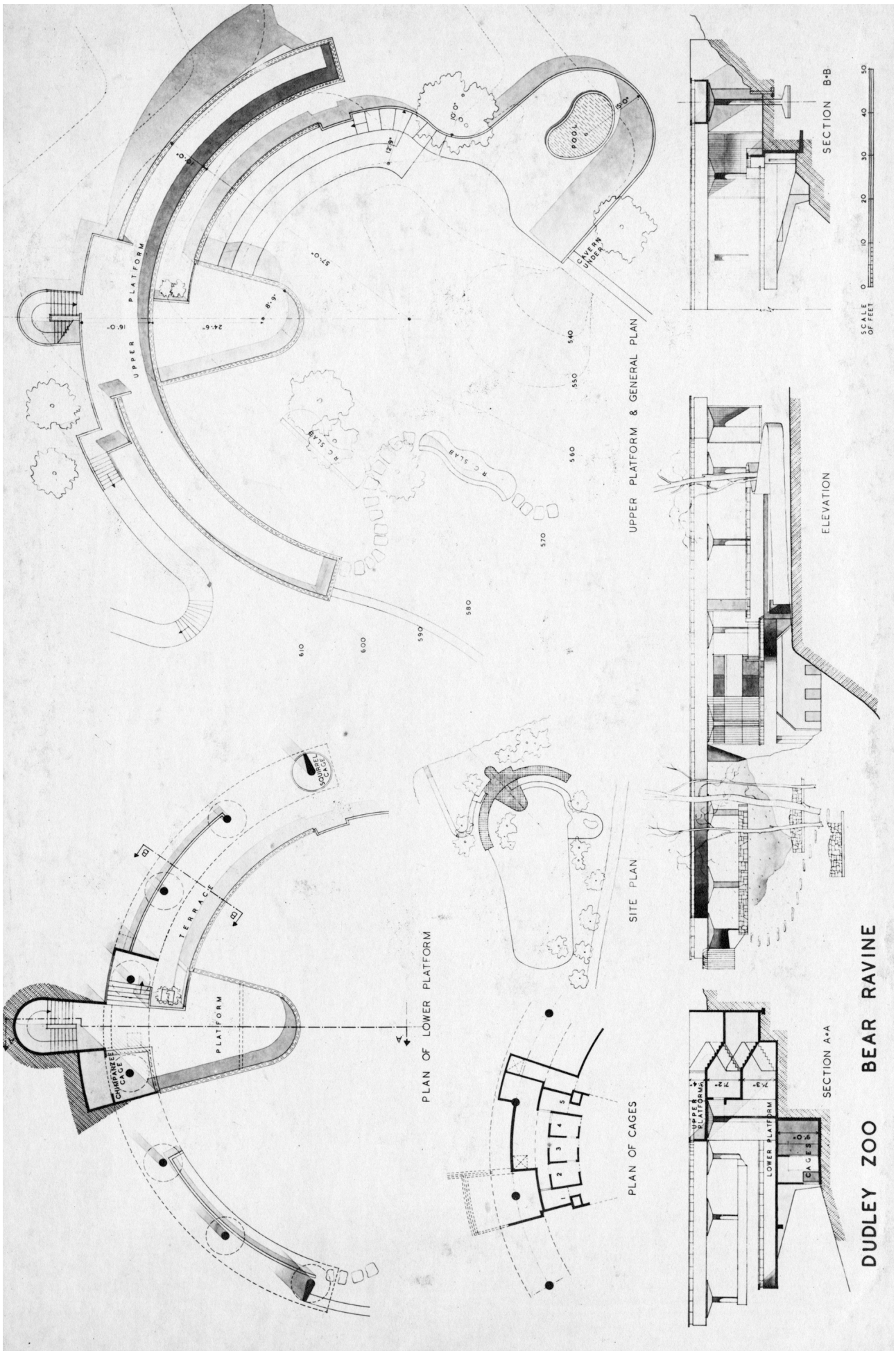


Fig 90. Drawing of the former Bear Ravine

Listed Building Description

Details

MATERIALS
Reinforced concrete.

PLAN
A semi-circular viewing platform curving against the contour of the hillside against which the enclosure is set, with a terrace at lower level projecting into the ravine; towards the east, below a lower terrace, there is a sinuously-curving perimeter to the enclosure, clasping a pool. There are various irregular platforms for the animals projecting from the sloping ground at the western side of the enclosure.

DESCRIPTION
The enclosure drops steeply from west to east, with the highest level viewing terrace set against the hillside, and projecting towards the west. The largest element of the design is a semi-circular terrace, 10 feet wide, reached by a stair from the rear, supported at 20-foot intervals on centrally-placed columns with mushroom capitals. At a slightly lower level, a boldly-cantilevered terrace projects out over the ravine from the centre of the semi-circle like the prow of a ship. The terraces have complex variations in their levels and circulation. The zoo's standard parapet and railing - a low wall with its coping raised on elliptical-section steel struts, giving adults a raised surface on which to lean, and allowing children to view the animals without being lifted up - is here used to either side of the terraces. The animal houses, with simple rectangular openings, are tucked under the terraces, against the hillside. The north-eastern corner of the enclosure is at ground level, and has a sinuously-curving wall describing its edge, surrounding a pool. There are various platforms projecting from the hillside at the western side of the enclosure, together with pools, steps and ramps, surrounding the deep ravine towards the eastern side.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1227748?section=official-list-entry

Original photographs & drawing shown overleaf

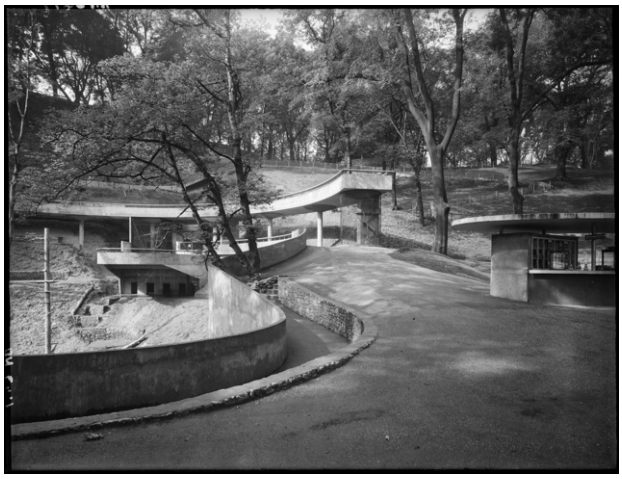


Fig 91. Image of the former Bear Ravine, View of the Bear Ravine and kiosk, 1937

Fig 92. Image of the former Bear Ravine, Elevated view of the Bear Ravine showing upper terrace and stairways, 1937

Fig 93. Image of the former Bear Ravine, View of the Bear Ravine showing cantilevered balcony and upper terrace supported by mushroom-headed colonnade, 1937

Fig 94. Image of the former Bear Ravine, Detail view of showing the geometry of the terraces, the squirrel cage enclosing the mushroom column and roof of kiosk below, 1937

Fig 95. Image of the former Bear Ravine, Elevated view of the Bear Ravine showing visitors ascending steps to the upper terrace and looking over the cantilevered balcony, 1937

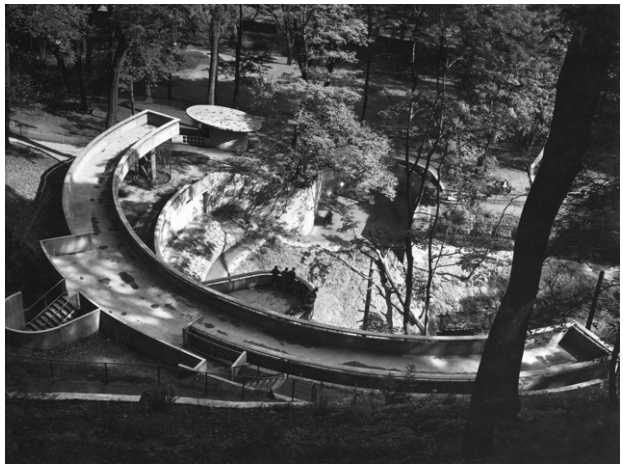


Fig 96. Image of the former Bear Ravine, Elevated view of the Bear Ravine showing the entire structure with the kiosk beyond and visitors on the cantilevered balcony, 1937

11.1.8 The Kiosk (next to Polar Bear Complex)

Listed Building Description

Fig 97. Image of the Kiosk, View of the kiosk looking in the direction of the Polar Bear Pit and Lion and Tiger Ravine, 1937

