

China's First Purpose Designed and Built Lighthouse: Findings from the Analysis of a Long Lost but Recently Rediscovered Photograph of the Xiyu Pagoda Light (李西山塔晚燈, Lixishanta Wangdeng)

Stephen Davies
University of Hong Kong
Email. stephen.davies79@gmail.com

Abstract

Although it has long been known that a purposely designed and built 'pagoda' lighthouse existed on the Penghu Islands' Xiyu (Fisher's) Island as of 1778, exactly what it looked like, how large it was and where it was placed vis-à-vis the 1875 Chinese Imperial Maritime Customs light that still exists has never been known. Existing Chinese data, from a contemporary stele the text of which was written by or for the then Taiwan Prefect, Jiang Yunshu, uses self-consistent traditional units of measure suggesting the seven level pagoda was of the order of 18m or more high. Other contemporary Chinese data speak of a powerful light that, rhetorically at least, could be seen from Taiwan in one direction and Xiamen in the other! Western reports, which we have from 1797 and more systematically as of Captain Richard Collinson's survey of 1844, propose a tower only some 10m high and a very occasional light visible at best only one mile distant. There has been no way of reconciling these very different reports until the recent discovery in a major British archive of a photograph of the 1778 pagoda - as rebuilt after typhoon damage in 1823 - that can be dated to c.1875. In this paper this photograph will be presented and discussed and an attempt made, thanks to modern three dimensional modelling, to give accurate dimensions. Additional discussion will focus on features of the pagoda lighthouse revealed in the photograph that connect with hitherto ill-understood remains both in the present day lighthouse compound and in the Buddhist temple in the nearby village of Wai'an.

Keywords: Fisher Island, Collinson, Revit, zhang, chi, Jiang Yuanshu, temple, Heavenly General

Introduction

The author is part of a City University of Hong Kong lighthouse heritage project sponsored by the Office of the Provost and led by Prof. Steve Ching. The project aims to make Hong Kong, Taiwan and China's lighthouse heritage more widely known and appreciated through well-made videos focussed on specific heritage lighthouses.

In support of the film-making the lighthouses are extensively researched, which is the author's main role in the team. Other than the obvious aim to ensure that the videos are factually correct, the project aim is to highlight the international, cross-cultural character of heritage lighthouses and the strong historical links between China's coast and the wider world, as well as to provide or supplement data for use by historians and archaeologists working on regional lighthouse heritage. One of the team's recent foci has been the heritage lighthouses of Taiwan's Penghu Islands (澎湖群島), in particular what is today called Yuwengdao Lighthouse on Yuweng Dao (漁翁島 (Fisher Island)) in Xiyu County (西嶼鄉).

The Puzzle

The location of the old Pagoda Lighthouse¹ is now occupied by Penghu and Taiwan's oldest modern lighthouse, the Yuwengdao Lighthouse. The latter was built in 1875, following a site survey in 1874, as part of the second lighthouse programme of the CIMCS Marine Department.² However, it had been preceded by an earlier, entirely Chinese designed, funded, and built structure dating from a century earlier.

Data recounting the erection of the 1778 lighthouse and an affiliated Mazu Temple can be found on two granite stelae, now so weathered as to be all but illegible, in the forecourt of the Wenchang Wang Temple (西嶼鄉外

垵村溫王宮) in the village of Wai'an (外垵), 1.4 kilometres west-north-west of the old lighthouse site, and two copies in the present lighthouse compound. The structures were built with money raised by the Taiwan Prefect, Jiang Yuanshu (蔣元樞), and the local Penghu magistrate, Xie Weiqi (謝維祺), largely from Taiwan and Xiamen based shipping interests. Styled the Xiyu Pagoda Courtyard, the construction began in 1777 and completed in 1778 on the site of a collapsed 17th century pagoda or, possibly, fort. In 1823, a typhoon severely damaged the structure. It was rebuilt and renamed the Xiyu Pagoda Temple and was back in commission in 1828.

