DRAFT 26.7.2018/Flemming Aalund

RESTORATION OF ST. OLAV CHURCH, SERAMPORE, WEST BENGAL

Introduction

Constructed in 1805 and repaired in 1821 no additional archival information has been identified concerning the maintenance and upkeep of the building during the period between 1821 and 1989. However, 15 to 18 successive layers of lime rendering and lime wash at the north facade of the church testify to a continued maintenance and upkeep of the building undertaken by Serampore College.

From 1950 onwards it is known that a *Repair Committee* was established at Serampore College with the explicit purpose of ensuring the maintenance and upkeep of the church with occasional funding from Denmark and Norway since 1950s [1] . The entire portico including the church tower and steeple as well as the terrace roof was repaired in 1989 and again in 1998. Carried out with little concern for the original materials and architectural detailing the quality of the renovation is disputed, and continued decay of roofing beams encased in the masonry resulted in the collapse of part of the ceiling in front of the apse in 2009, and subsequently the church were close by order of the Public Works Department.

The partly collapse of the ceiling and the advanced decay of the building generally prompted the then Principal of Serampore College to pay a visit to Copenhagen in (?) with the explicit purpose of appealing to Danish authorities to assist with a timely restoration of the building. The appeal triggered a Danish concern for rescuing the important historic building from further deterioration as part of a more comprehensive effort launched as the Serampore Initiative by the National Museum of Denmark in 2012.

Justified on basis of the survey carried out by the National Museum of Denmark in 2008-2009[2] with financial support by Realdania the restoration of the church was initiated in 2014 in partnership between the owner Calcutta Diocesan Trust Association, Serampore College and the National Museum of Denmark. Earmarked specifically for the restoration of the St. Olav Church the Ministry of Culture provided the funds, which was supplemented by contributions from the Realdania as part of the Serampore Initiative in a combined effort to preserve Indo-Danish heritage in Serampore.

A first preliminary assessment of condition and significance was completed at the outset to determine the scale of the required intervention and a Restoration Brief [3] was prepared setting out the aims and objectives of the planned restoration. Subsequently the Kolkata based architect Manish Chakraborti was selected as the architect consultant in charge of the restoration work. Based on a DPR, Detailed Project Document, a public tender process was initiated calling for quotations from three pre-qualified contractors with previous experience in restoration work of a similar scale and complexity. Based on a thorough evaluation process the Kolkata based firm Mascon was then selected as the main contractor headed by Ashish Mukherjee.

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[1] Information in the archieves of Serampore College …details..

[2] Flemming Aalund and Simon Rastén, *Indo-Danish heritage buildings of Serampore,* The National Museum of Denmark, 2010.

[3] Flemming Aalund, *Restoration Brief, St. Olav Church, Serampore* , National Museum of Denmark, revised 30.01.2012.

The setting

From the time of construction in 1805 St. Olav Church has been the major landmark of Serampore. Situated at the western end of the elongated, triangular space that makes up the historic square in the very centre of the town, the perspective view was further emphasised by an alignment of Casuarina trees to each side of the square, as it appears from early photographs and plans[4] (see fig x).

Surrounded by one storey buildings the very height of the steeple was the dominant feature of the silhouette of the town. More recent construction of multi-story buildings has changed the skyline of the historic town and the former scale and proportion of the church has been affected by the modern urban development. Built to five stories immediately to the south of the church the construction of the Post Office building in particular has diminished the perception of the church as the prime landmark of the town. However, the steeple is still contributing to the town silhouette, in particular when arriving by boat or seen from the other side of the river from where the skyline of the town is on view. The view from Barrackpore at the opposite bank of the Hoogly River was especially appreciated and commended upon by the British Governor the Marquis of Wellesley, who missed "the distant view of a steeple" from his country residence, which would give him the right romantic associations with his mother country.[5]

Until recently the town square was used as Serampore's busy bus terminal creating a hectic activity at the entire space, but still the church ground has been preserved as a unique green open space and the heart shaped memorial ground dating from the 1960s has somehow been shielding the church from the hustle and bustle creating a relative calm atmosphere within the church ground.

