Skerries Lighthouse
NPRN 41287
Recording of Fresnel Lens and Pedestal

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Acknowledgements

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1. Introduction

Lighthouses are often seen as symbols of stability. Immovable objects that stand, often in steadfast isolation, against the power of the wind, weather and sea ranged against them. Their ability to prevail should not however, be confused with an inability to change. The lighthouses we are familiar with around our coasts today, often date from the 19th century, but are themselves often replacements for earlier structures. Those most recent iterations have in turn been altered, extended and renovated to reflect fashion, function and architectural trends. The way they have been operated has changed from rock-bound lighthouse keepers to remote controlled automation. Their lighting, that most critical of technological functions for a lighthouse, has transitioned from coal, to oil, to electric (see also Schiffer, 2005), with concurrent alterations to power sources along the way. Even the ownership of our lighthouses has shifted from individual to institutional.

Lighthouses are pieces of maritime technology in a state of ongoing development in all their facets, forms and functions. But such development happens at a pace that is perhaps well suited to structures that are rooted so firmly to the ground. Individual aspects can be retained for decades at a time between refits and refurbishments. As such, while it is simple to demonstrate the change that in individual lighthouse, or piece of lighthouse technology, exhibits, we should also be aware of the considerable continuity that can exist within and between such instances of change.

Standing on a rocky set of islets 1.6 nautical miles off Carmel Head on the north coast of Anglesey (Figure 1.1), the Skerries Lighthouse (Figure 1.2) was first illuminated in 1717. Like many of its counterparts around the UK, it has been remodelled and extended over time, and is now operated automatically. At the heart of the Skerries Lighthouse is the first-order Fresnel Lens, named after Augustin Fresnel (1788-1827) and manufactured by Chance Brothers of Smethwick, installed in about 1904, and revolving on a bath of mercury, which in turn stands within a cast-iron mounting pedestal (Figure 1.3). Now, after 120 years of operation, this lens is due for replacement with an LED array. As noted above, continuity of operation gives way to technological change, in this case a further step in the process of electrification begun when the last oil lamp was removed in 1927.

Documentation of the Fresnel Lens and pedestal in-situ, prior to removal of the lens is a key part of the management, from a heritage perspective of the project to replace the lens. The Skerries Lighthouse is listed as a Grade II* building, and while the Fresnel Lens and pedestal are not original features of the lighthouse, the iconic status of such a lens means that it carries a high level of significance within the overall context of the Skerries Lighthouse, and forms part of the statutory listing of the site. Accordingly, Cadw requested the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) to undertake the recording of the Skerries lens and pedestal prior to its removal. This in turn builds on a tradition of recording the lighthouses of Wales by the RCAHMW (e.g. Hague, 1994).

This work was conducted with the assistance of the Trinity House team in July 2024 and this report forms part of the resulting record. Following this introduction, Section 2 outlines the methodology undertaken to document and understand the lens and pedestal through reference to original plans held within the Trinity House archive, a conventional photographic and measured survey, and documentation via a photogrammetric survey. A summary history and development of the Skerries Lighthouse is provided in Section 3 to better contextualise the lens and pedestal within the overall lighthouse facility. Section 4 then addresses the outgoing lens and pedestal directly, providing a written description, photographic record and updated plans and sections. Observable changes and differences between the installation of the lens/table in 1904 and its disposition at the time of survey in July 2024 are also addressed. A final brief section offers a series of recommendations for furthering our understanding of the Skerries lens, potential for public display, and observations on undertaking similar work in the future.

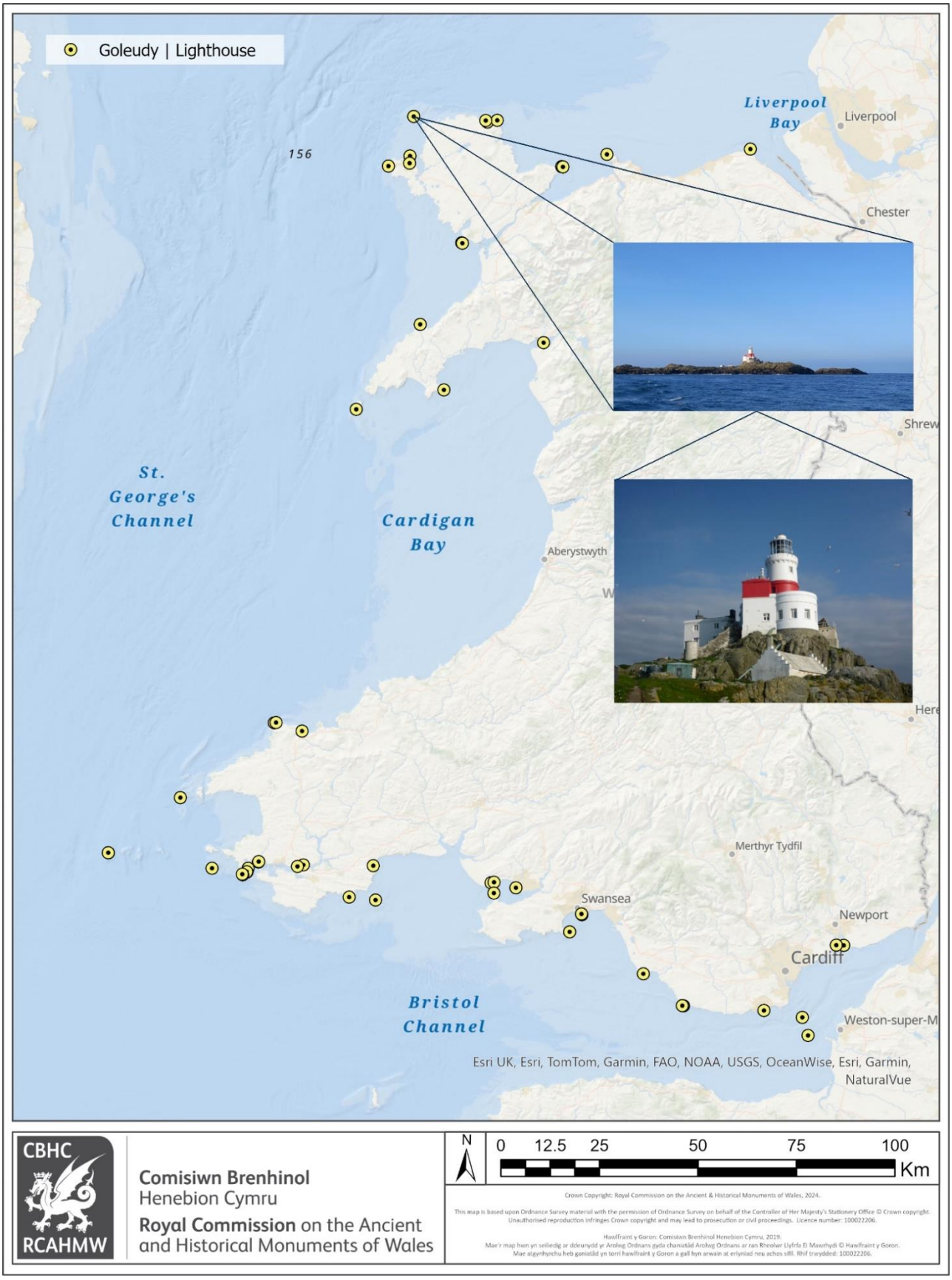

Figure 1.1: Location of the Skerries Lighthouse within Wales, alongside lighthouses listed within the National Monuments Record of Wales (© Crown Copyright: RCAHMW).

Figure 1.2: General view of the Skerries Lighthouse on the 16th July 2024 (© Crown Copyright: RCAHMW).

Figure 1.3. The first order Fresnel Lens and pedestal within the lantern room of the Skerries Lighthouse, on the 16th July 2024 (© Crown Copyright: RCAHMW).

2. Methodology

2.1 Introduction

The primary objective of the recording work around the lens and pedestal was to produce a record of those two objects in their present condition and disposition, prior to the removal of the lens in the current phase of work by Trinity House within the Skerries Lighthouse. It is important to note that although the pedestal is not being removed, its installation at the same time as the lens dictates that it is beneficial to record them both now. This work had three main parts to it, each of which is described in more detail in the following sections, but which entailed:

1. Historical Research (Section 2.2)
2. Photographic and Video Recording (Section 2.3)
3. Photogrammetric Survey and 3D modelling (Section 2.4)

The purpose of the historical research was to reach a position where the chronology of the lens and pedestal was fully set out, including its original disposition within the lantern room. This report also includes a wider section, based on historical research, summarising the overall development of the Skerries Lighthouse to better place the current phase of work, and structural changes within the lantern room, within the wider sweep of construction, rebuilding, adaptation, replacement, removal, etc. that has taken place since 1717.

The primary record of the lens and pedestal was intended to be formed from photographic and drawn record of both structures, within the lantern room. Such a record should allow a permanent visual record of the key features of both lens and pedestal, including alterations to them since their installation.

Finally, it was decided to undertake an experimental photogrammetry survey of the lens and pedestal within the lantern room. The purpose of this was to augment the photographic record through the generation of a 3D digital record of any parts of the lens and pedestal that were successfully modelled. This method also had potential to aid subsequent production of the drawn record, especially in the context of a limited amount of time on site. The work was also intended to test the feasibility of this method with a view to other Welsh lighthouses scheduled for similar work in the future.

Site access is not straightforward, with a requirement to be undertaken at the same time as a Trinity House visit, and also subject to weather conditions to allow access by boat from Holyhead. Work also had to be timetabled to fit within wider RCAHMW staff availability. Further restrictions arose from the need for the lens to continue turning during daylight hours, when the lamp is off, to prevent the sun's rays becoming focused through the lens on the inside of the lantern room. Stopping the rotation to keep the lens in a single position for photographic recording was only possible for a few hours.