The pagoda was of seven storeys and five *zhang* (丈) high, built of granite and was in some sense Buddhist.³ The stele text also gives the measurement of the sides of the base of the tower as five *zhang*. Although the translation is uncertain, it further states that each storey was served by a staircase that rose seven *chi* (尺), which may be another way of saying each floor was 7 *chi* high. That would be consistent with the height of five *zhang* allowing for a roof finial.⁴

Five *zhang* is not a determinate measurement. The *zhang* was divided into 10 *chi* but the relevant modern value of the *chi* in SI units is uncertain. The original value is thought to have been 9.5" (0.24m) to 9.8" (0.25m). As Louise Levathes notes however, by the Ming dynasty and probably for centuries before as in contemporary Europe, values for the *chi* varied between regions and between trades. Within shipbuilding alone one provincial range was from 10.53" (0.27m) to 13.338" (0.34m), and across China could be as small as 9.5" (0.24m).⁵ G.R.G. Worcester noted that in his days (1930s-40s) the value of the *chi* varied from 8.6" (0.22m) to 27.8" (0.71m) and that the *China Commercial Guide* of the day gave over 100

different values for the unit.⁶ The bounds of those values place the height of the Xiyu Pagoda Light as lying between 11m and 35.5m.

There are also descriptions in western sources. The earliest was on 1st July, 1797 by the Briton, William Broughton, passing two or three miles to westward, who noted,⁷ “an Obelisk of Stones rais’d I shou’d imagine for the advantage of the Junks who trade to these Islands.” The next came from Captain Richard Collinson’s surveying exercise along the coasts of China in HMS *Plover* from 1843 until 1846.⁸ The resulting sailing directions (a sort of sailor’s guidebook), the “Sailing Directions for the Panghu or Pescadore Archipelago, with notices of the islands”, recorded, “On (Fisher’s Island) SW. extreme is a Light-house 225 feet above the sea.”

A little over a decade later, a further British survey in 1858 by Captain GAC Brooker in the steam paddle sloop HMS *Inflexible* supplemented the earlier description. The third edition of *The China Pilot* in 1861, collated by John W. King, gave Captain Brooker’s update, which agreed with Collinson’s height above the sea, identified the date of construction, but declared the pagoda to be only 30’ (9.14m) high..⁹ It is evident that the differences between the given western height and the estimate from Chinese values (11m-35m) are hard to reconcile.

In addition to the uncertain measurements and verbal descriptions, two images of the old pagoda lighthouse survived. Jiang Yuanshu commissioned some paintings of his time in Taiwan that are now in the National Palace Museum, Taipei. One of them is of the Penghu Islands and shows a distinctly geographically separated pagoda and temple. The temple, shown in some respects where today Wai’an lies, is labelled *Tiān Hòu gōng* (天后宮, Tian Hou temple). The pagoda, shown quite conventionally as of a traditional form with seven storeys including the

base, is labelled *Juān jiàn xī yǔ fútú* (捐建西嶼浮屠, roughly “Buddhist pagoda/stupa established on Xiyu (Island) by donation”).

The second small and schematic image is on Captain Collinson’s manuscript chart.¹⁰ The structure shown had a wide base and a low building with a short tower on its seaward side. A doorway faced the viewer and a lantern chamber with a traditional curved-eaves roof topped the whole. Neither image is helpful in resolving either measurement issues or the actual appearance of the pagoda light.

Physical Remains

At the lighthouse site there is thought to be the following possible remains. To the north of the present lighthouse compound there is a debris field of bricks and brick fragments that may be associated with the earlier structure. No archaeological work seems to have been done on this, so the exact status of the remains is uncertain. Within the lighthouse compound there are two walls, of unknown age, not aligned with the present structure that folk memory associates with the earlier structure. There is also a raised, almost square c.15m x c.15m area similarly associated in folk memory with the earlier structure but aligned with the present compound on approximately 018°T south to north and 290°T east to west axes, not the 000°/180° and 090°/270° of the old walls. In neither of these cases has systematic research been done. Folk memory also associates some of the cut granite stones used in the present compound with relics from the older structure.

In addition, local Wai’an folk memory believes the smaller of two images of Mazu in a side altar in the Wenchang Wang Temple may have come from the temple built near the Pagoda Lighthouse. In a side recess in the

Wenchang Wang Temple there is also a board with large, carved characters, believed to be from above the altar in the small Mazu temple.