The original design and subsequent modifications

Construction of St Olav Church was initiated by Ole Bie in 1800 and the work was completed in 1806. Inspired by classical European ecclesiastical architecture, which was widely disseminated abroad by way of pattern books such as James Gibbs' *Book of Architecture*[6], the lay-out has been adapted to the available space. Originally planned as a rectangular building with six free standing columns, separating the central nave and two aisles on either side (cf. fig. x) the original plan is most probably modified during construction according to drawings prepared by the English lieutenant Alexander Armstrong, who modified and extended the plan by adding a front portico supported by four pairs of twin columns, a pediment with a broken cornice featuring the royal monogram of the Danish King Christian VII, as well as adding a vestry behind the apse with a spiral staircase leading to the roof and the bell tower. The alteration of the design may explain the peculiar change of width of the bays between each set of pilasters that otherwise provide a regular partitioning of the façade.

The series of window openings were originally extended down to the floor level with bi-folded glass panel shutters in full height opening to the inside, while four panel shutters with louvered shutters on top and panel shutters below was opening to the outside, providing excellent possibilities for blocking the glare of the light and still allowing a breeze to provide natural ventilation.

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[4] Nilsson 1968, p. 75; This feature has many similarities to medieval market squares in provincial towns of Denmark with the church as a focal point of attention.it is likely that the construction was decided in conjunction with the layout of the town considering that the open space provides a full view of the Church.

[5] Curzon 1925, cited in Nilsson 1968, p. 123.

[6] James Gibbs, *Book of Architecture, Containing Designs of Buildings and Ornaments,* London, 1728.

Only 14 years after completion of the construction it appears from archival information that major repair works took places as appears from archival documents identified in Danish records[7]. The work concerns construction of a new masonry wall all around the church ground in replacement of a previous wood structure, including new gate pillars and two guard houses (*one Dorwan House and One Palankin Room)*, in addition to various restoration works to the church buildings, such as repair of the window sills due to rod, putting up of a Chinese railing in teak wood in front of the church, painting the same and improving the railing at the left and right side of the entrance porch of which parts had been stolen, painting of the beams and roofing laths *(barghas),* in the interior*,* as well as white washing of the steeple, facades and interiors walls.

The front part of the church building, including the front portico, clock tower and steeple, was renovated in the 1989 by funds provided from Denmark [8]. In this process all exterior rendering was renewed and executed by cement plaster, the roofing was changed by replacement of the original wooden beams in favour of steel beams and the original capitals of the Ionic Order was changed and simplified. The whole front part of the church was then painted with an industrial paint in a light greyish colour with a 'hard' and smooth finish, which in parts had weathered with blackish and reddish patches of lichens in a stark contrast to the appearance of the otherwise mellow and 'soft' finish of the lime washed facades.

A preliminary assessment by visual inspection carried out in 2008-09 revealed a precarious condition of the roof structure due to termite attack and wooden beams and *barghas* had deteriorated further from moisture migrating down into the construction from cracks in the cement screed.

The render at northern facade in particular was deteriorated with large patches of missing plaster and the many layers of original lime plaster and lime wash were easily discerned providing full record of the treatment and different colour schemes in the past, whereas the lower part of the southern facade had been renovated fairly recently by use of cement plaster.

The interior has been regularly maintained with lime wash in blue colour, but with patches of salt efflorescence at the lower part of the walls. The generally damp and humid interior was to some extend caused by lack of proper ventilation of the space further increased by the modifications of the windows at some time unknown. Originally divided horizontally by a fixed mid rail the lower frame and panels had been dismantled and the space been bricked up at a time unknown, possibly as an easy way to overcome the destruction of the sill and lower parts of the frame from rod.