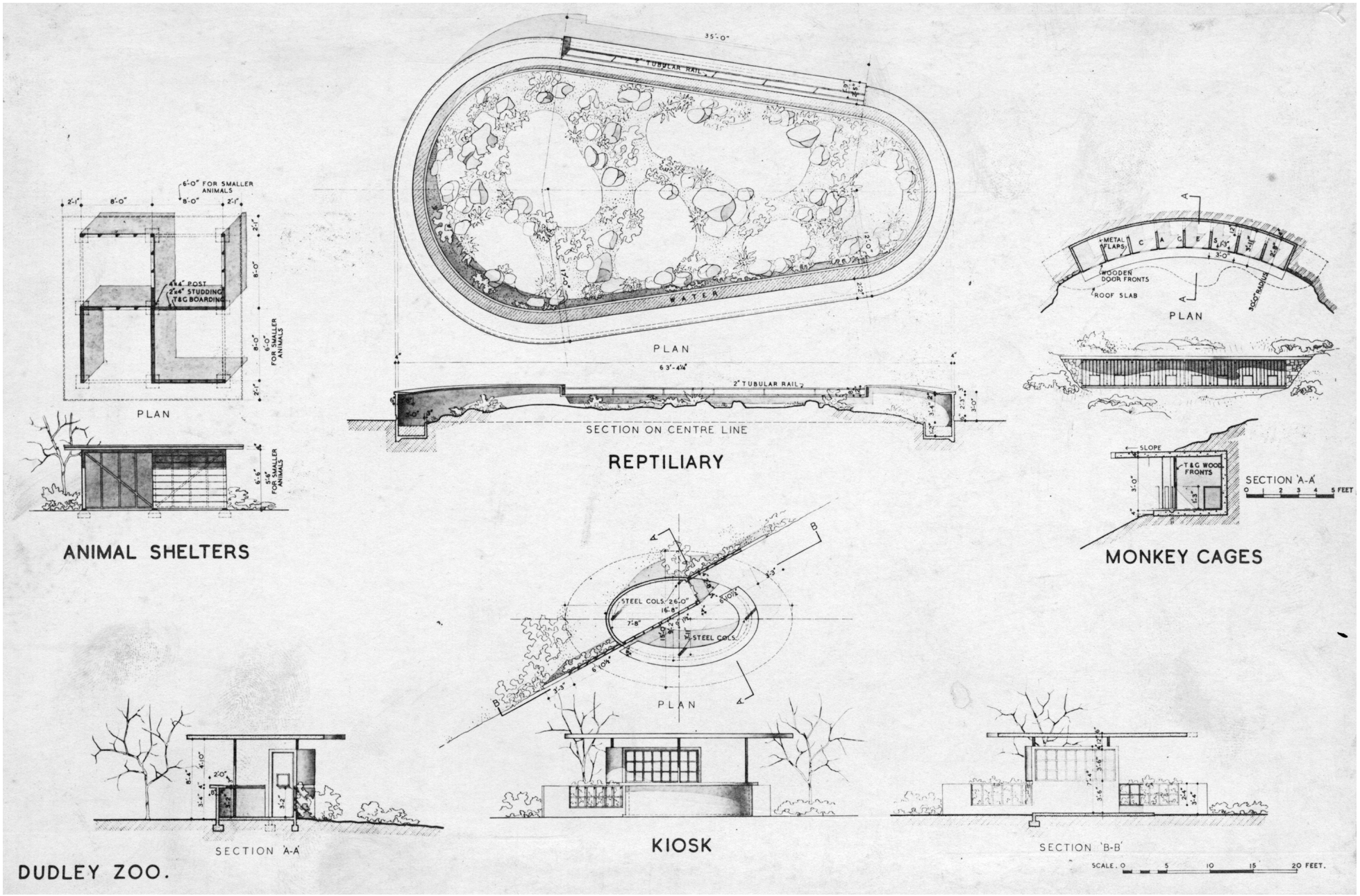
Kiosk to East of Former Brown Bear Pit AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II*
List Entry Number: 1077024
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

A kiosk for the sale of refreshments, designed by Lubetkin and Tecton, and built 1935-7.

Fig 98: Drawing of the Kiosk



Listed Building Description

Reason for Designations

The kiosk east of the former brown bear pit at Dudley Zoo, is designated at Grade II*, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building's dynamic, strongly geometric form is designed to create unity with the adjacent bear ravine, whose sinuous forms it reflects; * Group value: the kiosk demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the kiosk is designed to sit discreetly on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

Details

PLAN: The kiosk is elliptical on plan, with an open section to allow access, and a cross wall on the axis; a short, low wall extends to the north-east.

MATERIALS: Reinforced concrete, with metal columns.

EXTERIOR: The kiosk is a single storey in height, its roof raised slightly from the wall top on slender columns. The elliptical canopy roof extends well beyond the footprint of the building on all sides, providing shelter for queuing visitors. The serving area to the front has a lower wall with a wide capping for use as a counter; at the same height on the exterior of the full-height end and rear wall a depressed band continues around the building.

INTERIOR: The internal space is divided to allow display space at the rear, which is fitted with timber shelving on metal brackets; the lattice front of the display space and the access door to the north have been removed, though the openings remain unaltered.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1076024?section=official-list-entry

Original photographs & drawing shown overleaf

11.1.9 The Sea Lion Pools

Listed Building Description

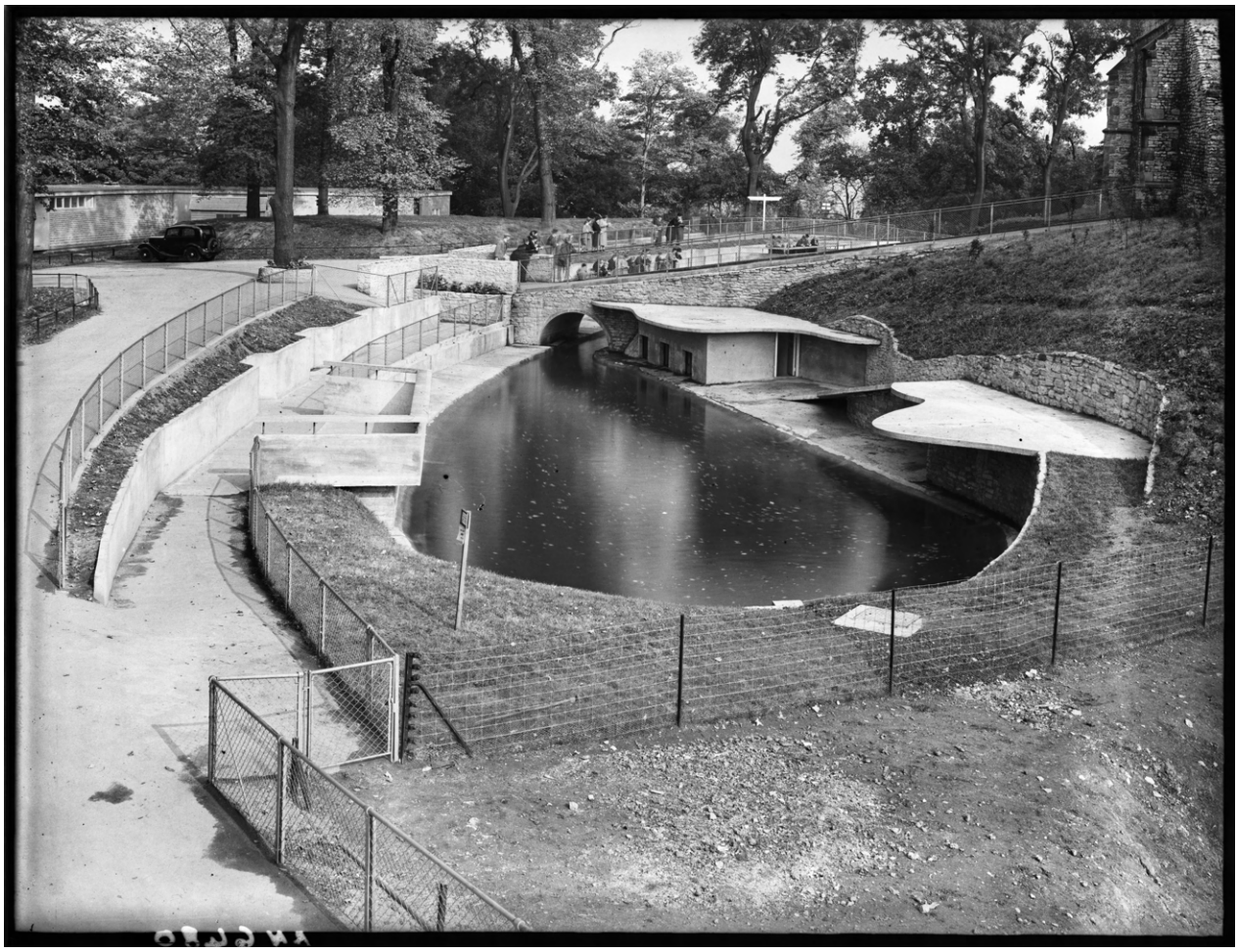


Fig 99. Image of the Sea Lion Pool, General view of the Sea Lion Pool, 1937

Sea Lion Pools AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II
List Entry Number: 1076026
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

Sea lion enclosure, including pools, ramps, sleeping areas and two viewing balconies, designed by Lubetkin and Tecton, and built 1935-7

Reason for Designations

The sea lion enclosure at Dudley Zoo, is designated at Grade II, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building's symmetrical and strongly-moulded form is designed to fit within the castle moat, whose curving forms and low profile it follows; * Group value: the enclosure demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the enclosure is designed to sit discreetly within the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