Separately, in the Wai'an, Buddhist, Cí Hángsì (慈航寺) Temple there are twelve, carved, bas-relief stone tablets around the main altar that are also associated with the old lighthouse buildings.¹¹

Finally, in the modern lighthouse enclosure is a solid, granite, jar-shaped object, around 0.80m tall and 0.4m in maximum diameter with three holes drilled into its top surface. Local folk memory describes this somewhat loosely as 'the old light', though exactly what is intended by the description is not certain. The three holes in the top may have been locators to hold something in position on the top surface of the stone.

It follows that no data, or no fully reliable data existed as to what the old pagoda lighthouse looked like, what its dimensions were, where exactly it stood, and how it related to the affiliated Mazu Temple. My main research thrust was to find a reliable image, if one existed, so that we could use it to resolve some of these puzzles and in the video.

Discovery

After a frustrating initial period that looked like the search could take years and may have gone nowhere, blind good luck during an Internet search found a photograph titled "Lighthouse on Fisher Island (Pescadores)", dated to c.1900, in the collection of London's Royal Geographical Society. The luckily spotted screen grab image was good enough to identify a catalogue number that, on enquiry, Ms Joy Wheeler of the RGS confirmed to be what I sought.

An inspection of a high-resolution, digital copy provided by the RGS allowed a ballpark date of 1874/75. We know that a Chinese Maritime Customs survey of the site took place in 1874, that the first notice of an

intended new light was published shortly after construction began on 11 July,¹² and that it was first lit on 20th December 1875.¹³ The light tower itself has a label above the entry reading “David Marr Henderson 1874.” Indicative of the advent of the new authority and its assumption of control over the old lighthouse, in the left middle ground of the picture there is a small, upright stone block reading 閩海關 (*Mǐn hǎiguān* – Fujian Maritime Customs (authority)).

Fieldwork done in Penghu in October 2016 meant immediate identification of one significant element in the photograph. In the left background of the image, just below the horizon line, there is a conspicuous row of pale objects. When shown in detail, it shows sixteen wedge-shaped blocks of grey stone. These are identical in conformity and number to the stones comprising the foundation of today’s lighthouse tower. Close to the blocks are at least six long wooden poles of the sort that are typically used as the main uprights in Chinese bamboo construction scaffolding. In addition, on the top of the plinth there appears to be some heavy cable and possibly chain flaked down, along with what may be a heavy sheave. There is also a tall bin in the shape of a truncated cone close to the entrance door from the plinth into the pagoda. It is possible to read these as preparations for the demolition of the older structure.

In short, the first elements necessary for the construction of the new lighthouse and demolition of the old are in place in the photograph. That would be consistent with a generous date bracket between at the earliest the very end of 1874 and the latest late spring/early summer 1875. The image shows an uncharacteristically stepped, octagonal pagoda fronted by a low, three component building. The latter consists of two projecting, single storey wings joined by a gateway topped by an illegible signboard at the right hand end and by a slightly taller, single-storey building across

their ends nearest the pagoda. A small courtyard lies between the gateway and the transverse building. Between the transverse building and the pagoda would appear to have been a second courtyard formed by the back of the transverse building and two enclosing walls joining the ends of the transverse building to the corners of the pagoda base.

The pagoda was built of ashlar blocks described in the stele as granite. The laying pattern cannot be distinguished, save that it is in parallel courses of long blocks irregularly interspersed with shorter stones that may be bond- or through stones. The small temple would appear by contrast to have been built using a random rubble construction technique with ashlar quoins.