Building survey archaeological investigations as prerequisite to the restoration

The interventions are from the outset adhering to internationally agreed conservation criteria and standards, which generally imply that as much as possible of the original fabric is conserved, and in cases where replacement are in avoidable, materials and construction techniques are compatible with the original ones, in particular has the use of lime for mortars and renders been of paramount importance. Unlike numerous modern products, lime-based materials are allowing the building to 'breathe' and move

[7] National Archives of Denmark, *Det Kgl. Ostindiske Guvernement. Kolonien Frederiksnagore. File no. 2051. Regnskabsbilag, 1815-1820.*

[8] The restoration was commissioned by DANIDA, The Danish International Development Agency , and the proposal for restoration and estimate of cost was prepared and submitted by Paul Bertelsen of MSAADA . The cost of restoration amounted Rs 9,50,000. Subsequently the quality of the work was criticized by Mr. Bertelsen.

gently whenever there is stress or thermal movements in the construction. The breathable nature of lime helps controlling moisture and dampness, which are essential properties with old buildings.

Architectural paint research

Architectural paint research has been carried out in order to determine the original appearance and subsequent decorative development of the colour scheme of the exterior and the interior from the time of construction up to the present time[9]. Direct observations of the exposed accumulated paint layers have been inspected *in situ and* supplemented by cross-section analysis of paint samples by microscopic examination[10].

The investigations have successfully established key aspects of the buildings' architectural and decorative development, which justify the decisions for reconstruction of the original color scheme. Chemical analyses of pigments, binding media and paint composition have not been carried out, and unfortunately, only very scarce archival data or original visual documentation is available to sustain the research.

Archival records

Carried out only 13 years after the completion of the building it is assumed that the account of the materials used for the restoration provides reliable information of the original appearance of the building. However, some discrepancies appear between the short descriptive text and the entries in the account of the materials used for the restoration. Translated from Danish the description goes …."At last painting of beams and *barghas* (e.g. battens or roofing laths) at the interior and repairing, as well as "whitening" the tower and the church building outside and inside"[11]. The term "whitening" in this context is probably misleading and is anyhow contradicted by the entries in the accounts testifying to the purchase of quite considerable quantities of *Europe yellow Oaker* (1 md/app. 37 kg), *Country Oaker (1 md, 2 seers/app. 39 kg), Europe red Oaker* (4 seers/app. 4 kg) as well as yellow paint (1 seer/app. 1 kg) [12]. Obviously a total quantity of about 81 kilograms of yellow ochre of different hues have to be put to use, and these pigments must have been used for colored lime wash of the exterior.

Chalk is listed in fairly small amount, which might have been applied for treatment of the interior walls as filling in distemper or composite paint. Alternatively white lead can be used and actually the account is listing a considerable amount of this toxic substance amounting to 114 kg (3 mds and 2 sees/ 114 kg). Also a minor quantity of indigo is included in the list, which might have been added to highlight specific architectural details in the interior with blue colour.

[9] Johanne Velling, *St. Olav Kirke- Farvearkæologiske undersøgelser udført december 2011 i Serampore, Indien*, (- *St. Olav's Church, - Architectural paint research***,** December 2011 in Serampore, India) National Museum of Denmark.

[10] - *Tværsnitsanalyse på prøver fra eksteriør på St. Olav Kirke og South Gate i Serampore* , Bevaring og Naturvidenskab, Nationalmuseet, 12.maj 2014, Sagsopgavenr. 11041763 sign. MCC/gha. English summary: *Analysis of paint cross-sections from the exteriors of St. Olav Church and the South Gate in Serampore,* translated by Vibeke Rask, The National Museum's Conservation department.

[11] The Danish wording is "hvidtet" which translated should denote "whiting". However, this treatment is used only for internal finish and prepared by grinding white chalk to powder and mixing it with water and size. It is more likely that the word has been used to signifying limewash, either whitewash or colorwash.

[12] The terminology for ochre is as wide as its use and many traditional spellings like *ocher*, *oker* and *oaker* occur in the past. In India it is common to call 'color wash' as white wash to signify a lime based exterior paint, info kindly provided by Neete Das.