2.2 Historical Research

Undertaking historical research had two main elements for the purpose of the recording work. The first was to arrive at a better chronological understanding of the development of the entire Skerries Lighthouse complex. In doing this, the lens and pedestal could be better placed within the wider chronology of the lighthouse. Only by doing this, is it possible to fully understand the transient nature, albeit over a period of 100 years, of aspects of the lighthouse such as the lens and pedestal.

Two main sources were used for this work. Firstly, a series of drawings held by Trinity House relating to the lantern room, lantern room floor, lens, and pedestal created between 1843 and 1924 (Trinity House Archive, Drawing No. 1785; 8420; 8457; 10304), and further written documentation for the period to 1987 were supplied by Trinity House. These were highly informative in unpicking some existing inaccuracies regarding

the chronology of installation reported in the National Monuments Record of Wales (NMRW), and the Cadw listing for the site. Moreover, the engineering context in which the drawings were created included details of the lens and pedestal at the time of installation that were not otherwise available, and which could provide a baseline against which to account for subsequent alteration and adaptation.

The second source was material held within the NMRW resulting from former RCAHMW investigator Douglas Hague's work on the lighthouses of Wales (see NMRW 6437166; Hague, 1994). This included photographs from Hague's own site visits to the Skerries, interpretative plans of the lighthouse building, and a written account of the history of the lighthouse. The results of the Historical Research are contained in Section 3 and have resulted in a major update to the NMRW record for the Skerries Lighthouse (NPRN 41287).

2.3 Photographic and Video Recording

The photographic recording was intended to provide a conventional photographic record of the lens and pedestal at the time of survey. Such a record can allow subsequent understanding of the structures of the lens and pedestal in a visual way to augment any written or drawn record. This was augmented by a video recording of the lens rotating at the level of the focal plane of the lens. This recorded the movement and sound of the lens rotating within the lantern room during daylight when the lens was fully visible. Trinity House have undertaken recording of the sweep of the loom from the lens at dusk with a UAV to document the movement of the light from a close-range external viewpoint.

Photographic recording of archaeological sites, monuments and upstanding buildings are a traditional form of recording, and one that is undertaken by RCAHMW staff on a regular basis. However, the features of the lens and pedestal and their setting within the lantern room resulted in a very specific set of physical constraints within which the survey was undertaken. The first of these is the combined height of the lens and pedestal, which is not readily apparent when reviewing images of the structure, or indeed, without close reference to the scale of archive drawings. The top of the pedestal stands 1.77m above the floor of the lantern room, the widest part of the lens at its focal point is 3m above the floor, and the top of the lens is 4.47m above the floor of the lantern room. Access around the structure is limited by the confines of the lantern room itself to about 1m from the windows of the lantern to the top of the pedestal or the focal point of the lens. The direct consequence of this is to place severe limits on what could be captured by a conventional camera in a single image, even when equipped with a wide-angle lens normally used during a building survey. This was further exacerbated by the requirements to get the camera some 4m high into the upper areas of the lantern room to record the upper parts of the lens. In expectation of this problem, a DJI Action2 Camera was chosen that has been successfully used by the RCAHMW for intertidal surveys due to its portability, 155° field of view, photo/video (full HD) recording function, and ability to easily mount on a telescopic pole for accessing the upper areas of the lens. The additional flexibility that this camera afforded for wider views of the lens and pedestal, alongside a conventional DSLR, is illustrated in Figure 2.1 below.

The final photographic and video record resulting from the survey contained 24 still images and a single 30 second high-definition video. These have been archived within the NMRW (DS2024_126) and can be viewed via the *Coflein* (the online catalogue of the NMRW) portal page for the Skerries Lighthouse.

Detailed measurements were taken of the pedestal and as much of the lens that could be accessed, to contribute to the production of a drawn record of the disposition of the lens and pedestal at the time of recording in July 2024. These measurements were augmented by data collected via the photogrammetry survey, and cross-referenced against the existing drawings of the lens and pedestal held within the Trinity House archive.

Figure 2.1: Two images of the same view of the Skerries Fresnel Lens. Left: Conventional wide-angle lens at maximum field of view. Right: 155° field of view afforded by a DJI Action2 camera (© Crown Copyright: RCAHMW).

2.4 Photogrammetric Recording

The potential limitations of photographic/video recording within the lantern room (above) identified during survey planning made undertaking a photogrammetry survey of the lens and pedestal an attractive option for augmenting the photographic and video record. Scaled 3D model and orthomosaic outputs from such a survey had the potential to be able to overcome some of the limitations imposed by the physical constraints of the lantern room, and also provide another method to convey the nature and character of the lens and pedestal within the resulting survey archive. Such a survey could also be undertaken relatively quickly, which fitted within the requirements of a single day on site to coincide with a Trinity House visit, and the need to have the lens stationary for the least amount of time.

From the outset, the photogrammetry survey was intended to be an experimental one to assess its usefulness as a method to augment the more conventional photographic survey. In particular, the pedestal was considered to have good potential to be captured with a photogrammetry survey in a more meaningful, and indeed measurable, manner, than a photographic survey. The lens itself is comprised of two main materials. First a metal framework formed of thin strips, 10-30mm wide, screwed together to make the overall form of the lens. The framework forms 26 areas on each of the three faces of the lens within which the Fresnel lens and prisms are situated. In planning the survey, it was hoped that the metal framework might model well enough to allow the overall form of the lens to be perceived in a useful way. By contrast, the glass element of the lens has a physical character of being simultaneously reflective and transparent. The focal properties of the lens also mean that the outward appearance of the surface of each glass element was different with even the smallest alteration in recording position, as the view *through* the lens constantly changed. Photogrammetry works best when the surface appears the same from different angles, hence water surfaces – a common feature of intertidal archaeological sites - are often a problem because they often appear slightly different in each individual image. Taking this into account meant that the glass elements of the lens were identified during the planning as being unlikely to produce a satisfactory record of that part of the structure.

Laser-scanning was considered as another means to record the lens and pedestal, but for the same reasons as described above, it was thought unlikely to produce a better record of the glass elements. It also had additional complexities in getting the scanner to the required height to record the top-half of the lens, within the confines of the lantern room.

In assessing the potential effectiveness of photogrammetry and laser scanning, consideration was also given to the feasibility of coating the lens with a spray that would mitigate the problems caused by reflection and

transparency. Such a coating would, in theory, disappear naturally within a few hours, but the need for the lens to be fully operational meant that the potential risk to navigation of such a coating not disappearing far outweighed any potential gain. Problems of access to apply a coating to the upper parts of the lens also precluded this approach.

Reference to the images within this report soon conveys the identical nature of the construction of the lens on all three of its sides. Likewise, the pedestal is repeatedly uniform all the way around, with the exception of the circuit board that has been added in one place. The lantern room itself is also a uniform structure apart from the access steps in one area, and a door to the surrounding balcony in another. To improve the effectiveness of the photogrammetry survey, a series of reference targets (circular, dual-ring, 12-bit) were placed on the lantern room floor, to the upper-most vertical face of the pedestal, and to the inside of the windows (Figure 2.2). The use of such targets is normal practice and allows for better alignment of the images during processing. Measurements between targets allow for the resulting 3D model to be scaled. A series of conventional scales were placed on the walkway around the sides of the pedestal to act as additional reference points and to check the scaling of the model during processing.

Figure 2.2. Photogrammetry targets used to aid image alignment. Left: Example target. Centre: Target in-situ on pedestal and lantern window. Right: Orthomosaic plan of targets and scales on the lantern room floor (© Crown Copyright: RCAHMW).

The survey was undertaken using the same DJI Action2 Camera, mounted on a telescopic pole that was used for parts of the photographic and video survey. This resulted in a dataset of 489 images spaced around the lens and pedestal from the upper areas of the lens to underneath the pedestal (Figure 2.3). The survey was processed using *Reality Capture* (Version 1.4) which resulted in 450 of 489 images being successfully aligned (Figure 2.4). Not achieving alignment of all the images was expected given the difficulties of both collecting some of the images and the nature of the subject matter (above). The 489 images of the photogrammetry survey provide an additional photographic record of the lens and pedestal to augment the process described in 2.2 above and capture the lens and pedestal from every angle.

The aligned images were then processed on the highest quality setting available within *Reality Capture* to produce a scaled high-density point-cloud. As suspected during the survey planning process, the modelling of the lens frame and pedestal both produced a useful output that was used in the subsequent reporting (Section 4). By contrast, the glass elements of the lens were largely incoherent, and not useful for subsequent reporting. They do however remain within the outputted point cloud as they provide some visual context and depth to the other elements.

The raw data in the form of the survey photographs, accompanied by metadata relating to the targets, were archived within the NMRW (ref. PGS2024_018) along with the scaled point-cloud. A copy of the archived

material was shared with Trinity House, and a modelled, lower resolution version of the point-cloud was uploaded to the RCAHMW pages of the Sketchfab Portal to further facilitate public consumption of the survey results (https://skfb.ly/ppJPC).

Figure 2.3. Selection of 70 of the 489 images from the photogrammetry survey to illustrate the distribution of images around the lens and pedestal, and the comprehensive nature of the resulting photographic record (© Crown Copyright: RCAHMW).