The pagoda is a low, stepped structure consisting of six octagonal storeys stood on a massive square plinth and topped by a classic, curved eave Chinese roof, itself topped by a Buddhist, 'precious water jar' shaped finial. This is identical in shape to 'the old light' that now stands in the present lighthouse compound. The seven levels are not equal, the values being broadly what we treat as a 'whole height' base or 1st and 4th, 5th, 6th and 7th levels, with the 2nd and 3rd levels each of half height. However, as with all vernacular, artisanal architecture, the 'whole height' measure, taking this to be the height of the plinth (=1), varies irregularly between 0.66 and 1.03.¹⁴

Much the most important element in the photograph is the six visible inset tablets with bas-relief images carved on them. These are on storeys four, five and six. The images on each level are on alternate faces. However the images on storey five are on the four faces left blank on storeys four and six. The visible images imply a further six on the faces of the pagoda out of shot for a total of twelve. Insofar as the resolution allows us to decide the matter, the visible images tally with some of the twelve images

in the Cí Hángsì temple in Wai'an, believed to have come from the old pagoda. The images would appear to be variants on what Chinese (and Japanese) Buddhism call the Twelve Heavenly Generals (十二神將, *Shí'èr Shén Jiāng*). In our estimation, the two sets of twelve are the same and more research is at present concerned with these images.

There is no certainty about the orientation of the pagoda and temple. However, the shadows beneath the shutters projecting from the two wings of the small temple suggest a sun high in the sky within an hour or so of local midday. The initial hypothesis was that the pagoda and temple complex were orientated North/South, with the pagoda to the north.¹⁵ This idea is supported by the entrance to the tower being on the south, and the two evident doors from the lantern chamber to the upper parapet walkway (which can be identified because some of its stonework has visibly collapsed), opening east and west. All the access points make sense because in Penghu the prevailing, very strong winds of winter are NE to N and in the summer, though far less strong, from S to SSE. The entrances thus offer sheltered access from the prevailing winds.

Evaluation

Dimensions

The main puzzle was the uncertain dimensions of the pagoda and temple, much confused by the very different values given by the traditional Chinese units of measure and the height of the pagoda from British sources.

To help decide this and more closely date the photograph, Steve Ching organized the help of Anthony Leung Ka Ho, an architecture student at the City University of Hong Kong, who is an adept with Autodesk Revit Architecture software.¹⁶ With the photograph as a backdrop template,

Leung drew a 3D CAD drawing, which he artistically rendered to replicate tones and textures of the original albumen image. This was then a fully manipulating computerized 3D model, the only missing aspects of which were the interior of the buildings, on which we remain entirely ignorant. All we can conjecture at present is that a closer investigation of the brick debris area just north of the present compound may give evidence of the tower interior to have been of brick.

The software also allowed analysis of the model to establish probable parameters for dimensions. This was done by scaling off such things as the height of any people and any known dimensions of objects in the original photograph. To this end the most important features of the photograph were two.

The first was the two human figures. One stands on the plinth leaning against the wall of the pagoda's second level with his elbow resting on its top. The second is standing in a doorway leading out from the small courtyard between the Mazu temple and the pagoda. Both figures are dressed in western clothing, though it is not possible to be sure if both are in fact westerners. In the present context, their importance lies in helping to narrow down feasible answers to the issue of the height of the pagoda. The broad height bracket that covers averages of the era is for Chinese people around 1.63m, Europeans around 1.67m and North Americans around 1.73cm.¹⁷ The normal variance in the mid-1870s for the average heights in question is ± 7 cm, so with one Chinese and one Western person, working numbers were taken to be 1.55-1.65m and 1.75-1.85m. Similarly, it was supposed that doorway heights in the visible doors were c.2m. Scaling the drawing using these values led Mr Leung to use a plinth height of 3.1m, which gave a pagoda height of 16m.

This estimated value vindicated and gave a more precise value to the traditional Chinese measure and led us to discard the Captain Brooker's claimed 30' (9.14m), but left us uncertain how to evaluate the given height of the lantern of 225' (68.6m) agreed by both Collinson and Brooker, which will have been measured by vertical sextant angle and will have been accurate to within quite close tolerances.

Today's height above sea level to the focal plane of the light is given as 199' (61m); the height above ground of the focal plane is listed as 36' (11m).¹⁸ It follows that ground level is 163' (50m) and within reasonable error margins this is confirmed by Google Earth, with its terrain layer set 'on', on which the average of eleven readings inside the lighthouse compound around the light itself is 48.4m.¹⁹ On that measurement the pagoda would have been between $(68.6\text{m} - 48.4\text{m}) = 20.2\text{m}$ and $(68.6\text{m} - 50\text{m}) = 18.6\text{m}$. The estimated spread for the pagoda's height is therefore 16m to 20.2m giving a *chi* of 0.32m to 0.404m.