Usually, emulsion paint would be applied to walls in two layers as a primer and a finishing coat. The primer differs from the finish by containing white pigment (chalk or lead) only and the overlaying colour layer appears brighter. There are several examples of this in the church interior.

Analyses of plaster and paint layers

Interpretation of the archival records is consolidated by the investigations and analyses of the accumulated layers of plaster and lime wash in the interior and exterior of the church. In certain locations about 12-15 successive layers of plaster and paint layers are preserved *in situ* and it is possible to establish a fairly accurate record of the historic colour scheme.

Exterior:

The visual investigations of flaking shows about indicate that the walls originally appeared in light ochre colors of different shades with the architectural details, such as pilasters, capitals, frieze, cornice and pediments, highlighted in white. During later periods, possibly from the 1850s onwards, also the architectural details have been treated with a unified pale ochre colour all over without any distinction of the details. This appearance of the church is verified by the hand-colored photograph from 1851.

One single layer of bluish colour, which appears to be of a rather late origin, indicates that the architectural details have been highlighted in a pale blue colour. Samples of plaster originating from the exterior facades have been analyzed in the laboratory, and the following conclusions were drawn from the investigations:

- The original layer does not seem to be included in the sample taken from the wall, but the most recent paint applications have all been an ochre colour.

- The first lime wash layers on the band below a capital were white.

- The oldest lime wash found in the sample taken from the capital is light blue. As the pigment appears to be synthetic ultramarine, which was first used in 1828, the paint layer in question cannot represent any of the oldest applications.

Blue colour is likewise used at the South Gate of the Government Compound, but only very few paint layers of more recent date are identified and this singular treatment during a short period of time has not been considered relevant for the restoration. Currently the exterior appears with a unified ochre colour with no distinction of the architectural details and this treatment has possibly been applied at least from 1851 onwards gradually using darker shades of ochre during more recent time.

About 12-15 successive layers of render and lime wash at the northern façade, mainly in white or light ochre hues, are preserved giving a unique possibility for documentation of the original materials and color scheme the church.

The visual analysis have concluded that the exterior facades originally were treated with a yellow ochre lime wash combined with a whitewash of the architectural details, and in the interior it might have been either a whitewash or a whiting with distemper. The aquatint depicting the front of the church and the steeple dating from 1851 (see fig 2) is verifying that for a long period of time the whole of the exterior has been treated with a uniform light ochre lime wash. This homogeneous treatment was changed as a result of the most recent restoration of the portico and the steeple now painted in a white color.

The Interior decoration:

Georgian interior design was prevailing in the colonial architecture during the late 18th and early 19th century. Various styles were in vogue and did involve considerable cross-over, however, it is safe to use the general term Neo-classical because of the extensive influence of classical Greek and Roman art and architecture. This style is also reflected in the interior decorative plasterwork of St. Olav. Generally the interior decoration was restrained and the architectural details were often standing out in white on a background of pale and subtle colors of various shades.

The paint investigations reveal about 5 successive layers of lime wash with a clear distinction of three periods, but there might have been more paint layers if distemper or emulsion paint, and verification of the original techniques are uncertain, because tempera or emulsion paint layers have been washed down before repainting was carried out.

The first layer is pure white followed by a layer with a warmer shade of beige from the addition of ochre pigment grains. Subsequently follows a sequence of paint layers in blue shades varying from grayish blue to a darker pale blue colour as the most resent paint layer. The same sequence has been identified at walls and architectural details, however, they can well have appeared at different periods and it is not firmly established whether the walls might have appeared in bluish color while the details have been white or *visa versa*

Woodwork and joinery

During more recent time the roof beams and *borgas* (e.g. batterns or roofing laths) have been painted in grey color, but earlier traces of yellow paint were identified . Doors and louver shutters have retained all the original paint layers with three successive coats. The initial one being a lacquer, subsequently a reddish-brown colour similar to iron oxide red or burnt ochre and the final coat appears with a darker brown shade, whereas the front doors had been painted with an additional coat of grey color at the renovation in the 1989.