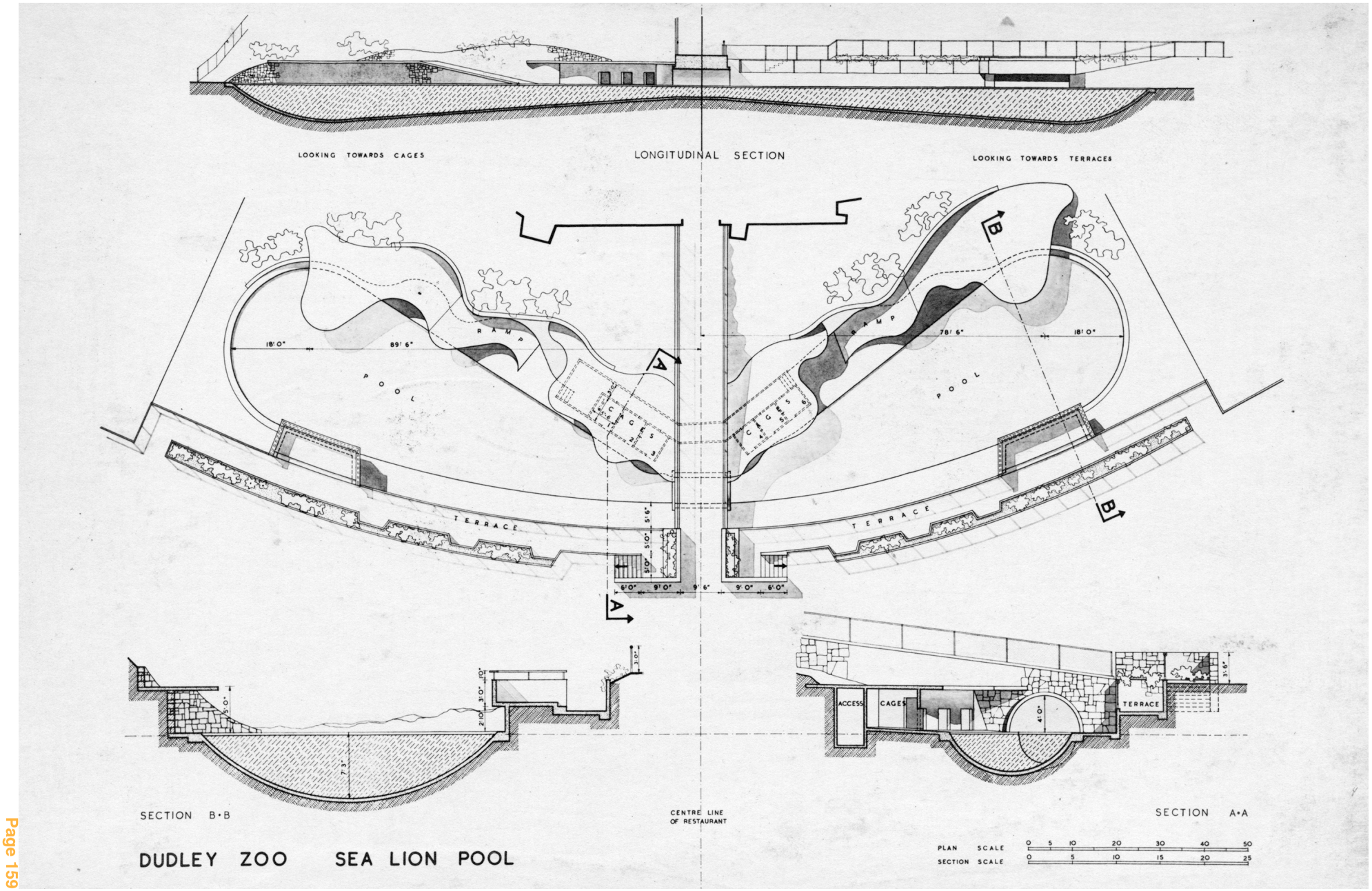


Fig 100. Drawing of the Sea Lion Pool

Listed Building Description

DETAILS

MATERIALS
Reinforced concrete, with rubble stone for the retaining walls to the rear of the enclosure and the bridge passing over the junction between the two pools.

PLAN
The pools and their ancillary structures are strongly symmetrical on plan, the whole designed to sit within the castle moat, and therefore echoing its curving shape and narrow depth. The pools are elongated teardrop shapes, running east-west from either side of a bridge giving access to the castle beyond from the restaurant immediately to the north of the enclosure; to the rear are platforms and sleeping areas, following the contours of the back of the moat.

DESCRIPTION
The enclosure consists primarily of the two curving teardrop-shaped pools, which are joined at their narrowest point; this point is bridged by a stone-built structure with a single round-arched opening, allowing access to the castle beyond.

To the north the public viewing area has two rectangular balconies which project slightly over the edge of each of the pools (now not accessible to the public, one partially removed). These had the ingenious parapet designed by Tecton for all of the larger animal enclosures at Dudley Zoo: the low wall has its coping raised on elliptical-section steel struts, giving adults a raised surface on which to lean, and allowing children to view the animals without being lifted up.
To the south, set against the retaining wall of the rear of the enclosure, behind the pools, a series of curving and projecting platforms reached by sloping ramps allows the animals space in which to rest, and built under them are simple rectangular sleeping areas, each with a series of square openings.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1076026?section=official-list-entry

Original photographs & drawing shown overleaf

Fig 101. Sea Lion Pool under construction with Lubetkin overloooking from the terrace, 1937

Fig 102. Sea Lion Pool under construction with Lubetkin overloooking from the terrace, 1937

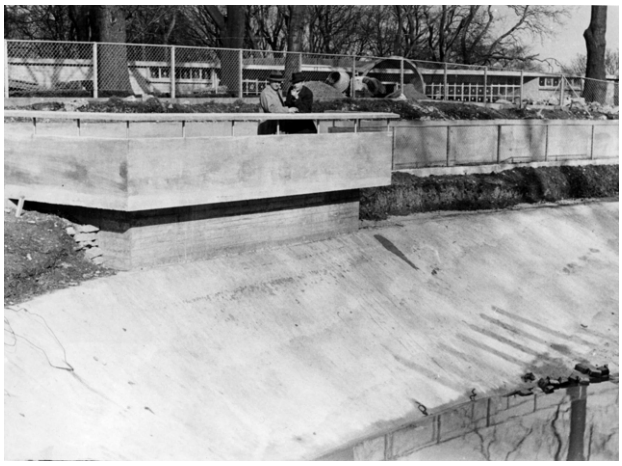


Fig 103. Sea Lion Pool under construction with Lubetkin overloooking from the terrace, 1937

11.1.10 Meerkat Enclosure former Reptilliary

Listed Building description

Fig 104. Image of the former Reptilliary, View of the Reptiliary showing visitors leaning over the concrete wall, 1937

Meerkat Enclosure AT DUDLEY ZOO, approximately 2 yards to east of Reptile House

Heritage Category: Listed Building
Grade: II
List Entry Number: 1279273
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

An enclosure originally built for reptiles, now occupied by meerkats, designed by Lubetkin and Tecton, and built 1936-7.

Reason for Designations

The former Reptiliary, now the Meerkat Enclosure, at Dudley Zoo, is designated at Grade II, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building's strongly geometric form is designed to create unity with the nearby enclosure for polar bears, tigers and lions, and the elephant house, whose curving forms it reflects; * Group value: the enclosure demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the enclosure is designed to sit on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

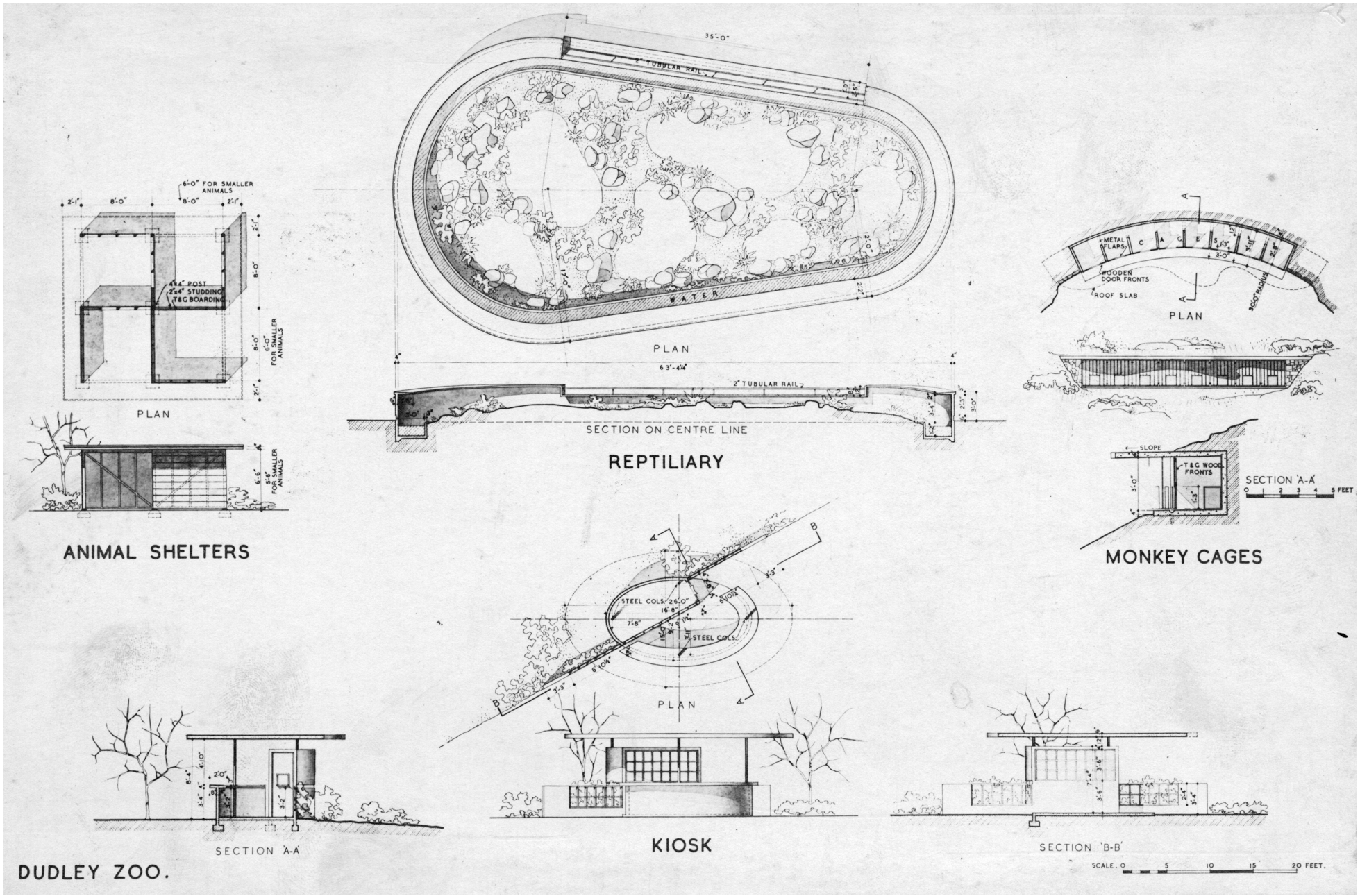


Fig 105. Drawing of the former Reptiliary

Listed Building description

Details

PLAN: The enclosure has apsidal ends, wider at the west end than the east.

MATERIALS: Reinforced concrete.