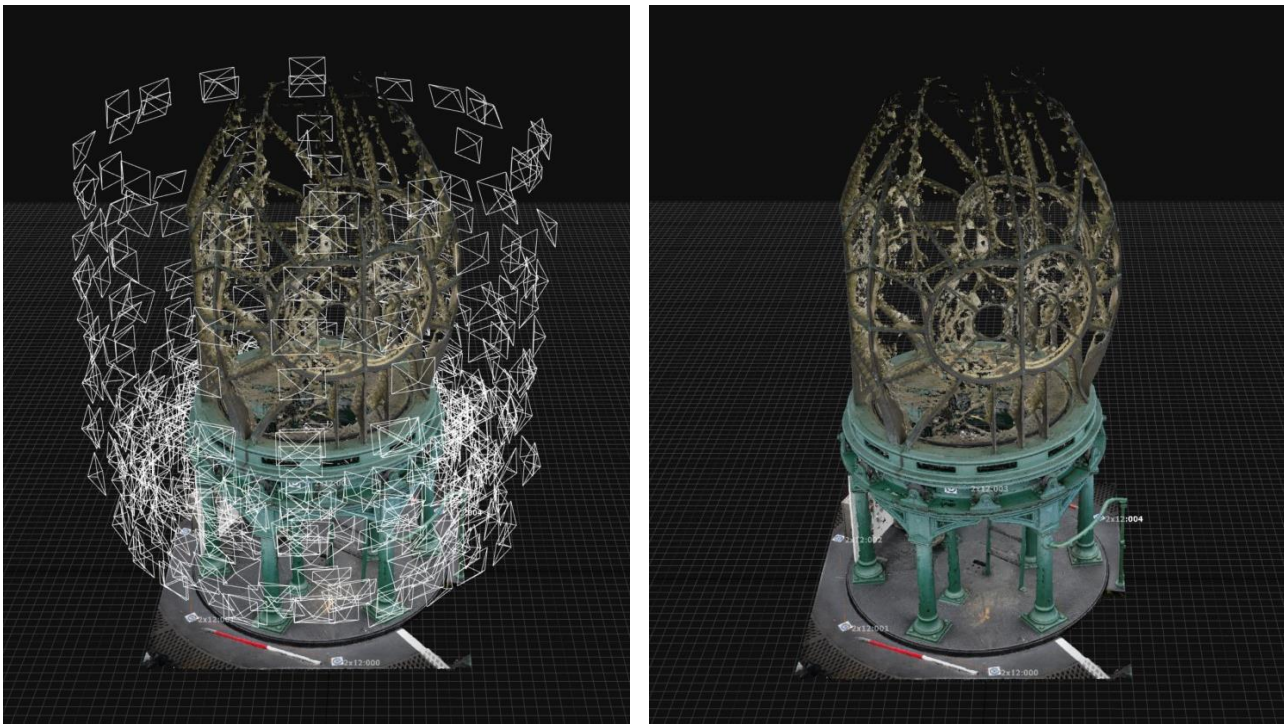

Figure 2.4. Left: Distribution of aligned images, shown as rectangles, taken during the photogrammetry survey. Right: Point-cloud derived from photogrammetry survey of the lens and pedestal (© Crown Copyright: RCAHMW).

3. Skerries Lighthouse: History and Development

3.1 Introduction

To fully understand the lens and pedestal the wider chronological development of the structures, fixtures and fittings must be considered (Table 3.1). This allows the lens and pedestal to be properly placed within the overall sequence of development of the lighthouse on the one hand, and also allows an appreciation of the fact that although iconic in their own right, particular when considered together, they are part of a technological trajectory that is much longer and of wider scope than just the lens and pedestal.

The Skerries Lighthouse formed part of the research into Welsh Lighthouses undertaken by the RCAHMW and in particular by Douglas Hague (see Hague, 1994), whose survey work at the Skerries included the production in 1971 of a sectional drawing of the tower illustrating some of the various phases of construction and alteration (Figure 3.1).

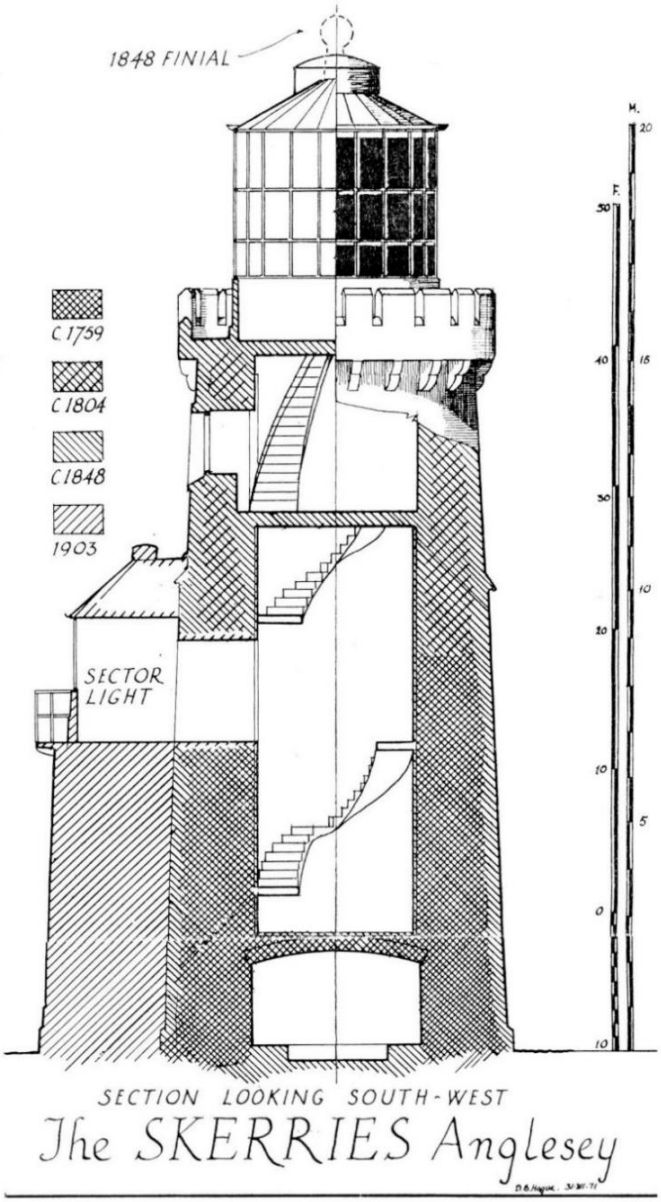

Figure 3.1. Cross-sectional interpretation of the building phases of the Skerries Lighthouse produced by Douglas Hague in 1971 and published in 1994 (© Crown Copyright: RCAHMW).

Table 3.1: Chronological Development of the Skerries Lighthouse, Sources: Hague, 1994; Trinity House, 2024.

Year	Event
1658	First proposals for a lighthouse on the Skerries by Henry Mascard.
1717	First lighthouse opened by William Trench.
1759/60	Possible partial rebuilding.
1804	Replacement of coal brazier with oil lamps.
1841	Skerries lighthouse purchased by Trinity House.
1852	Completion of rebuilding by Trinity House into current form, under James Walker, including
	Replacement of 1804 Lantern
	Replacement of 1804 Lens
	Replacement of 1804 Lamp
1875	Fog Syren building added.
	Oil Store building constructed.
1876	6-wick burner added to lamp.
1903/4	**Replacement of 1852 lens with 1st order Fresnel Lens, mercury bath and pedestal** (the focus of this report and related recording work).
	Strengthening of lantern room floor.
	Low light/sector light tower constructed.
1927	Electrification of lighthouse station.
	Replacement of 1903/4 lamp.
	Fog Syren building extended.
	Wireless room tower constructed.
	Lantern roof remodelled.
	Circulating water tanks added.
1964/5	Replacement of 1927 lamp.
1970	Installation of electric drive for lens rotation.
1986	Engine room in fog signal house converted to living accommodation
1987	Full automation of Skerries Lighthouse.
	Replacement of 1964/5 lamp.
	Removal of clockwork rotating mechanism.
2004	Solarisation of Skerries Lighthouse
	Replacement of 1987 lamp
	Alteration of rotation to a 15-second period

3.2 Origins

The concept of a lighthouse on the Skerries can be traced to at least the 1658 and a proposal by Henry Mascard, which was opposed by Trinity House. In 1714 William Trench was granted a patent by Queen Anne to build a light, which was first lit on 4th November 1717 (Trinity House, 2024: 1.2) with a coal brazier. Trench died in 1725 and his son-in-law, Sutton Morgan, took over the lighthouse. An Act of Parliament in 1730 allowed Morgan to increase the shipping dues and confirmed the patent for the light to Morgan's heirs. The lighthouse was rebuilt in c. 1759/60 in the form of a limestone tower 8.5m in height (Hague, 1994: 51), retaining the coal brazier at the top. Further alteration ensued in 1804 by Morgan Jones who had inherited the light in 1778. Jones raised the tower a further 6.7m to about 15m in height, introduced an oil lamp in place of the coal brazier, and surrounded the light with an iron balcony and lantern glazed with square panes.

3.3 The 19th century

Trinity House purchased the Skerries Lighthouse in 1841 for £444,984 (Trinity House 2024: 1.3). At this point the lighthouse was extensively redeveloped by lighthouse engineer James Walker. This work, completed in 1852, included building the adjoined keepers' accommodation and extending the lighthouse tower itself into its current 23m high form. This work included replacing the 1804 lantern with a new lantern and roof topped by a ball finial. The form of this is detailed in Drawing No. 1785, signed off by James Walker in 1843 (Figure

3.2). Hague (1994: 50), dates the finial (Figure 3.1) to 1848, while a notation on the drawing, dated to 1844, records the details of the lens and its manufacture by “Wilkins”, along with “Capt. Nisbet’s Pressure Lamp”. A further annotation, dated 1876, records the fitting of a 6-wick burner and ventilation tube. The lens pedestal is not included in any detail in the 1843 drawing. However, a series of support brackets are shown extending from the lower walls of the lantern room towards the centre to afford support to the pedestal. Following completion of the rebuilding of the lighthouse in 1852 further structural work saw the addition of a new fog siren building, and the construction of a detached oil store in 1875 (Trinity House, 2024: 1.4).