One route to tighter measurement is via the bas-relief carvings on the pagoda's faces and now in the Cí Hángsì temple in Wai'an. Whilst we cannot be certain that the tablets are exactly as they were when in situ, given that they are granite it seems unlikely they will have emerged significantly reduced in size. Although the twelve tablets are not all of the same dimensions, they are all the same height to within c.10mm, which is c.500mm. Using these as a gauge suggests a pagoda height of c.15.5m.

The final benefit of the software was that, once we were sufficiently satisfied that the CAD model we had derived was close enough to what we thought the photograph showed, it enabled us to 3D print a plastic scale model, the evaluation of which has allowed us further to refine the 3D CAD drawing.

Orientation

An additional bonus was that with the use of the software's built in sun and shadow creation tools and some initial ideas, based on crude on-screen analysis of the photograph and data on annual and diurnal solar movements (altitude/elevation, azimuth and declination) derived from a nautical almanac, the shadow patterns observed in the original photograph could be replicated on the CAD model. The key shadows were those cast by the shutters on the temple annexes' windows, by the overhang of the eaves above the windows, and by the intensity of the shade on the left side of the ensemble of structures.

Once the shadows were matched, the software settings gave the time of year in which the photograph was taken to within extremely tight parameters. The precision of the result is probably illusory but the software suggests the photograph was taken at c.1105 a.m. on 17th May, 1875. A safe conclusion would be that the image was taken in mid-May 1875.

The software also supported the hypothesis that the pagoda and temple complex was orientated facing south. This was derived from the azimuth (compass bearing) of the sun when the shadows on 3D rendering and photograph matched. For the sun's path from sunrise to sunset was shown on the CAD drawing as a celestial arc orientated in relation to a compass rose on the 'ground' around the model. This showed that to within a few degrees the orientation of the structures was as surmised.

Location

The final element of the puzzle, which could then guide further, on site investigation, was the location of the pagoda and temple complex in

relation to the present Yuwengdao Lighthouse compound. The photograph offers only three indirect hints.

The first and least reliable is the stockpile of cut stones for the platform on which the new light would be erected. Given that each would have weighed perhaps two tonnes,²⁰ it is unlikely they would have been stockpiled very far from where they were expected to be needed, though manifestly well out of the way of the intended demolition work on the old pagoda and temple and subsequent marking out of the site and site formation.

A second, possibly more reliable hint is what appears to be the line of a footpath or track coming in from the right, about one third of the way up the photograph's edge, running across in front of the temple and petering about in the area of what we surmise to be scaffolding poles. There is a fork in the path just to the left of the temple, leading around in the general direction of the doorway into the back courtyard between temple and pagoda, suggesting that there may have been no direct access from the temple into the courtyard and to the pagoda. Supposing the old structures to be facing south, the track has roughly the alignment of today's motor road from Wai'an as it reaches the lighthouse compound, which is what one would expect.

The present location of the lighthouse is surrounded on the southwest, west and northwest by a roughly ten metre high, vertical cliff varying from twenty to forty metres from the compound wall. Because of this, and as we know from how new lighthouse machinery was delivered by the Japanese authorities in 1937 or 1938,²¹ the materials for building the new lighthouse will have been landed at Wai'an and then probably carried or dragged overland to the intended lighthouse site along the track we can see.

This thought leads to the final, more indicative, but extremely hard to interpret hint. This comes from the horizon beyond the pagoda and temple. The indicator is the visibly different 'firmness' to the horizon line on the two sides of the building complex. On the left it is sharp and closer to the camera. On the right it is further away, less well defined and suggestive of ground rising very gradually up the right of the picture. When related to a contour map of the south western end of Xiyu Island, the presumed location of the old structures can be inferred from these observations and the location of the materials stockpile shown.