DESCRIPTION: The enclosure is bounded by a continuous low wall, with a wide coping, which dips to the north side, where a horizontal tubular metal bar is inset. The wall has visible upright reeding resulting from the use of corrugated iron shuttering, and retains its original colour and finish. The enclosure nestles snugly into the contour on which it is situated, and makes the most of its position below the castle keep, which provides it with a dramatic backdrop.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1279273?section=official-list-entry

Original drawing shown overleaf

11.1.11 Polar Bear Pit and Lion and Tiger Ravines

Listed Building Description

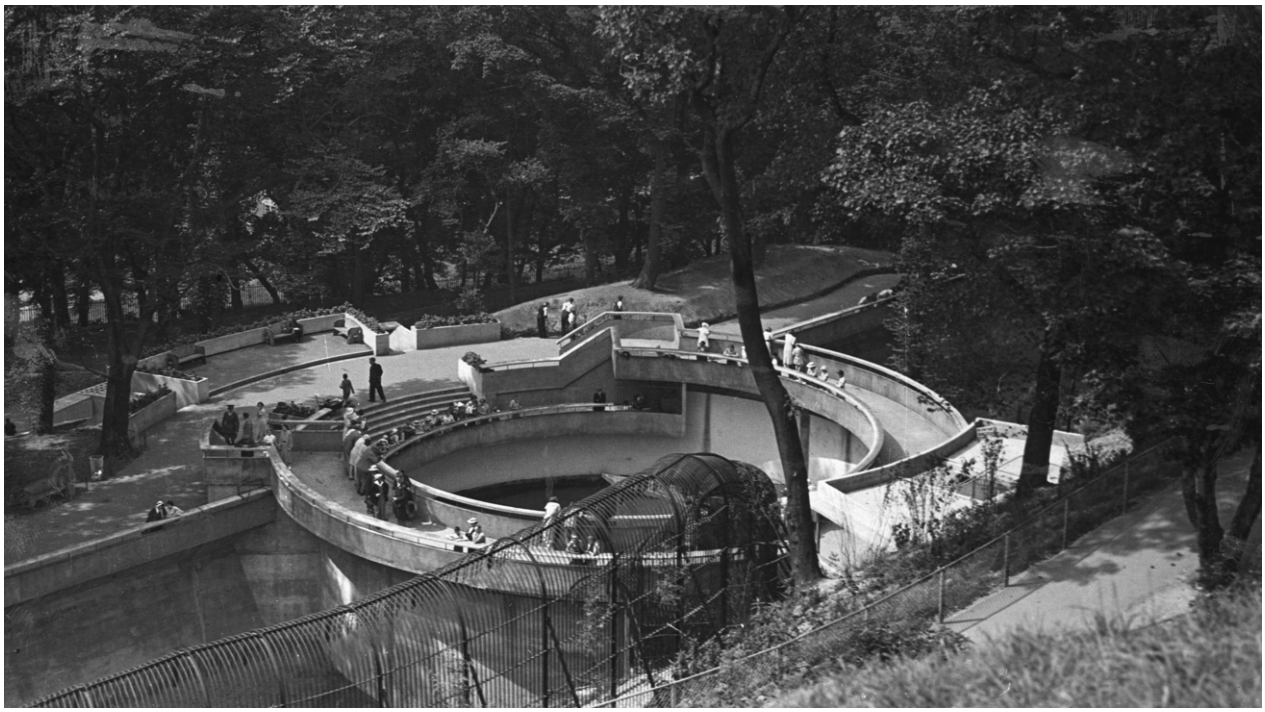


Fig 106. Image of the former Polar Bear Pit and Lion and Tiger Ravines, Elevated view of the Polar Bear Pit with visitors on the terraces, 1937

Polar Bear Pit and Lion and Tiger Ravines, Dudley Zoo

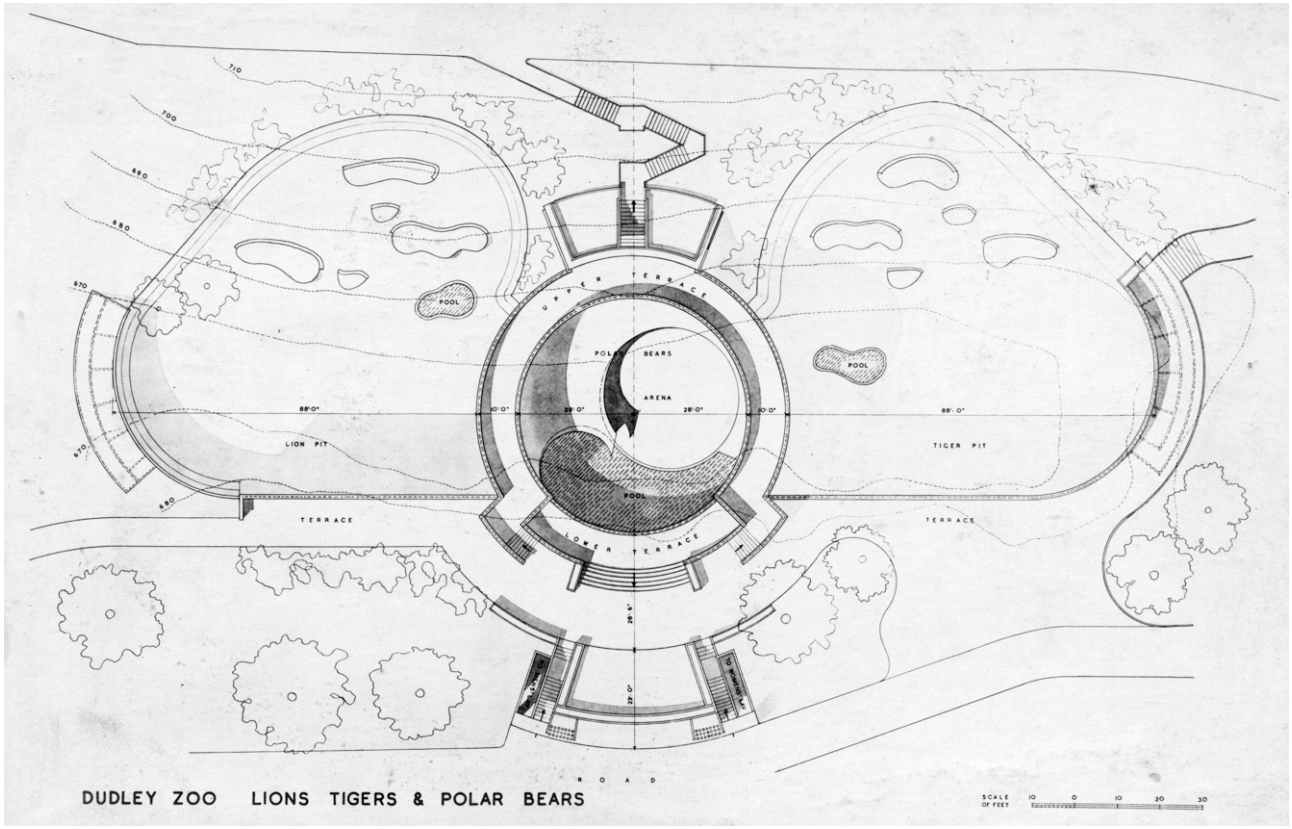
Heritage Category: Listed Building
Grade: II*
List Entry Number: 1076027
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

Summary

Former polar bear pit, and lion and tiger ravines, with associated features including viewing platforms on several levels, enclosure walls and ramps and platforms within the enclosures, designed by Lubetkin and Tecton, and built 1935-7.

Reason for Designations

The Polar Bear Pit and Big Cat Ravines at Dudley Zoo, is designated at Grade II*, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the structure is of more than special interest for it's unflinchingly geometric forms, and complex levels of viewing platforms and circulation elements which demonstrate a high degree of design and engineering interest; * Group value: the enclosures demonstrate a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the complex is designed to sit on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created; it makes full use of a natural ravine to give depth to the enclosures, and provide a dramatic contrast between the geometric structures and the rugged natural backdrop.



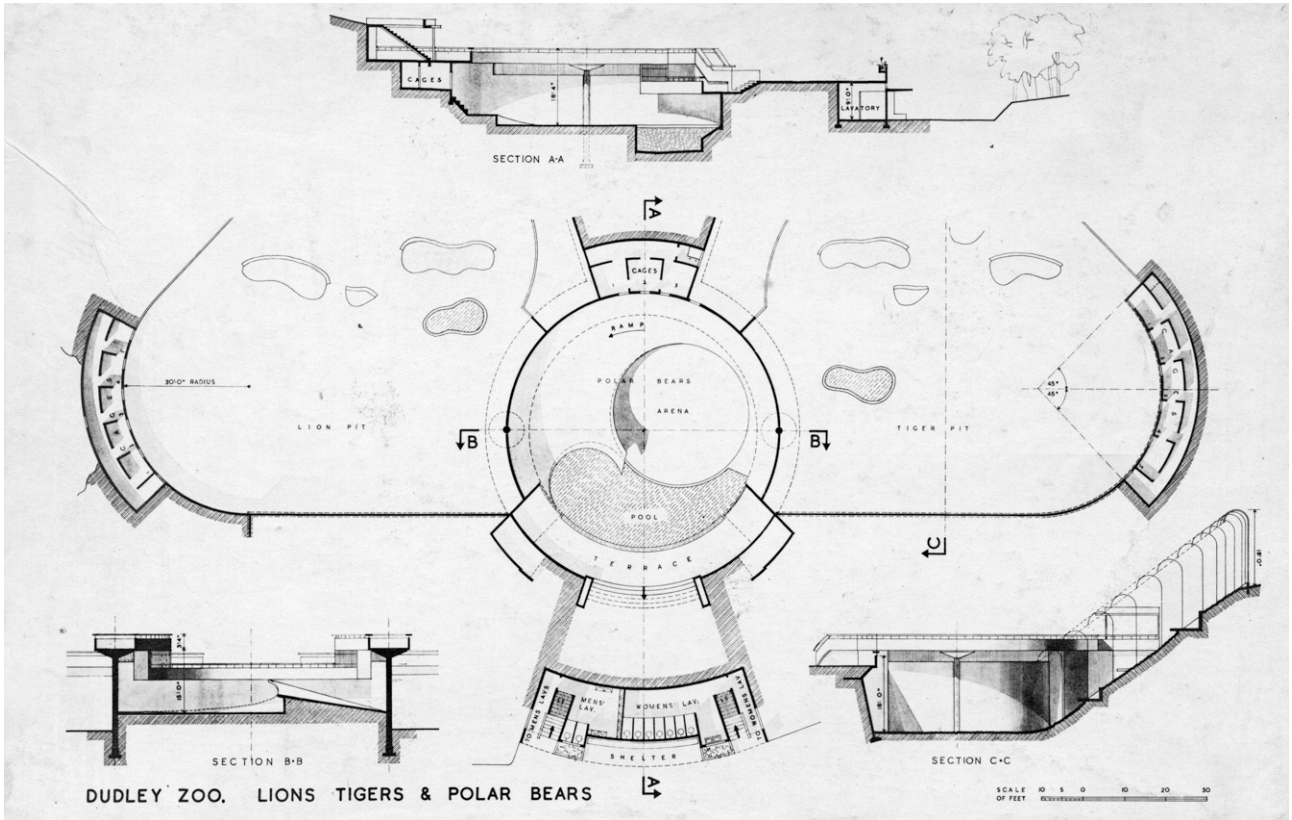


Fig 107 & 108. Drawing of the former Polar Bear Pit and Lion and Tiger Ravines, 1937

Details

PLAN: The central element, the polar bear pit, is circular on plan, with stairs, ramps and viewing terraces to opposite sides. Flanking the central pit are enclosures for lions and tigers, which follow the curve of the hillside against which they are set; above them, to either side of the western edge of the polar bear pit, a viewing terrace runs along the western edge of the whole ensemble.