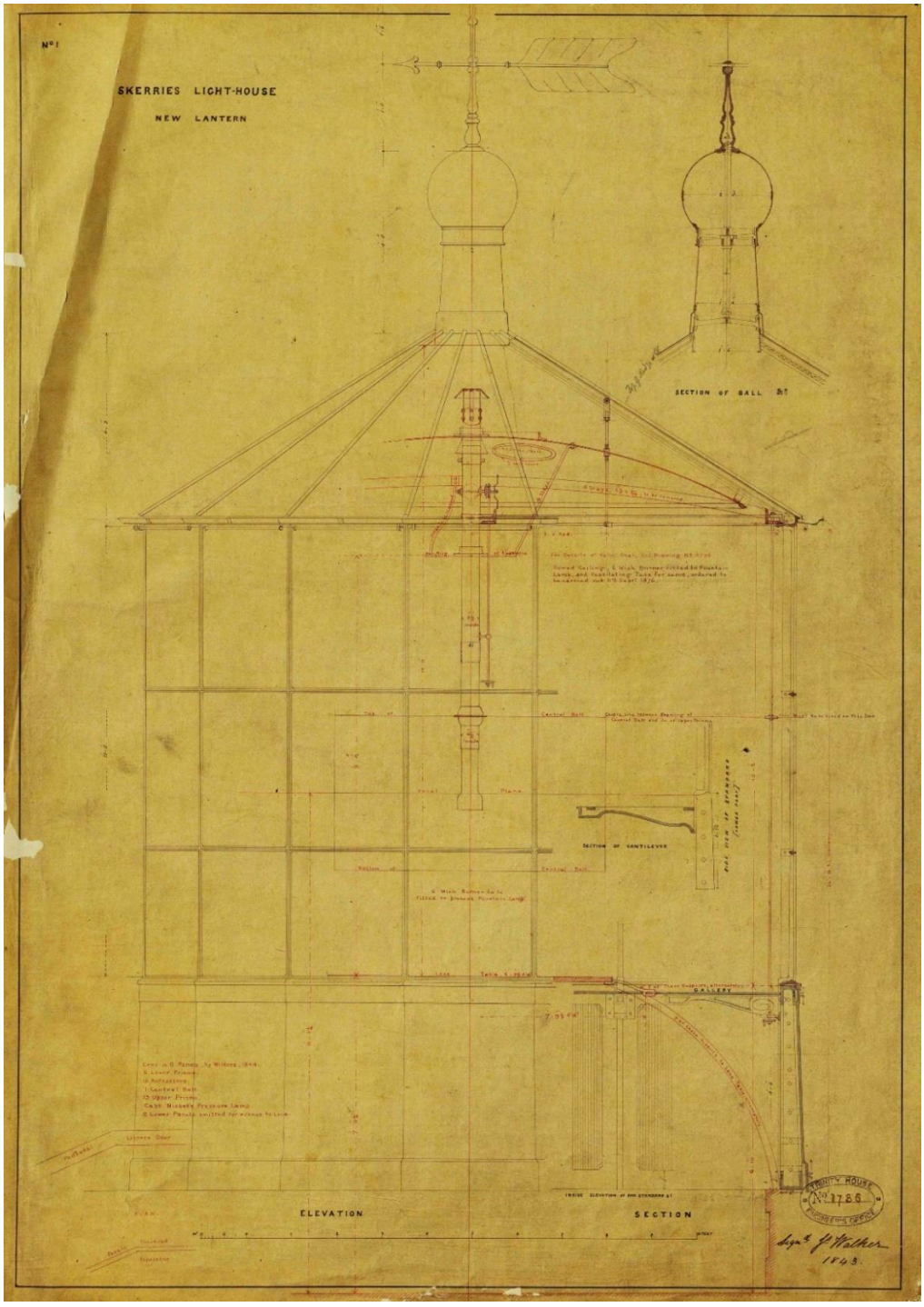

Figure 3.2: Drawing, dated to 1843, for a new lantern room at the Skerries Lighthouse (image courtesy of Trinity House Archive. Drawing No. 1785).

3.4 The 20th and 21st Century

The light itself was subject to a major overhaul at the beginning of the 20th century with the replacement of the 1852 lens with a 1st-order catadioptric Fresnel Lens, which was mounted on a cast iron pedestal that contained the mercury bath upon which the lens floated to ensure its smooth, clockwork powered rotation. This was designed to give a double flash, every ten seconds. The lens and pedestal are detailed in an engineering drawing, No. 8420, signed off in September 1903 (Figure 3.3). The freestanding nature of the new pedestal meant that the lateral supports struts shown in the 1843 drawing (Figure 3.2) were no longer required and can be assumed to have been removed with the installation of the new lens and pedestal. The magnitude of this work also required strengthening of the lantern room floor, itself detailed in drawing No. 8457 which was signed off in December 1903 (Figure 3.4). Finally, a low light/sector light was constructed in the form of a small tower adjoining the main tower. The installation of the lens and pedestal is normally assigned to approximately 1903 (e.g. Trinity House, 2024), although the sign-off of the drawing for the strengthening of the lantern room floor in December 1903 suggests that the work took place in 1904.

A further phase of work took place in 1927 when the Skerries Lighthouse underwent electrification and further extension. This included the construction of a new fog signal and wireless room tower, and a set of circulating water tanks in association with the new engine required for the electrification (Trinity House, 2024: 1.4). The process of shifting to electrical power dictated that the oil lamp from the 1903/4 installation was replaced with an electric one. At about this time, or maybe slightly beforehand, further alterations were made to the ventilation system within the roof of the lantern, most notably, the replacement of the 1848 finial with a cupula (see also Figure 3.1). The work to the roof is detailed in an engineering drawing, No. 10304, dated to March 1924 (Figure 3.5) and which includes the lamp, lens and pedestal. The clockwork mechanism is not shown in the drawing although it is thought to have remained in place until 1987 (Jim Veall, personal communication).

Further alterations to the lighthouse took place in the second half of the 20th century. The 1927 lamp was replaced in 1964/5 with an incandescent filament lamp and associated lamp changer (Trinity House Drawing No. 65/85). The clockwork rotation mechanism was superseded by an electric drive motor in 1970, although Trinity House documentation indicates that it was retained for emergency use until the 1980s (Jim Veall, personal communication). Modifications to the arrangement of accommodation ensued in 1986, followed by the full automation of the lighthouse in 1987. That work entailed the removal of the clockwork rotation mechanism, and the replacement of the 1964/5 lamp with a mercury vapour discharge lamp (Jim Veall, personal communication). A solar power source was installed in 2004 when the current lamp was installed as a replacement for the 1987 lamp. Improvements in bulb technology have allowed the removal of the vertical air-extract shafts that are visible in both the 1843 and 1924 drawings of the lantern ventilation systems. The 2004 work also entailed the slowing down of the rotation of the lens, changing the characteristics of the light to a double flash every 15 seconds, rather than 10 seconds (Notice to Mariners, 2004). The entire complex was given statutory protection as a Grade II* Listed Building (Cadw No. 18028) in March 1996, with an amendment to the listing in November 2000.