Church furniture

It is noteworthy that the church furniture, including fixed pews, chairs, benches, wooden partition rails, pulpit and alter, has maintained the original paint layer of reddish lacquer, possibly containing shellac. The restoration involves cleaning and repair paying great attention to maintaining the original lacquer and make only partial repainting when required.

Roof construction

The collapse of a section of the ceiling in front of the apse in 2009 was the ultimate sign of an advanced deterioration of the roof structure. Rain water had been percolating through the concrete screed affecting the supporting wooden beams and *barghas*, making the roofing system extremely vulnerable to collapse.

For reason of safety a steel scaffolding was put up to support the roof as the very first intervention, when the restoration was initiated in 2014, and subsequently a detailed condition survey was undertaken to provide documentation and information about the structure, to assess of the building condition and decide on what works need to be undertaken.

The investigations made it clear that the problems had accumulated over the years. Embedded into the wall crown to a depth of about half meter the end of the load bearing beams had slowly disintegrated due to termite attach and the damp that permeates the fabric, and some individual hard wood beams had been replaced by iron beams , whereas many more wooden beams were in a precarious condition. Furthermore, it appeared that the part of the roof above the porch had been totally renewed in 1989 and all wooden beams had been changed in favor of steel beams.

The terrace roof was constructed according to traditional techniques with a layer of lime concrete on top of two layers of tiles supported by wooden beams and *barghas*. It appeared, however, that an additional layer finished by a cement screed had been added on top of the original roofing system, considerably increasing the total weight of the entire roof. With no expansion joints to compensate for thermal movements, which will be required for rigid materials such as cement mortars, cracks and fissures allowed rain water to percolate into the roof construction gradually, and in combination with the accumulated weight some of the wooden beams had bended and cracked at mid-span, and there was no other way but to replace and renew the entire roof construction including the load bearing structure.

It is an established tradition since long in India to replace hard wood beams with H-steel beams due to the exorbitant high price of well seasoned hard wood in the required dimensions. As an affordable alternative to Burma teak it was therefore decided to use steel beams for the renewal of the roof construction throughout and by welding two standard U-channel sections together it was possible to form built-up box sections of the same dimension as the original wooden beams, but a close look will still reveal that steel has been used to substitute the original wooden beams (refer detail drawings fig. x). This change of construction is more ecological sustainable, considerably reducing the total cost of the restoration, and eliminating risk of attack by termites. For aesthetic reasons the main steel box beams, running the longitudinal direction have been jacketed with wire mesh, plastered with a composite mortar and a groove line drawn along the edges of the beam as a finishing touch to the detail.

The traditional method of laying lime concrete terrace roof was revived redoing the construction to the original finish [13]. Spanning the gap between the beams all wood *bargash* were renewed by reuse of sound and solid hard wood recovered from the existing damaged wood beams, which were cut to required size and subsequently the construction is built upwards from the primary framework by two layers of terracotta tiles properly pointed and sealed with lime *surkhi* mortar. The final layer of lime concrete is composed of stone lime with an aggregate of finely crust burned bricks, generally termed brick dust, and crushed over burnt bricks, known as brick bats, in the proportion of 1.5: 2: 7 respectively. Mixed with water at site, beaten and rolled the final mix is laid to an average thickness of about 20 cm with an adequate slope towards the drainage points, where rain water is discharged through outlets in the parapet wall leading to the down pipes.

Subsequently the lime concrete is compacted properly by uniform beating. When properly hardened the surface is treated with a slurry of traditional admixture of *khayer and molases* [14] that will help to improve the water proofing properties, and finally is the roof substrata cured for about 10 days under a cover of straw, which are kept wet continuously(se fig x)

[13] An *Indian Standard IS 3036, second revision 1992*, sets out the correct procedure for making lime terrace roof covering.

[14] Additives of Jaggery, Molases, Yeast and other traditional admixtures ? More info required ??