MATERIALS: Reinforced concrete.

EXTERIOR: The deep polar bear enclosure at the centre is circular, and surrounded by viewing terraces.The terraces have complex variations in their levels and circulation. The zoo's standard parapet and railing - a low wall with its coping raised on elliptical-section steel struts, giving adults a raised surface on which to lean, and allowing children to view the animals without being lifted up - is here used to either side of the terraces, and as a balustrade and handrail to the staircases, which allow access to the viewing areas. The interior of the enclosure has curving geometric platforms on several levels, including an upward-sweeping projection which was intended as a diving platform; in the base of half of the pit is a pool eight feet deep.

The polar bear pit is flanked by ravines for lions on one side, and tigers on the other. A continuous terrace, with the characteristic parapet with raised coping, runs along the western side of the entire ensemble. The ravine enclosures have curved ends echoing the central, circular enclosure. There are various platforms projecting from the hillside within the ravines, together with pools and ramps. The rear retaining wall is of reinforced concrete, to match the rest of the complex.

SUBSIDIARY FEATURES: Access to a lower terrace is by steps from the western terrace, running to either side of a narrow, curving block echoing the curve of the circular enclosure, under which lavatory blocks are built. The parapet with raised coping used for all the Tecton animal houses around the zoo is here employed as a balustrade and handrail to the flanking staircases, which allow access to the viewing area on the upper level.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1076027?section=official-list-entry

Original photographs & drawing shown overleaf

Fig 109. Image of the former Polar Bear Pit and Lion and Tiger Ravines, Visitors leaning on the balustrade of the upper terrace of the Polar Bear Pit looking into the Tiger Pit. Good view of the geometry of the structure, 1937

Fig 110. Image of the former Polar Bear Pit and Lion and Tiger Ravines, Detail view of upper spectator terrace looking into the central arena, showing corrugated finish on facing concrete, the tip of the concrete iceberg and water in the pool below, 1937

Fig 111. Image of the former Polar Bear Pit and Lion and Tiger Ravines, Visitors watching polar bears from upper terrace and a . view of the concrete iceberg, 1937

Fig 112. Image of the former Polar Bear Pit and Lion and Tiger Ravines, Visitors watching polar bears from upper terrace. Shows dens recessed into the back wall and stairway connecting the exhibit to the orbital route above, 1937

11.1.12 The Kiosk (next to the Bear Ravine)

Listed Building Description

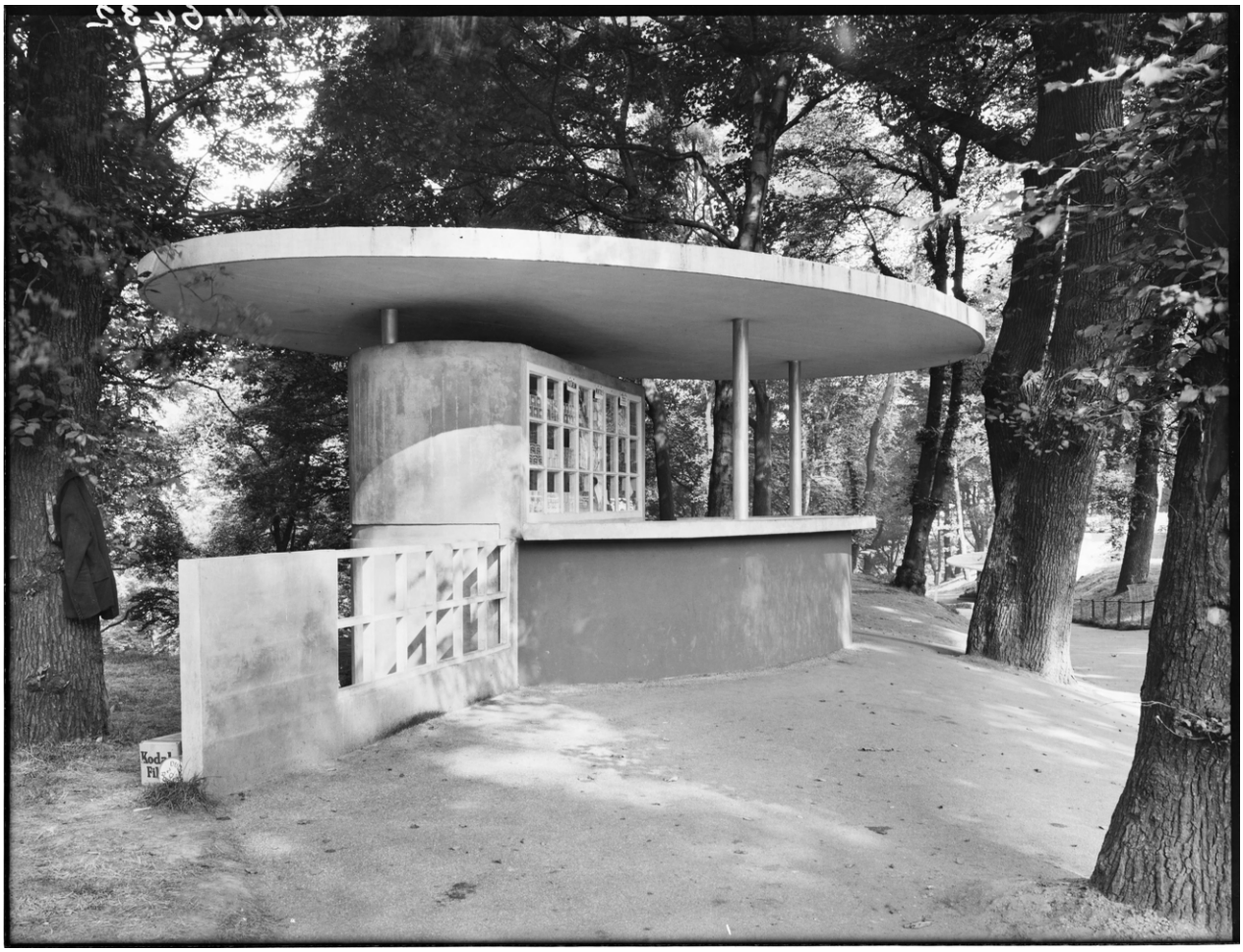


Fig 113. Image of the Kiosk, View of the kiosk looking in the direction of the Polar Bear Pit and Lion and Tiger Ravine, 1937

Kiosk to South of Bear Ravine AT DUDLEY ZOO

Heritage Category: Listed Building
Grade: II*
List Entry Number: 1227903
Date first listed: 20-Aug-1970
Date of most recent amendment: 14-Dec-2011
Statutory Address 1: 2 The Broadway, Dudley, West Midlands, DY1 4QB

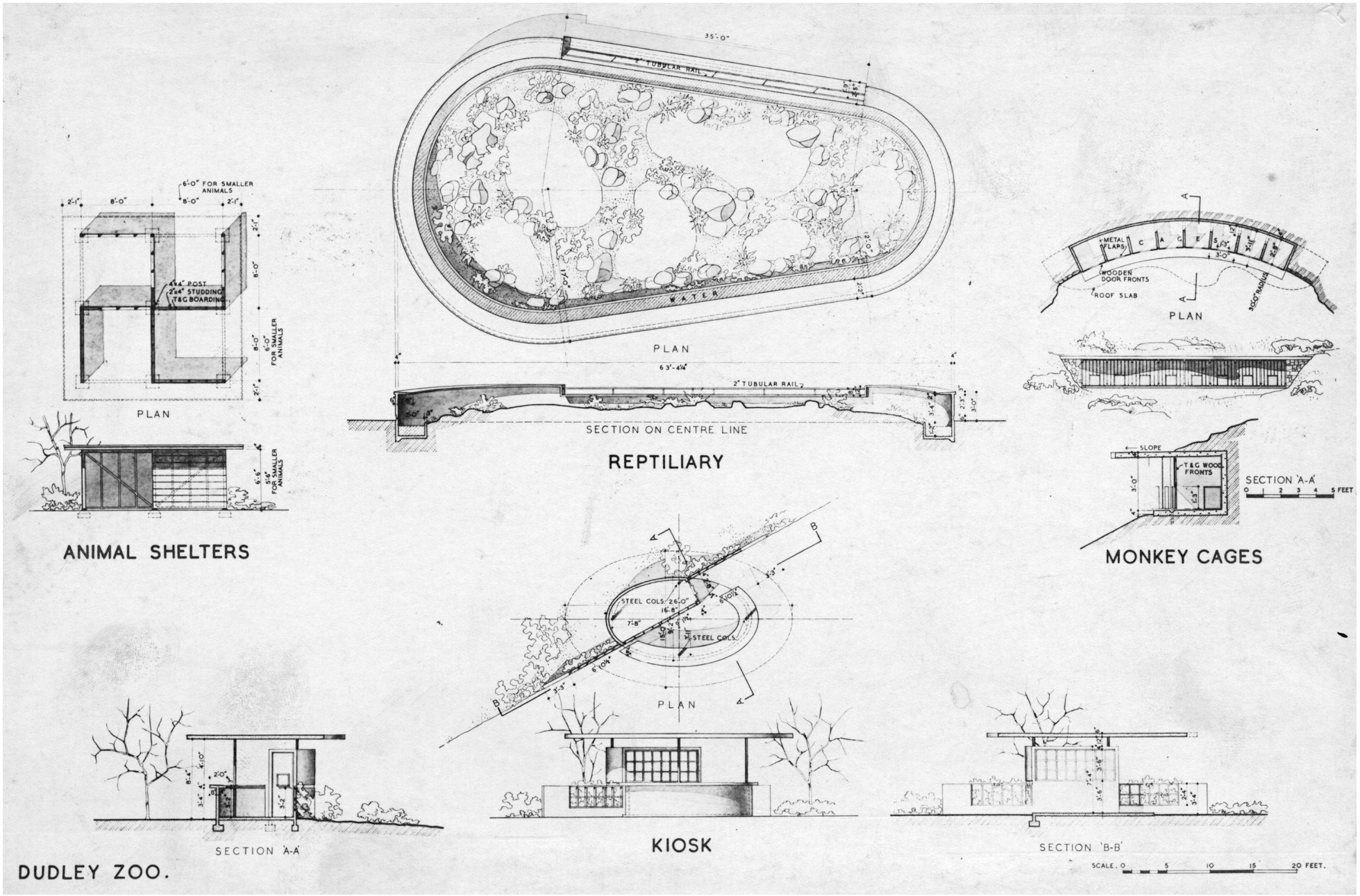
Summary

A kiosk for the sale of refreshments, designed by Lubetkin and Tecton, and built 1935-7.