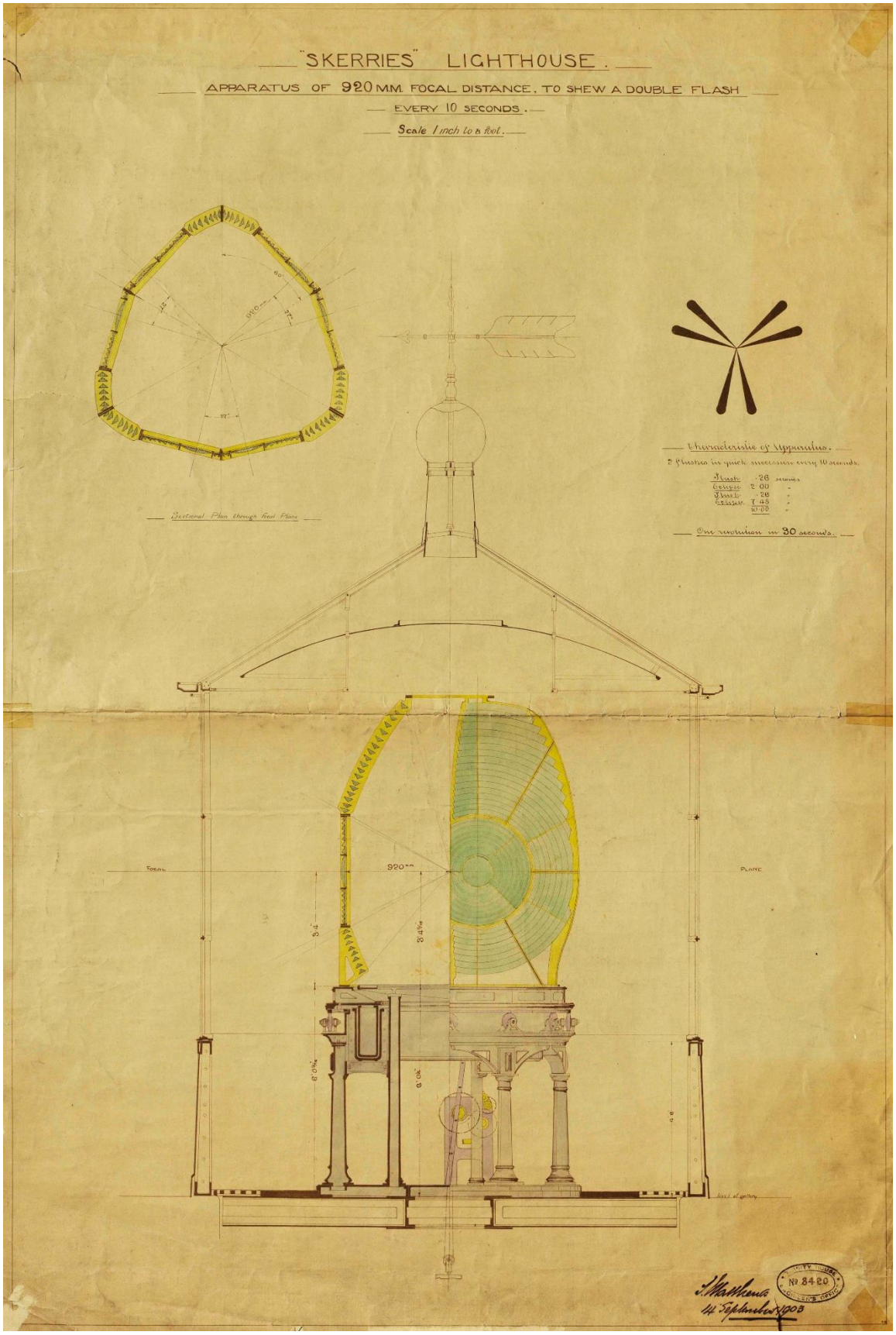

Figure 3.3: Drawing, dated to September 1903, for a new lens and pedestal for the Skerries Lighthouse (image courtesy of Trinity House Archive. Drawing No. 8420).

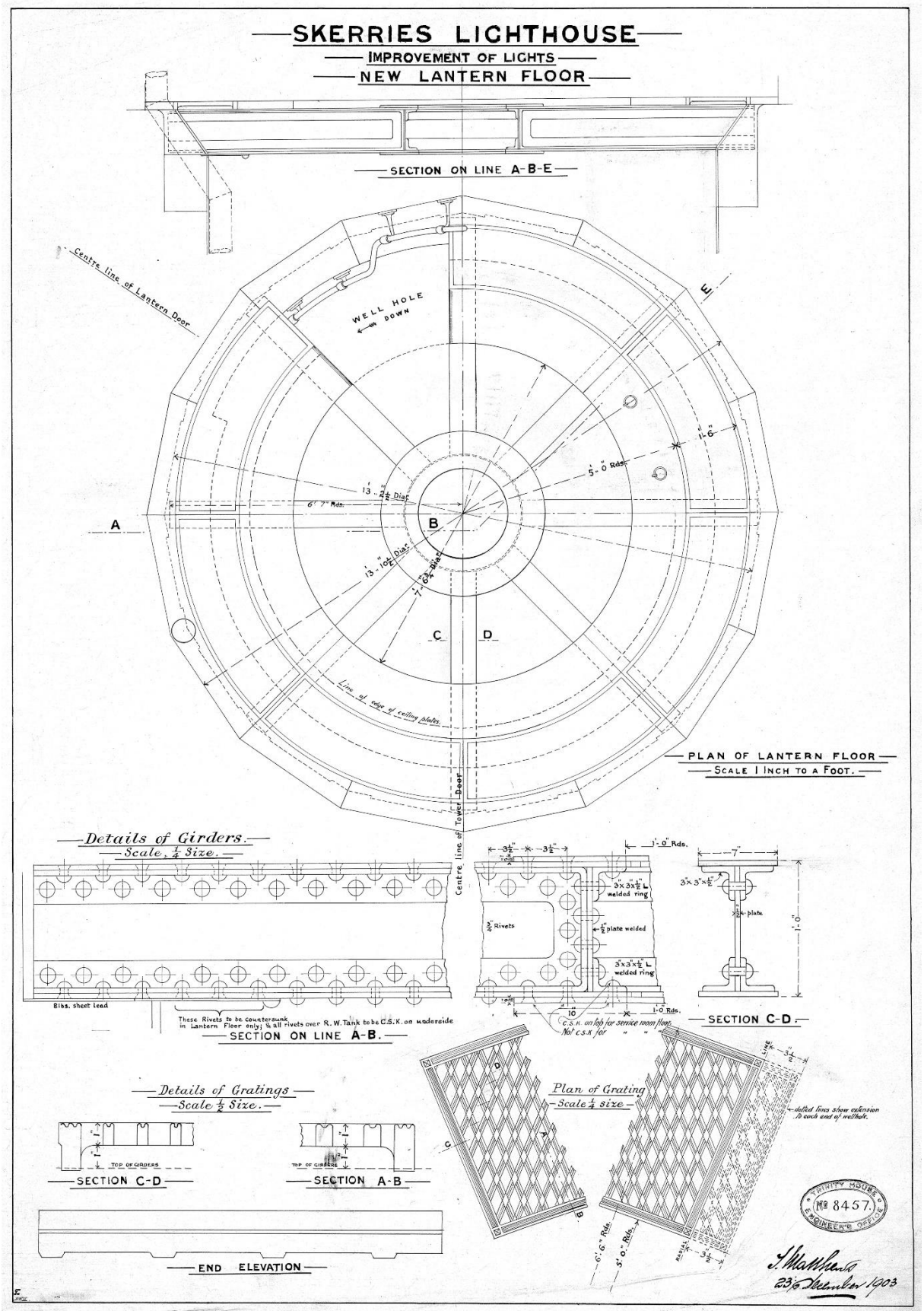

Figure 3.4: Drawing, dated to December 1903, for improvements to the lantern room floor, associated with the installation of a new lens and pedestal (image courtesy of Trinity House Archive. Drawing No. 8457).

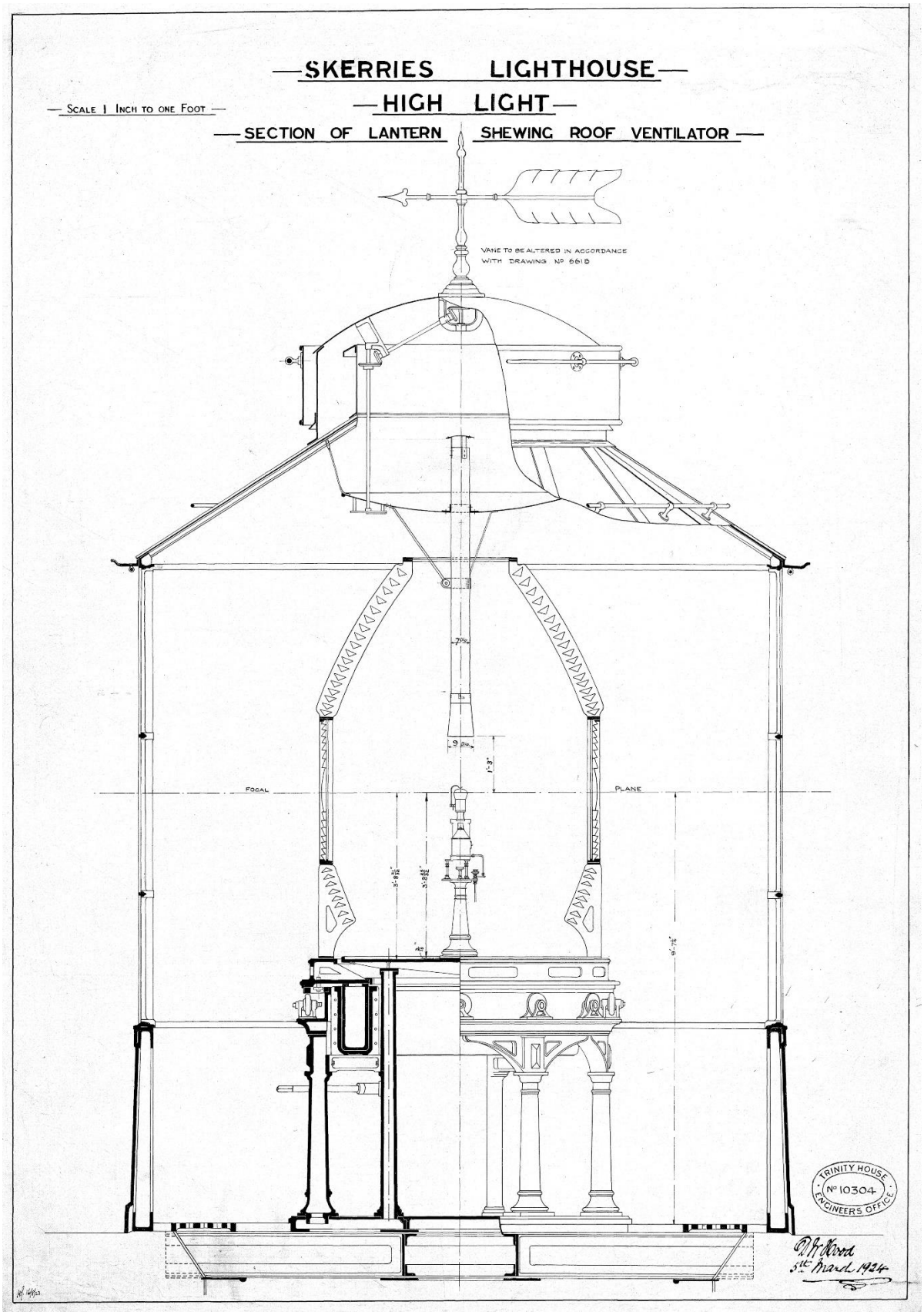

Figure 3.5: Drawing, dated to March 1924, for improvements to the lantern room ventilation and roof (image courtesy of Trinity House Archive. Drawing No. 10304).