Put briefly, the left horizon is the nearby cliff edge. The right horizon, which reappears from noticeably further 'behind' the old structures, suggests that, in the region we cannot see behind structures, the horizon has trended more north-easterly. This is what it does on the ground today. From the contour map, we can also see that northeastward through east from the presumed location the ground rises very slowly and unevenly to around 60m as part of the plateau on the western extreme of which today's lighthouse compound stands. This fits the image and helps explain the less sharply defined horizon line to the right of the buildings.

A further bonus of the 3D modelling software is that it allowed us to work out the placement of the camera in relation to the building depending on some tentative conclusions as to the lens used. This in turn allowed us to assess the suggestion that the raised area by the present generator house and the old wall on the north side of the animal pen are relics of the old structures.

From a contour map with today's compound, it is clear the camera and photographer had to have been almost on the edge of the low, 10m cliff that surrounds today's compound from south round to north, at most around 40m distant but as little as 20-25m. The computer modelling

showed that this was indeed the case. Taking the centre of the west wall of the temple and pagoda complex as the reference point, the analysis placed the camera 28.94m away in a direction of 210°T so that it stood just short of the cliff edge. The angle of around 20° between the camera and the top of the pagoda accounts for the foreshortening evident in the photograph.

That this was the broad set of relationships was partially supported by a review of the range of what were called view or landscape lenses in use in the 1870s.²² Crucially, these had angular fields of view of 60° to 100°, with the most common types having a field of view of 60° – 80°. Analysis suggested that the lens used to take the image covered an angular field of view of 63°. This incidentally also helped support our conclusions derived from other sources as to the height of the pagoda.

This photographic and desktop analysis is intended as a preliminary guide to guide on site investigation that will serve to assess the analysis with archaeological work on the area of raised ground in the pagoda and the area with brick remains to the north of the present compound.

Conclusion

In default of precise data, our research has shown how, with modern computerised tools and a photograph, uncertain verbal and visual data from historical sources about vanished coastal buildings like lighthouses can be used to derive quite tightly defined measurements and locations that, in turn, can help guide subsequent archaeological fieldwork.

Endnotes

¹*The first western chart named it Lixishanta Wangdeng (李西山塔晚燈) for reasons utterly obscure. Although western Light Lists referred to the light as Litsitah Light until well into the 20th century, in Penghu the name is unknown and the characters bear no relation to any current or*

historical Chinese name. In early days the Chinese for lighthouse was 晚燈 (wǎndēng, night light), not today's 燈塔 (dēngtǎ, light tower)

²Banister, T. Roger, 1932. *The coastwise lights of China: an illustrated account of the Chinese Maritime Customs Lights Service*, Inspector General of Customs, Shanghai: 6. The CIMCS Marine Department had been created in 1868

³大清乾隆44年(1779) 澎湖廳通刊謝維祺撰的「澎湖西嶼浮圖記」(建修西嶼塔院落成碑記). The local rock is basalt, so if the structure was of granite, it will have been imported, probably from Fujian.

⁴see清乾隆43年(1778) 台灣府知府蔣元樞所撰的「刀建西嶼浮圖記」(建修西嶼塔院落成碑記 / 創建西嶼塔燈碑記)

⁵Levathes, Louise, 1994. *When China ruled the seas: the treasure fleet of the Dragon Throne 1405-1433*, Simon & Schuster, New York: 80.

⁶Worcester, G.R.G., 1947-48. *The junks and sampans of the Yangtze; a study in Chinese nautical research*, 2 vols., Inspectorate-General of Customs, Shanghai: vol.1, xiv. Morrison, John Robert, 1834. *A Chinese commercial guide*, consisting of a collection of details respecting foreign trade in China, The Albion Press, Canton: 70 gives a range of 12.65" (0.32m) to 14.58" (0.37m). A later edition has values 12.1" (0.31m) to 14.81" (0.38m), see Williams, Samuel Wells, 1856. *A Chinese Commercial Guide*, 4th ed., The Chinese Repository, Canton.