Reason for Designations

The kiosk south of the former brown bear pit at Dudley Zoo, is designated at Grade II*, for the following principal reasons: * Architectural interest: the building is one of twelve surviving structures at the zoo designed by Lubetkin and Tecton, with engineering by Ove Arup, built in 1935-7; * Design interest: the building is of more than special interest for it's dynamic, strongly geometric form designed to create unity with the adjacent enclosure for polar bears, tigers and lions, whose curving forms it reflects; * Group value: the kiosk demonstrates a strong group identity through the sharing of form, scale, materials and finishing with the other purpose-built structures created by Tecton for the zoo; * Setting: the kiosk is designed to sit discreetly on the steeply-terraced slopes below the ruins of the medieval Dudley Castle, in whose grounds the zoo was created.

Fig 114. Drawing of the Kiosk



Details

MATERIALS
Reinforced concrete, with metal columns.

PLAN
The kiosk is elliptical on plan, with an open section to allow access; a short, low wall extends to the north-east.

DESCRIPTION
The kiosk is a single-storey in height, its roof raised slightly from the wall top on slender columns. The elliptical canopy roof extends well beyond the footprint of the building on all sides, providing shelter for queuing visitors. The serving area to the front has a lower wall with a wide capping for use as a counter; at the same height on the exterior of the full-height end and rear wall a depressed band continues around the building. The internal space is divided to allow display space at the rear, which is fitted with timber shelving on metal brackets; the lattice front of the display space and the access door to the north have been removed, though the openings remain unaltered.

For full official list entry please refer to: https://historicengland.org.uk/listing/the-list/list-entry/1227903?section=official-list-entry

Original photographs & drawing shown overleaf

11.2 Tecton Planning Applications

Former Bird House

Reference: P22/0734
Application Date: 2022-05-23
Proposal: Listed Building Consent for Strip Out, Repairs and Renovations to the Tropical Bird House including surrounding landscape works
Decision: -
Decision Date: -

Former Moat Cafe

Reference: P22/0743
Application Date: 2022-05-23
Proposal: Change of Use from F1(A) provision of education to E(B) sale of food and drink for consumption (mostly) on the premises, this includes elevational changes and associated works.
Decision: -
Decision Date: -

Reference: P22/0742
Application Date: 2022-05-23
Proposal: Listed Building Consent for Change of Use from F1(A) provision of education to E(B) sale of food and drink for consumption (mostly) on the premises, this includes elevational changes and associated works.
Decision: -
Decision Date: -

Queen Mary

Reference: P22/0747
Application Date: 2022-05-23
Proposal: Strip Out, Repairs and Renovations to the Queen Mary (former Castle Restaurant)
Decision: -
Decision Date: -

Reference: P22/0746
Application Date: 2022-05-23
Proposal: Listed Building Consent for Strip Out, Repairs and Renovations to the Queen Mary
Decision: -
Decision Date: -

Reference: 84/51616
Application Date: Unknown
Proposal : Retention of refreshment building.
Decision : Withdrawn
Decision Date : 1984-10-10

Elephant House

Reference: P22/0745
Application Date: 2022-05-23
Proposal: Strip Out, Repairs and Renovations to the Elephant house including surrounding landscape works
Decision: -
Decision Date: -

Reference: P22/0744
Application Date: 2022-05-23
Proposal: Listed Building Consent for Strip Out, Repairs and Renovations to the Elephant house including surrounding landscape works
Decision: -
Decision Date: -

Reference: P00/51354
Application Date: 2000-08-10
Proposal: New Elephant House and enclosure including regrading to form ha ha, removal of existing path and two trees and erection of fences.

Decision: Approved with Conditions
Decision Date: 2000-09-25

Reference: 88/51374
Application Date: 1988-06-16
Proposal: Listed building consent for the refurbishment of toilets and conversion of Elephant House store to public toilets.
Decision : Approved with Conditions
Decision Date : 1988-09-08

Reference: 88/51408
Application Date: 1988-06-23
Proposal: Refurbishment of toilet facilities.
Decision: Approved with Conditions
Decision Date: 1988-09-08

Reference: DB/72/10672/M1
Application Date: 1972-08-30
Proposal: Extension to tigers sleeping quarters & alterations to Elephant House.(Multi bound site-2 of 2 sites.
Decision: Approved with Conditions
Decision Date: 1972-11-20

Entrance

Reference: P21/0144
Application Date: 2021-01-22
Proposal: Listed building consent for installation of feature lighting to the Tecton entrance structure
Decision: Approved
Decision Date: 2021-03-30

Reference: P12/0255
Application Date: 2012-02-28
Proposal: Listed Building Consent to repair and make good four reinforced concrete structures at Dudley Zoo; Entrance Structure, Station Cafe Bear ravine and Kiosk to include reinstatement to the original design of lost historic features.
Decision: Approved with. Conditions
Decision Date: 2012-09-07

Reference: 96/50657
Application Date: 1996-05-09
Proposal: Listed Building consent for the display of a non-
Decision: Withdrawn
Decision Date: 1997-04-09

Station Cafe

Reference: P12/0255
Application Date: 2012-02-28
Proposal: Listed Building Consent to repair and make good four reinforced concrete structures at Dudley Zoo; Entrance Structure, Station Cafe Bear ravine and Kiosk to include reinstatement to the original design of lost historic features.
Decision: Approved with. Conditions
Decision Date: 2012-09-07

Reference: P10/0024
Application Date: 2010-01-11
Proposal: Change of use of former night club (OSG) to offices (B1) with elevational change
Decision: Approved with. Conditions
Decision Date: 2010-03-05

Reference: P10/0023
Application Date: 2010-01-11
Proposal: Listed Building Consent for minor alterations and additions to rear wall of Grade II Listed building ‘Station Cafe” (Safari Shop) to Facilitate use of former night club as zoo offices.
Decision: Approved with. Conditions
Decision Date: 2010-03-24

Reference: P04/1834

Application Date: 2004-09-06
Proposal: Change of use from Nightclub to Zoo Shop
Decision: Approved with. Conditions
Decision Date: 2004-11-16

Reference: 95/50975
Application Date: 1995-07-11
Proposal: Listed Building Consent for the installation of security
Decision: Approved with. Conditions
Decision Date: 1995-09-28

Bear Ravine

Reference: P19/1479
Application Date: 2019-10-16
Proposal: Listed Building Consent for erection of Bear House and Enclosure
Decision: Approved with. Conditions
Decision Date: 2020-04-07

Reference: P19/1459
Application Date: 2019-10-16
Proposal: Erection of Bear House and Enclosure
Decision: Approved with. Conditions
Decision Date: 2020-04-07

Reference: P12/0255
Application Date: 2012-02-28
Proposal: Listed Building Consent to repair and make good four reinforced concrete structures at Dudley Zoo; Entrance Structure, Station Cafe Bear ravine and Kiosk to include reinstatement to the original design of lost historic features.
Decision: Approved with. Conditions
Decision Date: 2012-09-07

Kiosk (close to Bear Ravine)

Reference: P12/0255
Application Date: 2012-02-28
Proposal: Listed Building Consent to repair and make good four reinforced concrete structures at Dudley Zoo; Entrance Structure, Station Cafe Bear ravine and Kiosk to include reinstatement to the original design of lost historic features.
Decision: Approved with. Conditions
Decision Date: 2012-09-07

Former Bird House / Bear Ravine / Kiosk / Polar Bear Pit /

Renovations were made in the 1980s by Alan Powell in conjunction with DMBC. We have enquired with DMBC however no record has been found of the renovations that were conducted.

Sea Lion Pools / Reptilliary

Renovations were undertaken on both of these structures following the Phase one works however no record has been found of the renovations that were conducted.

11.3 Berthold Lubetkin Biography

BERTHOLD LUBETKIN
Architect (1901-1990)
Designing Modern Britain - Design Museum Exhibition[1]
2006

Convinced that architecture was a tool for social progress, Russian-born BERTHOLD LUBETKIN (1901-1990) was one of the European émigrés who championed modernism in mid-20th century Britain and whose built projects include the Highpoint housing complex, London Zoo penguin pool and Finsbury Health Centre.

Looking back on his life in his seventies, Berthold Lubetkin summarised it as being "born into one world, tested in another and abandoned in a third." The first world was pre-revolutionary Russia where he grew up. The second was the birth of the modern movement in 1920s Paris and 1930s London. The third was conservative Britain after World War II in which Lubetkin, one of the country's most prolific architects in the pre-war years, did feel abandoned.

Despite the disappointments of his later years, Lubetkin accomplished a great deal when being "tested" in his second world. He arrived in London from Paris in 1931 to discover a new generation of young architects eager to experiment with the ideas of the continental modern movement. As co-founder of the radical Tecton group, he was able to design and build a succession of radical housing projects in the 1930s, from a modest terrace to the de luxe Highpoint apartment block, and to move on to intellectually ambitious public schemes from zoos to the Finsbury Health Centre. Like so many of his peers, Lubetkin's work ground to a halt during World War II and his post-war career never regained its lost momentum. He completed a number of public housing schemes, but felt increasingly frustrated by bureaucratic intervention and inadequate budgets. The final defeat came in the late 1940s when he was appointed architect-planner of the new town to be built at Peterlee in County Durham only to offer his resignation from what could have been his most exciting challenge after months of conflict.

Born in what he later described as "the back of beyond" in Tiflis, Georgia in 1901 to a liberal Jewish family, Berthold Romanovich Lubetkin spent his childhood moving around Russia as his father's business expanded with holidays spent travelling in Europe to visit relatives. Cultured as well as cosmopolitan, his parents encouraged his intellectual interests. When Lubetkin left school in 1917 on the eve of the Russian Revolution, they helped him to move to Moscow to enrol at a private art school.