3.5 Conclusion: Historical Summary

It is clear, even from the summary chronology presented above, that the Skerries Lighthouse has witnessed continual development and remodelling of its structures, fixtures and fittings since it was first lit in 1717. At the same time, long periods of continuity, both in technological systems, and the physical form of those systems, can also be identified between the various phases of rebuilding and refitting. As such, defining the Skerries Lighthouse by a single phase of development across a 300-year period is to dismiss the other phases as less important, or indeed not important. Acknowledging the ongoing cycles of continuity and change is therefore a key part of understanding the lighthouse, both at the level of the overall building, and of the elements within it, such as the lens and pedestal.

Put another way, when seen in the context of the entire chronology of the Skerries Lighthouse, it is remarkable that the lens and pedestal installed in 1903/4 has not been replaced earlier. The work to remove the lens 2024/5, after c. 120 years of use should perhaps be seen as an inevitable part of the ongoing process of maintaining the navigational effectiveness of the lighthouse. Despite this, the remarkable, and indeed iconic, nature of such lenses dictates the need to afford them a detailed record of their physical form at the time of removal. The following section seeks to present this, based on the recording work undertaken in the Lantern Room by the RCAHMW in July 2024.

4. Fresnel Lens and Table

4.1 Introduction

This section undertakes the complex task of providing a detailed account of the lens and pedestal via a written description, photographs, and drawn record (Figure 4.1, Appendix 1). The purpose of this is to provide a record of the lens and pedestal in its in-situ state, prior to the lens replacement. For ease of comprehension the description moves from bottom to top, starting with the floor plinth and pedestal, and moving onto the lens. The surrounding lantern room, including the roof, are not included as they were outside the scope of the recording work.

Overall, the pedestal (Section 4.2) is 1.77m high and 2.29m in maximum diameter. The lens (Section 4.3) is 2.7m tall, making an overall structure that is 4.47m in height and with a maximum width of 2.29m.

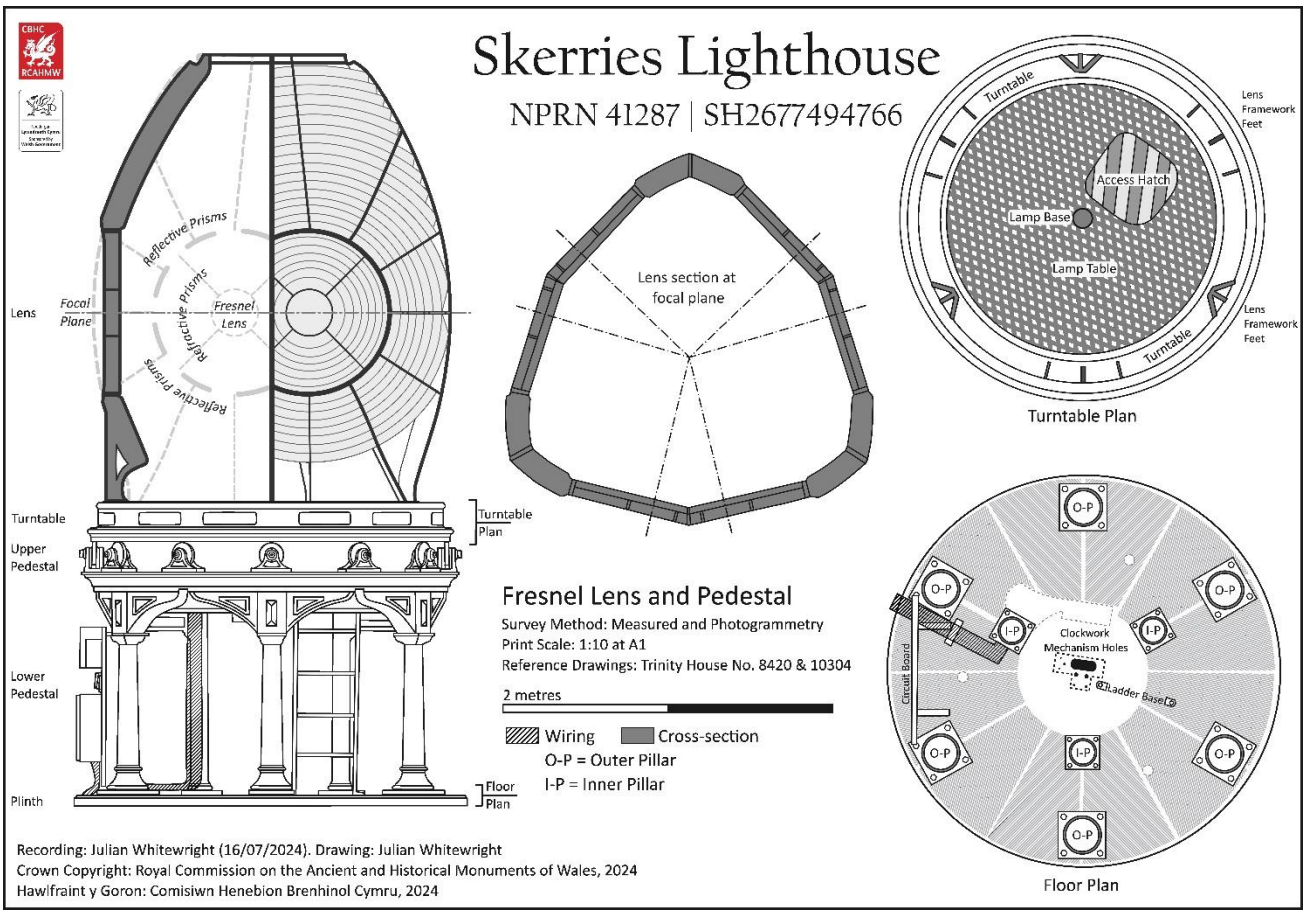

Figure 4.1: Skerries lens and pedestal as recorded in July 2024 (© Crown Copyright: RCAHMW).

4.2 Pedestal

For the purposes of this written description, the pedestal is divided into the plinth that it stands on within the centre of the lantern room, and the pillars and brackets that form the lower pedestal. The upper pedestal comprises the main part containing the mercury bath and rotation supports, upon which sits the turntable itself, and the separate non-rotating lamp-table. The plinth (Figure 4.2) itself was installed in 1903/4 as part of the strengthening of the lantern room floor and is 2.38m in diameter and 60mm in height, with a bevelled edge. Holes and markings in the centre of the plinth indicate the location of the clockwork mechanism that was removed in the 1987 automation process (Figure 4.2). The pedestal legs comprise six outer-pillars and

three inner-pillars. The outer-pillars have a 290mm square base (Figure 4.3), and a cylindrical main body, 880mm in height, that tapers in diameter from 250mm at its base to 107mm at its top. The legs are hollow, with a wall thickness of c. 13mm (Jim Veall, Personal Communication). A string-moulding is situated towards the bottom of the pillar body, as shown on the 1903 and 1924 drawings. A second string-moulding shown towards the top of the pillars on the 1903 and 1924 drawings is absent, assumed not to have been included when the pedestal was made. The pillar capitals are 184mm square with a double-step, and topped with a rectangular moulding, 260mm high x 184mm wide. A bracket extends from the sides of the moulding and is 400mm along its horizontal arm (Figure 4.4).

The three inner-pillars largely mirror the form of the outer-pillars, although they lack the lower string-moulding and the square capitals are truncated and only present on the outward facing half of the pillar (Figure 4.5). Their bases are 214mm square and the main column is 922mm high to the bottom of the truncated capital. The inner-pillars then continue upwards to support the underside of the lamp-table. In the very centre of the plinth is a set of holes that would have originally allowed the passage of the clockwork rotation mechanism from the floor below. A six rung iron ladder, 420mm wide and offset to one side allows access through the lens pedestal to the inside of the lens.