⁷Broughton, W.R., (Intro & Ed. Barry Gough) 2016. *William Robert Broughton's Voyage of Discovery to the North Pacific 1795–1798*, CRC Press, Boca Raton FL: 140

⁸Dawson, L.S., 1885. *Memoirs of hydrography*, vol. II, Henry Keay, The Imperial Library, Eastbourne: 31. See also Fix, Douglas, 2014. *Charting Formosan waters: British surveys of Taiwan's ports and seas, 1817-1867*. 漢學研究 (Hanxue Yanjiu (Chinese Studies)), 2014, Vol. 32.2: 7-48 and Barr, William, 2007. *Arctic Hell-ship: The Voyage of HMS Enterprise, 1850-1855*, University of Alberta Press: 7-8

⁹King, John W. (Ed.), 1861. *The China Pilot*, 3rd Edition, The Hydrographic Office, London: 127.

¹⁰Collinson, Richard, 1844, Draft survey, H.M.S. Plover and Young Hebe. Hydrographic Office archives, L4368 Shelf 13G.

¹¹ The project team is indebted to Mr Xu Youzhi, president of the Da Chi elementary school and keen local historian for showing us these relics.

¹²For the survey and the date of the start of construction on July 11 1875 see Taiwan's National Cultural Heritage Database Management System at

<https://nchdb.boch.gov.tw/English/cultureassets/Building/upt.aspx?p0=10116> accessed on 23.6.2017. For the notice of intention July 13 1875.

Notice to Mariners No.99—CHINA—PESCADORES ISLANDS—FISHER ISLAND. (1.) Intended Light on Litsitah Point. The London Gazette, No. 24227: 3566,

¹³March 3, 1876, Notice to Mariners No.25 —CHINA—PESCADORES ISLANDS—FISHER ISLAND. (1.) Fixed Light in Litsitah Point, The London Gazette, No.24302: 1734 The version of the Taiwan National Heritage Database in Chinese contends that the light was first lit on 18 November, shortly after completion.

¹⁴The actual values, using the plinth as unity, are approximately: Plinth = 1, 2nd level = 0.41, 3rd level = 0.34, 4th level = 0.81, 5th level = 0.75, 6th level = 0.66, 7th level (to top of finial) =1.03. The total value is exactly 5 'plinth units'

¹⁵In general temples – like many important Chinese buildings – were orientated (i.e. had the principal entrance) facing south – see Mak, Michael Y. and So, Albert T., 2015. *Scientific Feng Shui for the Built Environment: Theories and Applications*, New Ed., City University of HK Press, Hong Kong: 83-85. Tian Hou /Mazu temples were often exceptions since there was an overriding requirement that the temple faced the sea, see Wang, Chen-shan Ellen, 2003. *Historic Preservation in Taiwan: The Restoration of Tainan Da Tianhou Gong*, unpublished Master of Science thesis, University of Pennsylvania: 50. The Xiyu Pagoda temple could achieve both.

¹⁶See <https://www.autodesk.com/hk/products/revit-family/architecture>

¹⁷ see <https://ourworldindata.org/human-height/> accessed on 15.5.2017

¹⁸National Geospatial-Intelligence Agency, 2015. Pub. 112 - List Of Lights Radio Aids And Fog Signals 2015: Western Pacific And Indian Oceans Including The Persian Gulf And Red Sea, National Geospatial-Intelligence Agency, Springfield VA: 172. For the listed height as to the focal plane of the light see International Hydrographic Bureau, 2004.

Standardization of List of Lights and Fog Signals, International Hydrographic Bureau, Monaco: para. 3.1, A-4 and para 4.5, A-13.

¹⁹ the values were 45m, 44m, 47m, 49m, 50m, 49m, 50m, 49m, 49m, 50m and 50m – Google Earth sampled 11.5.2017. Errors are known to be $\leq \pm 30\text{m}$ – see discussion at <https://productforums.google.com/forum/#!topic/earth/3Th8MuHzKtE> accessed on 15.5.2017

²⁰Online tables and calculators give one cubic metre of granite as weighing c.2,75 tonnes. Each of the granite stones will have been c.0.7-0.8 cu. m.

²¹Oral testimony gathered in Wai'an Village, October 2016

²²Illustrated Catalogue issued annually by Thomas H. McCollin, Thos H. McCollin, Philadelphia: 1-17 and other related materials on the excellent website at <http://piercevaubel.com/cam/catalogs/1876mccollinlp819.htm>

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