Lubetkin and his art school friends were inspired by the Revolution and the "Heroic" early years of Bolshevik rule. When their art school closed, they enrolled in the SVOMAS system of free workshops, which offered free art training to everyone over the age of 16. Influenced by his teachers Rodchenko and Popova, and the work of their fellow constructivists, Tatlin and El Lissitzy, Lubetkin experimented with sculpture. Struck by the constructivist concept of the "artist engineer", who used industrial techniques to produce socially useful objects, he investigated design and architecture. For the rest of his life, Lubetkin remained devoted to the constructivist belief in technology and architecture as tools of social transformation.

By 1922, he left Russia to work as an assistant on an Exhibition of Russian Art in Berlin. Young and obscure though he was, Lubetkin was charming and resourceful. He swiftly befriended avant garde artists and writers such as Paul Klee, Thomas Mann, George Grosz and Käthe Kollwitz. He considered studying at the Bauhaus, but decided that it had little to add to his SVOMAS experience, and enrolled instead at the Berlin Textile Academy to study under the art historian Wilhelm Worringer, a specialist in carpet design. Grounding aesthetics within social history, Worringer's lectures had a lasting influence on Lubetkin. "It was an attempt to trace regularity in terms of preconceived pattern," he observed, "and, in showing systematic arrangement to pass finally from observation to vision."

Lubetkin also used his time in Berlin to study modern construction techniques, particularly reinforced concrete, which were considerably more advanced in Germany than Russia. In 1923 he moved to Poland to study architecture at Warsaw Polytechnic and in 1925 moved to Paris to complete his studies at the Ecole des Beaux-Arts. Lubetkin arrived there for the opening of L'Exposition Internationale des Arts Décoratifs et Industriels Modernes where he discovered Le Corbusier's Pavilion de L'Esprit Nouveau describing it as "cool, laconic and elegant in its self-assured intellectual simplicity".

At the Ecole des Beaux-Arts he insisted on joining the radical atelier led by Auguste Perret, the progressive architect famed for his experiments with concrete and who, ten years earlier, had taught Le Corbusier. The son of a builder, who considered construction to be as important as architecture, Perret instilled his students with intellectual rigour in the search for order and inner logic. As in Berlin, the charming, young Russian socialised with artists and intellectuals such as Fernand Léger, Jean Cocteau and Le Corbusier. Surviving on a government stipend, Lubetkin worked as a freelance translator and as a market porter at Les Halles. At one point he was reduced to selling the gold dentures he had found in a trunk in the attic of the apartment he was renting until his neighbour, the circus artist Roland Tutin, asked him to design

[1] *Berthold Lubetkin Design Museum Exhibition 2006* © Design Museum + British Council

the set for the Club Trapèze Volant, a nightclub intended for fellow circus artists but which became a fashionable haunt for the avant garde.
Club Trapèze Volant established Lubetkin as a promising young architect and in 1928 he and a student friend - Jean Ginsburg - were commissioned by the latter's father to design an apartment block at 25 Avenue de Versailles. Heavily influenced by Le Corbusier's purist villas, the nine storey building was sophisticated and assured, incorporating many of the latest construction materials and techniques in a bold version of the glacial International Style.

For the first few years after Lubetkin left Moscow he intended to return, but by the end of the 1920s he felt disinclined to live in Stalin's increasingly repressive regime. In 1931 he was offered a commission to design a house in London for the wealthy Harari family and decided to move there. Lubetkin arrived to find that the architectural establishment was largely conservative and immune to the modernist fervour that had swept across continental Europe. Traditional materials were still used for most large buildings, although reinforced concrete was becoming increasingly common in small structures such as shops, garages, factories and warehouses. Moreover a handful of academics were championing the modern movement, notably Howard Robertson at the Architectural Association, as were the young writers and photographers working for the Architectural Review magazine.

The optimistic Lubetkin was convinced that Britain's engineering and scientific heritage, egalitarian exercises like the 19th century Garden City Movement and, what he confidently expected to be the demise of the landed aristocracy, would foster the rise of modernism. His optimism was shared by other émigrés arriving in London from Europe: his fellow Russian Serge Chermayeff, Hungarian-born Ernö Goldfinger, the German-born Erich Mendelsohn and the former Bauhüsslers, Walter Gropius, László Moholy-Nagy and Marcel Breuer. They influenced young British-born architects, such as Maxwell Fry, Jane Drew, Francis Skinner and Denys Lasdun.

Less than a year after his arrival in London, Lubetkin joined forces with a group of these young architects including Skinner and Lasdun, with Godfrey Samuel and Lindsay Drake, to form a group named Tecton, an abbreviation of Architecton, the Greek word for architecture. Lubetkin's command of English was still slight, but his young collaborators were awed by his intellect and sophistication. They opened a tiny attic office and struggled to find commissions, while the Trad v. Rad debate divided British architecture, and Lubetkin made his name by writing articles and giving speeches as a rad.

The first Tecton commission was a Gorilla House at London Zoo in Regent's Park. Odd though the project may seem, the architectural possibilities were fascinating, not least as Lubetkin was able to indulge his fascination for incorporating movement into buildings by designing sliding and revolving screens, to create a controlled environment to protect the gorillas from human infection. He built the house in his favourite form, a circle, as a Corbusian machine à habiter for animals. Determined to build the circule in concrete, Lubetkin contacted the Parisian civil engineers, Christiani & Nielson, who referred him to their London representative, a brilliant young Dane, Ove Arup. Sharing Lubetkin's zest for experimentation, Arup made an inspired contribution to the Gorilla House and they began a lifelong collaboration.
Tecton also won a series of housing commissions. When Lubetkin returned to Moscow in 1934 for the First All-Union Conference of Soviet Architects, he felt so dispirited that he returned to Britain, where his prospects seemed more robust. On the voyage back he met a radical young architecture student, Margaret Church, the granddaughter of a founder of the Tate & Lyle sugar group, which whom he would fall in love and, in 1939, marry.

On the Gorilla House's completion in 1934, Tecton was commissioned to design a Penguin Pool for London Zoo. Lubetkin conceived it as a stage set with walkways for the waddling penguins in the favourite constructivist form of a double helix and a spacious pool where they could show off their speed and grace when swimming. Structurally he and Arup achieved a coup in the wafer-thin cantilevered walkways, which illustrated the sculptural qualities of concrete.
Tecton was then invited to design two zoos: the first at Whipsnade in Bedfordshire, where Lubetkin also designed a series of bungalows, including one for himself, and the second at Dudley in Warwickshire.

In 1935, Lubetkin was offered an opportunity to develop his ideas on housing on a more ambitious scale by designing a de luxe high rise apartment complex in North London, which was to define a new ideal for urban living. The complex was to offer every amenity that its wealthy modern residents required, and the brief extended to designing or specifying every element of the building, from hinges to wash basins. Highpoint One conformed to the Le Corbusian principles of housing construction, down to the pilotis which raised the first floor above the ground. Arup applied his favourite technique of monolithic and slab reinforced concrete and introduced a system of climbing shuttering, which was common in civil engineering, but hitherto unused in housing. Heating, refrigeration and as many other functional facilities as possible were designed to be communal. When a neighbouring plot of land became vacant, Tecton returned to design an adjacent block at Highpoint Two, which was even more luxurious than One. He and Margaret made their home there and furnished it with wooden sofas and low chairs made to their own design from specially imported Norwegian yew, sand-blasted pine panelling and custom-built mobiles made by the sculptor Alexander Calder.

A year after starting work on Highpoint One, Tecton was appointed to design a new Health Centre next to Sadler's Wells theatre in the Clerkenwell area of London. It was the first time that a progressive architectural group had been awarded a municipal commission in Britain and offered an important opportunity for Lubetkin to publicly use architecture as a catalyst for progress to change people's behaviour. He was determined that the design of the Health Centre would encourage the public to become healthier, from the "sunny and airy effect" of its glass brick façade, to the cheerful murals

painted on the walls by Gordon Cullen which adjured visitors to “live out of doors as much as you can” and to benefit from “fresh air night and day”.

When the centre was completed in 1938, Finsbury Council invited Tecton to devise a visionary Finsbury Plan to rebuild the borough after the demolition of its squalid 19th century slum housing. The councillors were committed to pursuing progressive solutions to the borough’s problems, but when World War II began the following year, Tecton was diverted towards a less ambitious, but sorely needed project – the design of air-raid shelters.

Architectural commissions disappeared during the war. The 39 year-old Lubetkin, who only two years before had been feted in New York at the opening of the Exhibition of Modern Architecture in England at the Museum of Modern Art, left London for a centuries-old farmhouse in the Gloucestershire countryside where he and Margaret would live until 1962. They transformed it into a working farm and, during the war, looked after a succession of hippos, chimps and other exotic animals which were evacuated from London Zoo.

After the war Finsbury Council asked Tecton to resume its work there, and the practice designed a series of public housing schemes, notably the 1943-1950 Spa Green Estate and the 1943-1957 Priory Green Estate. In both projects Lubetkin was able to apply many of the ideas developed for the luxurious Highpoint apartments to inexpensive council housing. Tecton disbanded in 1948. Having expected to be charged with rebuilding Britain after the war, the members were disillusioned by the conservative climate of post-war commissions. Lubetkin completed the estates with Francis Skinner and Douglas Bailey, even though Priory Green descended into exhausting battles with the council over its inadequate budget. More public housing commissions followed: the 1946-1954 Holford Square Housing in Finsbury; the 1946-1954 Hallfield Estate in Paddington; and the 1951-1957 Dorset Estate in Shoreditch, but none had the vigour of Highpoint or Spa Green.

Lubetkin’s great hope for his post-war career, his appointment in 1947 as the architect-planner of the new town of Peterlee for 30,000 residents on the coalfields of County Durham, ended in disaster. “It is a dream of our time,” he had written optimistically in 1948. “In the midst of national austerity, we are going to build a new town, lock, stock and barrel.” The topography was inspiring, the social need for the town compelling and Lubetkin was assured of the support of the National Coal Board, the government and the local authorities. He flung himself into the intellectual challenge of redefining the modern town, only to find his vision mired in red tape and bureaucratic opposition. In 1949, Lubetkin offered his resignation, all his work wasted.