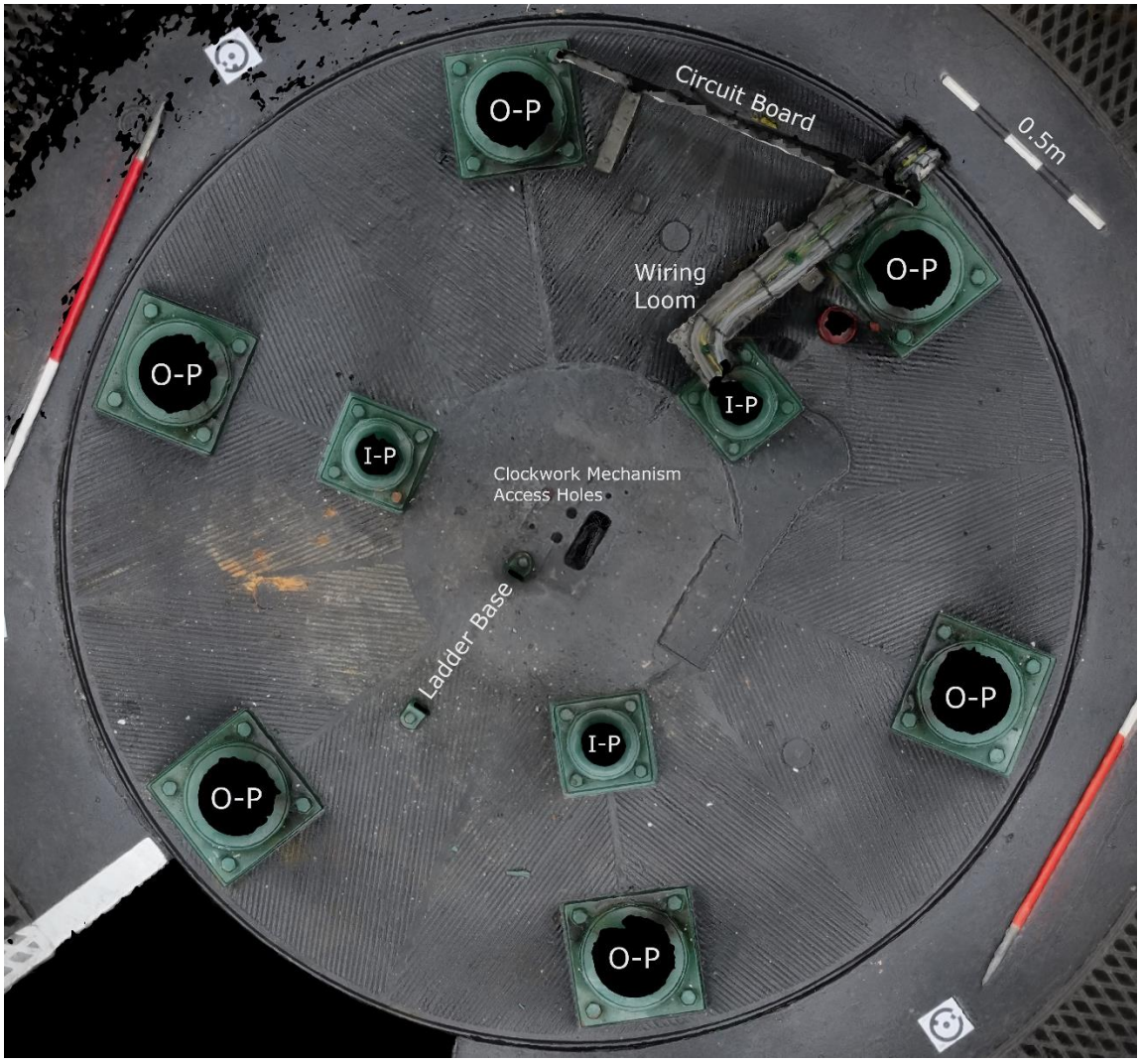

Figure 4.2: Orthomosaic floor-plan, derived from the photogrammetry survey, of the circular floor plinth and pedestal support pillars. O-P = Outer-Pillar, I-P = Inner-Pillar (© Crown Copyright: RCAHMW).

Figure 4.3: Detail of pedestal outer-pillar base and lower moulding, scale is 10cm (© Crown Copyright: RCAHMW).

Figure 4.4: Detail of pedestal outer-pillar top, capital and brackets, scale is 10cm (© Crown Copyright: RCAHMW).

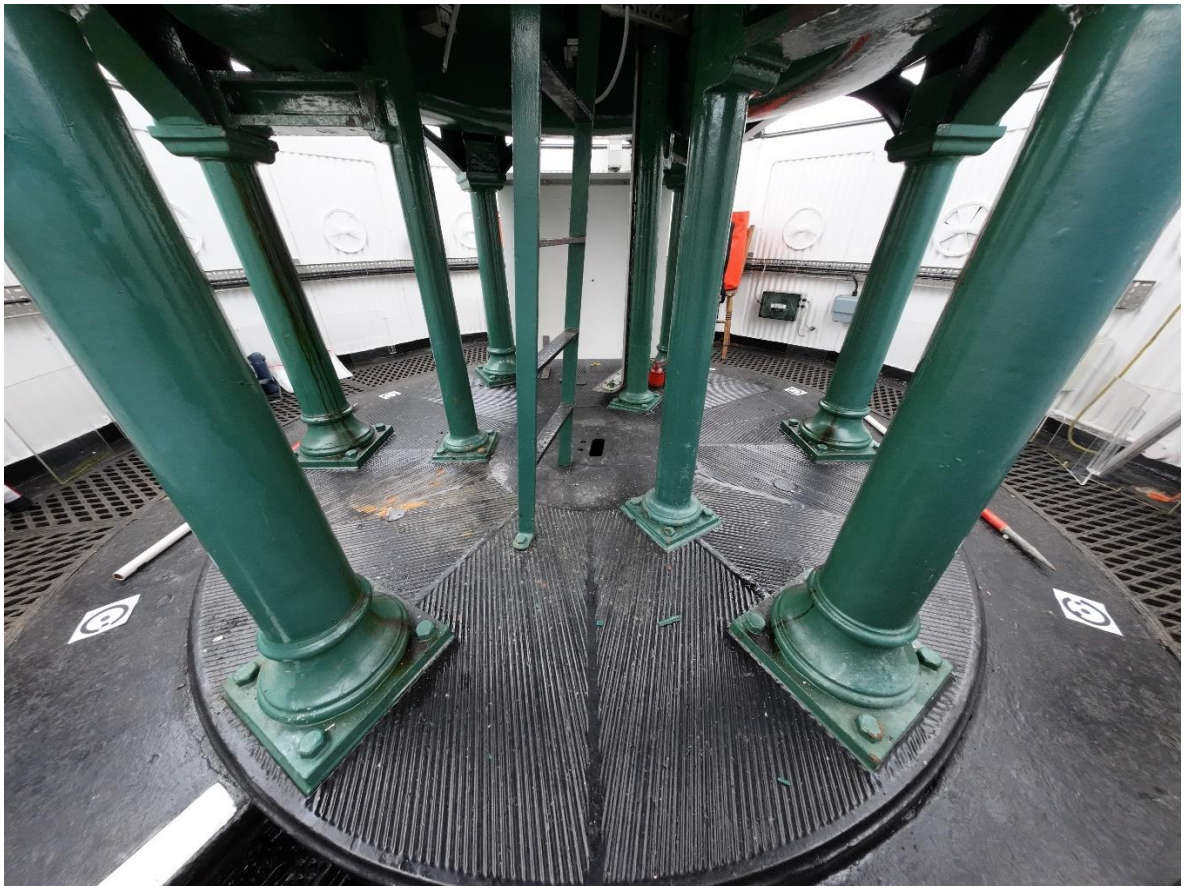

Figure 4.5: View of inner and outer-pillars of the lens pedestal (© Crown Copyright: RCAHMW).

The pillars and brackets support the main circular element of the upper pedestal, 2.29m maximum diameter, which contains the mercury bath and rotation mechanism on its inside, and a series of supporting wheels around its outer edge. The latter are covered by a modern Perspex screen, to guard against entrapment of people or objects, which was removed during the recording. The mercury bath is documented in cross-section on the 1903 and 1924 drawings. But only its outer bottom face could be accessed in 2024, measuring 210mm in width and sitting on a 100mm square-sectioned shelf set between each of the inner and outer pedestal pillars.

The outside of the upper pedestal is characterised by the 12 identical support wheels and brackets that are arranged around it (Figure 4.6; Figure 4.7); one over each of the six outer-pillars, and one in between each pillar. The wheels are 154mm in diameter, 32mm thick, and housed within a bracket formed of a rectangular base 250mm long, 124mm wide, and 27mm thick. A pair of side cheeks sit upon this to form the point for the wheel axle to attach (Figure 4.7). The support wheel brackets are located on a shelf formed by a moulding that projects upwards (127mm) and outwards (80mm) from the top of the outer-pillar capitals and side brackets. The lowest part of the moulding is formed from a single band, 3 mm in height, this is different to the double band shown in the 1903 and 1924 drawings. Above this is a thick single band 62mm in height, topped by a further 15mm band, and then the edge of the support wheel shelf, also 15mm thick.

Resting on the top edge of the support wheels is the lowest edge of the turntable to which the frame of the lens itself is attached. The turntable is 2.17m in diameter at its lowest point where it rests on the support wheels, 224mm in height, and 2.11m in diameter across its top, at the base of the lens. The top of the turntable is 200mm wide, leaving a 30mm gap, to the lamp-table which the turntable and lens revolve around. The sides of the turntable are formed from a series of mouldings and a single inward step (Figure

4.6). The upper vertical face is broken-up by six pairs of rectangular ventilation holes 310mm long, 60 mm high and defined by a 10mm wide D-shaped moulding. The ventilation holes are spaced 135mm apart, with 256mm between each pair of holes. Finally, the lamp-table is 1.66m diameter and comprised of a flat metal lattice-work that is stationary within the turntable. At the centre of the lamp-table is the lamp itself (Figure 4.8), now a modern bulb, with an alternate bulb on a moveable mount. There is an access hole in the lamp-table which has a squarish yellow and black cover-plate

Overall, the pedestal is largely unchanged since its installation in 1903/4. The most significant removal is probably that of the clockwork mechanism taken out during the 1987 automation programme and now evidenced only by the holes in the lantern room floor. Meanwhile, significant additions are the modern electrical circuit board (Figure 4.9 left) attached to two of the outer pillars, and the associated wiring loom (Figure 4.9 right) that runs up the inside of one of the inner pillars to the lamp table.

Figure 4.6: Support wheels around the outer upper-band of the pedestal. The turntable gently rests on the support wheels (© Crown Copyright: RCAHMW).

Figure 4.7: Detail of support wheel and bracket, scale is 10cm (© Crown Copyright: RCAHMW).

Figure 4.8: The lamp and lamp table within the Skerries Lens (© Crown Copyright: RCAHMW).