Lubetkin exiled himself in Gloucestershire and, although he continued to develop ideas, schemes and, occasionally, built projects, he bitterly saw himself as having been “abandoned” in the third stage of his career. After his death his daughter Louise Kehoe wrote a harrowing account of the influence of his anger and disappointment on his children. Until his death in 1990, Lubetkin remained equally bitter about the state of architecture and used the speech he gave in 1982 when awarded a Gold Medal by the Royal Institute of British Architects to vent his views: “A society that openly professes that the present is expendable and the future unintelligible begets artists who have to scream to be noticed and remembered for a quarter of an hour.”

BIOGRAPHY

1901 Berthold Romanovich Lubetkin is born to a liberal Jewish family in Tiflic, the capital of Georgia.
1917 Leaving school in St Petersburg, Lubetkin goes to Moscow to enrol at art school. After the Revolution his art school closes and he joins the new Bolshevik art school system of SVOMAS free workshops.
1922 Travels to Berlin to work as an assistant on a state-sponsored Exhibition of Russian Art. Studies under Wilhelm Worringer, a scholar in the history of carpet design and aesthetics, at the Berlin Textile Academy.
1923 Moves to Warsaw for two years of architectural studies at Warsaw Polytechnic.
1925 Arrives in Paris to complete his study of architecture at the École des Beaux-Arts, where he joins Auguste Perret’s radical atelier.
1927 Commissioned by a neighbour, the circus artist Roland Tutin, to design an acrobatic set for a circus nightclub the Club Trapèze Volant.
1928 Starts work on the design of a new apartment building at 25 Avenue de Versailles with a friend, the Polish-born architect Jean Ginsburg.
1931 Moves to London with a commission to design a house for the Harari family.
1932 Co-founds Tecton as a radical architectural group with younger architects including Francis Skinner and Denys Lasdun. Tecton wins its first commission to design the 1932-1934 Gorilla House at London Zoo in Regent’s Park, which marks the start of Lubetkin’s collaboration with the Danish-born structural engineer Ove Arup.
1933 Starts work on the second London Zoo commission, the 1933-1934 Penguin Pool. Appointed as architect of the 1933-
1935 Highpoint One apartment block in Highgate, north London.
1934 Appointed as architect of the new 1934-1935 Whipsnade Zoo at Dunstable, Bedfordshire, where Lubetkin also designs a series of bungalows.

1935 Finsbury Council commissions Lubetkin and Tecton to design the 1935-1938 Finsbury Health Centre. Tecton begins two year project to design a new zoo at Dudley.
1936 Starts work on the design of the 1936-1938 Highpoint Two.
1937 Begins the design of the Busaco Housing Estate in Finsbury, which will be completed after World War II as the 1943-
1957 Priory Green Estate. Lubetkin is feted at the opening of the Exhibition of Modern Architecture in England at the Museum of Modern Art, New York.
1938 The Finsbury Health Centre opens and Lubetkin is commissioned to devise an urban plan for the reconstruction of the borough. Starts work on the construction of the Sadler Street Estate in Finsbury which, like the work on the Busaco, is disrupted by the war and then resumes as the 1943-1950 Spa Green Estate.
1939 Marries Margaret Church and, his projects suspended with the outbreak of World War II, they move to a Gloucestershire farm.
1943 Resumes work on the Sadler and Busaco housing estates in Finsbury, now the 1943-1950 Spa Green Estate and 1943-1957 Priory Green Estate.
1946 Begins the development of the 1946-1954 Holford Square Housing project in Finsbury and the 1946-1954 Hallfoield housing estate in Paddington.
1948 Appointed architect-planner of Peterlee, a new town for 30,000 residents in County Durham, only to resign the following year. Tecton disbands and Lubetkin completes his housing projects with Francis Skinner and Douglas Bailey.
1951 Starts work with Skinner and Bailey on the design of the Dorset Street Estate in Shoreditch.
1982 Awarded a Gold Medal by the Royal Institute of British Architects.
1990 Death of Berthold Lubetkin.

11.4 Ove Arup[2]

Lubetkin and Tecton

If Arup's relationship with Christiani & Nielsen provided an important bridge between his theoretical training and the reality of engineering as a business, his introduction to architect Berthold Lubetkin (1901-1990) represented his first opportunity to put his own ideas into practice. He dreamed of a more intimate relationship between architect and engineer, a focus on total design, or as he phrased it in later papers, 'total architecture', a phrase that echoes the title of influential architect Walter Gropius' 1956 book, The Scope of Total Architecture.

Born in Georgia, Lubetkin had arrived in London in 1931 after time spent in Berlin, Warsaw and Paris. In 1932 he set up the radical architectural partnership Tecton with Francis Skinner, Denys Lasdun, Godfrey Samuel and Lindsay Drake. He met Arup in 1933 when he was referred to Chistiani & Nielsen's London office after seeking advice at their Paris office in connection with the project he was working on, the Gorilla House for London Zoo.
With the political situation in central Europe becoming more and more difficult, many intellectuals were moving to London. Lubetkin was followed by such distinguished figures as Sigmund Freud, art historian Nikolaus Pevsner, architect Ernö Goldfinger and, eventually, Gropius himself.

In 1933, before he met Lubetkin, Arup joined the Architectural Association, which offered a vibrant forum for exchanging ideas about contemporary building design and an equally important source of ideas about the architect-engineer relationship. He would later give a series of short annual lectures there on reinforced concrete design.
It was through Lubetkin, however, that Arup joined MARS — Modern Architectural ReSearch — a small radical centre left group affiliated to CIAM (Congrés Internationaux d'Architecture Moderne), of which Le Corbusier and Gropius were leading figures. CIAM, whose leading members were the leaders of the Modern Movement, was engaged in a reassessment of architecture.

At this time, Arup was working on the aforementioned Labworth Café, as architect, engineer and contractor for Christiani & Nielsen. Although the design has an obvious Modernist influence, he didn't commit himself to the Modernists' strong belief in functionism, though he later acknowledged a debt to MARS. He admired Gropius' 'goal of unity' — the Bauhaus vision that brought together craftsmen, artists and architects — and Le Corbusier's enthusiasm for engineering and passion for following the 'laws of nature'.

In early 1934, Arup joined contractor J.L. Kier & Co., who were reinforced concrete specialists of Danish origin. He was made director in charge of tenders and chief designer, and was to stay until 1938. He joined Kier with the stipulation that he could develop his professional connections with the Modernists, and thus began his long association with not just Lubetkin and Tecton but a number of significant architects, including Wells Coates (1895-1958), Maxwell Fry (1899-1987) and Ernö Goldfinger (1902-1987). He would work as consulting engineer with these last three after World War II.
Arup considered Lubetkin's influence as formative, and praised him as his first real teacher of architecture. They were both perfectionists and Arup was keen to exploit his own knowledge of concrete in conjunction with Lubetkin's artistic vision and awareness of new technologies.

Arup's collaborations with Lubetkin and Tecton include such iconic London structures as the Penguin Pool at London Zoo, the apartment blocks Highpoint I (1935) and Highpoint II (1938) in Highgate, and Finsbury Health Centre (1938).
The Penguin Pool established their reputations. The interlocking spiral ramps, whose playful form took inspiration from behaviourist research and was intended to mimic the penguins' natural habitat, cantilevered off two slim columns, and appeared to soar above the pool entirely unsupported. The influence of Cubism is apparent in the shape of the ramps, the oval plan of the pool and enclosure, and its rendered screen walls. While Arup was working on it, Felix Samuely (1902-1959) was hired as his assistant, a position he held for nine months.

The two apartment blocks, Highpoint I and Highpoint II, are sited on one of the highest points in London and are considered pioneering examples of design method and construction. Here, Arup could reevaluate and move away from his earlier disappointment with the Labworth Café, using not dissimilar techniques but advancing his understanding of how best to apply his skills. It was here that he began to gain a reputation for "doing tricks with reinforced concrete".
Arup suggested the use of external loadbearing walls and floor slabs supported on spine beams, a combination that provided greater clear floor area. Of equal note is his introduction of climbing shuttering, a concrete construction technique then only in use for industrial projects. This approach to multi-storey concrete pours uses a moveable formwork system, which largely dispenses with scaffolding. At Highpoint, the shuttering was raised by jacks, three lifts per storey. The team won a prize for the shuttering and toured France with the proceeds to look at Le Corbusier's work.
In 1935 the Lubetkin-Tecton-Arup collaboration won a design competition run by the Cement Marketing Company for working-class residential flats. Their solution, in reinforced concrete using the same structural principles and construction techniques as Highpoint I, was published in National Builder.

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[2] *http://www.engineering-timelines.com/who/arup_O/arupOve5.asp*

In the summer of that year, Arup's article 'Planning in Reinforced Concrete' was published in Architectural Design and Construction. In it he proposed that concrete structures should be conceived as one unit with the joints as strong as the rest. He saw aesthetic potential in this approach — any shape could be achieved. This was a radical idea at a time when the strength of concrete walls wasn't even considered in frame calculations for reinforced concrete frame buildings. Working for Kier held Arup back to a certain extent in that he had to tender for projects rather than offer his services directly. In 1938, he left and set up independently with his cousin Arne in Broadwick Street in Soho. Mathematician and structural analyst Ronald Jenkins, who had joined Kier in 1935, followed him. Ove and Arne formed Arup & Arup Ltd as civil engineers and contractors. The company would last until 1946.

It was a sign of the coming times that some of his last work for Kier included sheds for the War Office at Purfleet and Sheerness, and reinforced concrete aircraft buildings for the Air Ministry at Kemble, Gloucestershire. Arup's vision for architect-engineer collaboration is somewhat indebted to the Modernist masters but how he put this vision into practice was to be significantly tested during the World War II.

Arup and Lubetkin continued to collaborate but their relationship occasionally became heated. They did not see eye-to-eye ideologically, which became apparent through various public shelter-related episodes. By 1946, their interest in working together was waning, though they still met regularly.

11.5 Rowan Technologies Annual Report 2016

11.6 Rowan Technologies Annual Report 2017

11.7 Rowan Technologies Annual Report 2018

11.8 Rowan Technologies Synthesis Report 2019

11.9 Rowan Technologies Annual Report 2020

11.10 Rowan Technologies Annual Report 2022

11.11 Rowan Technologies Defects Report 2022

11.12 Architectural Historic Paint Research and Analysis Report - Phase One

11.13 Architectural Historic Paint Research and Analysis Report - Phase Two

11.14 Getty Conservation Institute Concrete Research

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