Figure 4.9: Left: Modern electrical circuit board on one side of the pedestal. Right: Wiring loom running up an inner-pillar within the pedestal (© Crown Copyright: RCAHMW).

4.3 Fresnel Lens

The lens structure stands upon the turntable described above and is formed from glass lenses and prisms within a metal framework, the scale and arrangement of which is termed as *catadioptric*, being comprised of a lens, surrounded by refractive and reflective prisms. The history and development of this in the wider context of lighthouse use is explained in detail by Hague and Christie (1975: 161-178). The Skerries lens structure can be conceived as a three-sided structure, triangular in plan. Although reference to Figure 4.1 demonstrates the full complexity of the lens form.

It is essentially identical on each of its three main-sides, and each main-side is divided vertically in half. Within each half there is a circular lens, the Fresnel Lens, set at the focal plane of the lamp, making two to each main side (Figure 4.1, 4.10), that give the lens its characteristic pattern of two flashes every 15 seconds. These are surrounded by an inner-zone of refractive prisms, divided into four areas by the metal framework. A further outer-zone of reflective prisms surrounds this, comprising the rest of the glass elements of the lens, and divided into eight areas by the metal framework. There are 13 areas of glass-work to each half-side, 26 to each main-side, and 78 in total.

Figure 4.10: The Fresnel lenses and refractive prisms, bordered by the reflective prisms, comprising one main-side of the lens, seen at the level of the focal plane (© Crown Copyright: RCAHMW).

Each Fresnel Lens is 275mm in diameter with a brass structural band 10mm wide around their circumference. Four straight structural pieces, 11mm wide, and set 45 degrees from the vertical, extend outward from the frame of each Fresnel Lens and quarter the area around each. This forms the framework within which a series of seven refracting prisms are set in a concentric pattern around the Fresnel Lens. This pattern is truncated in the area between each pair of Fresnel Lenses where there is only space for a single complete prism (Figure 4.1, 4.10). This inner zone of prisms is in turn bounded by a further circular brass framework, 0.96m in diameter to its inner edge and 29mm wide. In the context of this report it can be noted that the 1903 plan of the lens shows the inner-zone around the Fresnel Lenses divided into thirds, rather than the quarter-areas that were installed and present at the time of recording in 2024.

The outer-zone of reflective prisms around each Fresnel Lens is divided into eight areas, defined by seven brass frames set radially around the centre-point of each lens (Figure 4.1, 4.10). These vary in width from 10mm for the top and bottom frames, to 29mm for the diagonals and horizontal frame, and 15mm for intermediates between these. As with the inner-zone of prisms, the pattern is truncated where the areas

between each Fresnel Lens meet each other. This meeting point is defined by a vertical piece of framework, 29mm wide that marks the middle of each main-side of the lens, dividing it in two (Figure 4.1, 4.10). The outer-zone of the lens is taller above the focal plane than below it; 1.49m above compared to 0.9m below, allowing for 18 concentrically arranged reflective prisms in the two upper-most outer-zone areas (Figure 4.1, 4.11), compared to only eight in the three lowest areas and seven at the sides (Figure 4.11, 4.12). The corners between each of the main-sides (Figure 4.12) are formed by a further vertical section of brass framework 29mm wide.

Figure 4.11: Reflective prisms in the upper areas of the outer-zone of prisms (© Crown Copyright: RCAHMW).

Figure 4.12: The corners between the main-sides, at the level of the focal plane (© Crown Copyright: RCAHMW).

4.4 Conclusion: Changes since installation

On the basis of the historical research (Section 3) and in-situ recording (Section 4), a number of observable changes to the lens and pedestal can be documented as having taken place since its installation in c.1904 and these are summarised in Table 4.1. Some changes to the lantern room have been included because of their relationship to the context of the lens and pedestal within the lantern.

Table 4.1: Alterations to lens, pedestal and lantern room since 1903.

Year	Event	Outcome
1927	Electrification	Replacement of 1903/4 lamp. Remodelling of lantern room roof.
1964/5	Modernisation	Replacement of 1927 lamp.
1970	Modernisation	Installation of electric drive motor for lens rotation.
1987	Full automation	Removal of clockwork rotating mechanism. Removal of vertical ventilation duct. Replacement of 1964/5 lamp and lamp changer.
2004	Solarisation	Replacement of 1927 lamp Alteration of rotation to a 15-second period Installation of existing fuse board and wiring loom.

The vestiges of some of these alterations and modification can be traced within the structure visible in 2024, most notably the holes and outline in the plinth relating to the clockwork mechanism that was part of the original 1903/4 installation but removed in 1987.

Additionally, some minor differences can be noted to the lens and pedestal compared to the drawings of 1903/4 and 1924. These are the results of differences to the actual, rather than planned construction, as opposed to features removed since 1903/4:

- The framework for the refractive prisms around the Fresnel Lens is shown forming three areas in the 1903/4 drawings, but is actually four quarters.
- A moulding shown at the top of the outer-pillars of the pedestal in 1903/4 and 1924 is not present, and seems unlikely to have ever been present.

Finally, in producing Figure 4.1, and working with the reference drawings from 1903/4 and 1924, a significant discrepancy between the height of the focal plane above the lamp table was noted between the two drawings. This distance is 1.02m on the 1903/4 drawing and 1.14m on the 1924 drawing. Cross-checking against the drawing for the 1964/5 lamp indicates that the 1924 drawing is correct. As such, the entire lens structure in the 1903/4 drawing is c. 120mm shorter than in the 1924 drawing, and as recorded in 2024. By contrast, the section through the focal plane drawn in 1903/4 was almost exactly the same as that recorded in 2024. This serves to illustrate the importance of updating the description and drawn record of the structure, rather than simply relying on archive drawings.

5. Reflections & Recommendations

The chronological development of the Skerries Lighthouse summarised in Section 3 and the description set out in Section 4 highlights the various periods of continuity and change in the form, fixtures and fittings over time. The statutory listing of the Lighthouse focuses on its excellence as an example of James Walker's design and implementation noting that it is:

"Listed at grade II as an excellent example of the work of James Walker, a compactly planned complex which exploits the constraints of its site in a highly dramatic conception."*

With this in mind, it is worth noting that since the completion of the Trinity House rebuild overseen by Walker in 1852, the lamp has been replaced five times, the rotation has moved from clockwork to motorised, the flash period has altered from 10 seconds to 15 seconds, and the lantern roof has been remodelled. Yet the overall significance of the lighthouse remains undimmed, both navigationally, and architecturally.

The current replacement of the Fresnel lens, itself a replacement for the 1852 lens (and support), is part of the longer sequence of development of the lighthouse over the last 300 years. While the latest adaptation within the lantern room should not be seen as reducing the historic significance of the Skerries Lighthouse, it is appropriate that as complete a record as possible is made of it. The recording work described in this report has sought to achieve this through the creation of a visual, audio, and written record of its form in its in-situ state, prior to removal.

In doing this, several constraints were encountered relating to the space within which recording work took place, and the physical characteristics of the lens itself. Despite this, the combination of photographic, video and photogrammetry recording has been successful in capturing the form and character of the lens and pedestal within the lantern room. Although the photogrammetry survey was unable to capture the surface of the glass elements of the lens in three dimensions, it was successful in creating a record of the pedestal and lens frame and resulted in a comprehensive archive of photographs of the lens and pedestal from every conceivable angle. The 3D model derived from the photogrammetry survey also provides an additional way for the nature and character of the lens and pedestal, especially its symmetry, to be experienced. Notably it is possible to make this freely accessible to the general public (see https://skfb.ly/ppJPC).

The material generated in the recording of the Skerries Lens and Pedestal includes this report, the 2024 drawn record, a formal photographic record, a high-definition visual and audio recording, an extended set of photos relating to the photogrammetry survey, and a scaled point-cloud. The entry for the lighthouse within the NMRW has been significantly updated as a result and all the material just listed has been archived within the related NMRW archive holdings for the Skerries Lighthouse where it is publicly accessible. Copies of all generated material have been circulated to Trinity House.

Although it is felt that the main objectives of the work have been met, two recommendations can be made relating to the ongoing display and further recording of the lens following its removal:

1. If possible, the Skerries lens should be re-assembled and displayed, ideally in a way to facilitate public access, e.g. an appropriate museum, perhaps on Anglesey, where it can be enjoyed first-hand by the public in a way that was not possible during its working life.
2. Once re-assembled, the lens can be re-recorded without the spatial restrictions imposed by the lantern room, and with potential to mitigate the physical characteristics of the lens to allow combined laser scan and photogrammetry recording. Doing this would provide an improved digital version of the artefact as a means to enhance the existing digital element of its preservation by record, and to better facilitate virtual access.

Looking more widely, other lighthouses within Wales (South Stack, Strumble Head, The Smalls) are scheduled to undergo similar work to upgrade their early 20th century lenses in the coming years. The Listed Building status of all these lighthouses dictates that comparable recording work will need to be undertaken as part of such work. As with the Skerries Lighthouse, a key part of this will be the in-situ recording of the lens/pedestal structure to document it as a first-phase of work, prior to removal. Further follow-up recording can then be undertaken when appropriate as a second-phase. The combination of photographic, video and photogrammetric recording used at the Skerries is likely to provide a suitable option for the first phase, given the likely similarities between lens, pedestals, and lantern, and the associated working constraints. Undertaking such work, in conjunction with the two recommendations above, will ensure that Wales will have a detailed record for posterity of these iconic pieces of navigational technology.

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Trinity House Archive. Drawing No. 65/85. *Skerries Lighthouse, Large MkII Lampchanger & Pedestal. General Arrangements & Details.*

Appendix 1: 2024 Drawing of the Lens and Pedestal