Foundation, plinth protection and flooring

Cement concrete slaps about 8 cm thick and 2 m wide are cast *in situ* at a layer of flat brick soling placed on rammed earth apron all around the building to ensure the fast run-off of rain water, and the rough cast surface texture provide visitors a safe walkway that connects the different parts of the church ground. Rainwater is drained away from the immediate surroundings of the church by way of new surface drains connected to sub terrain soakaways and below ground level the foundation is treated with bitumen intended to reduce rising damp in the lower parts of the facades.

The whole interior floor area is raised about 75 cm above ground level by a fill consisting of *clinker* bricks with twisted and irregular shapes, that appear as being discarded from a brick yard. The vitrified properties of the over burned bricks may prove to provide an insulating foundation below the floor that prevents the capillary rise of ground source moisture.

Finished by a cement screed of fairly recent date, and further investigation of the substrata in various part of the church revealed no traces of any previous tile or stone flooring that may have been used originally at the time of construction. Due to lack of any historical evidence the choice of new material and pattern had to be rely on comparative study of contemporary buildings, especially the Danish Government Building, where parts of the original sand stone tile floor had been retained, and finally, it was decided to use a grayish, reddish *Dholpur* sandstone cut from stone quarries in Rajasthan. The natural texture of the stone was retained without polishing, but the surface was treated with two applications of linseed oil, which saturates the pores of the stone, and makes the surface less absorbent and susceptible to dirt and discoloring. Future maintenance and cleaning will be carried out with natural soap produced from a fruit called *Ritha*[15].

The exterior steps leading up to the entrance porch were likewise copied from the former Danish Government House with 5 cm solid flagstone with a rounded edge at the front and a more coarse surface texture by maintaining original cleavage structure that will be sufficient rustic at the exterior as compared to the interior and less slippery when wet.

Wall construction, renders and finishes of external facades

It appeared that the foundation, circular columns and load bearing masonry walls were all sound and solid with no serious cracks in the masonry, however, rising moisture due to capillary action in the foundations and lower part of the masonry had caused decay of the plaster in certain areas, and lack of maintenance was the obvious reason for an advanced deterioration of render and lime wash at all external facades (see fig x).

At the outset it was estimated that about 50% of the external rendering was in need of renewal, but when work started, the entire outer rendering was knocked down and renewed, including the cement rendering of the portico. Prepared at the lime preparation vat at site slaked stone lime was used to prepare the lime sand plaster in the proportion of 1: 3, which was applied in two layers to an average thickness of 25 to 35mm, and a final wash with lime water increases the strength and durability of the lime wash, and most

[15] More info required ??

important the breathable nature of lime helps maintain the building's equilibrium, controlling moisture and dampness

Plasters and finishes of internal walls

Internal wall surfaces were likewise renewed with lime mortars, however, a more even surface texture was obtained by a finishing coat of lime punning with a thickness of about 3mm made by a mixture of stone lime and shell lime in the proportion of 1: 3 with egg yolk, molases and traditional admixtures [16].

Final color scheme

Based on visual observations of the plaster and laboratory test of samples it was possible to apply the original color scheme of 1805, which proved to be similar to the early depiction in 1826 of St. Andrew´s Church in Kolkata as it appeared during its period of greatest significance (see fig. 1.). The facades were then treated throughout with a light ochre lime wash and all decorative architectural details, such as cornice, pilasters, pediments and architraves, were white washed.

Taking the historic design as point of departure for the restoration of the interior it was decided to lime wash the interior walls in a pale blue color and white wash columns and architectural details, including the architraves and window embrasures as well as the architectural details of the apse.

Structural steel members have been treated with zinc primer and wooden members have been sprayed with termite insecticides before the final coats of industrial paint in light yellowish color, while doors and windows have been painted with oil paint in a reddish brown color.

Front portico, church tower and steeple.

For economic and practical reasons the cement rendering at the church tower and steeple dating back to the renovation in 1989 has been retained, and it was decided to make only partial repairs, although a restoration proper should include a complete renewal with lime mortar. However, the cement render adheres well and the knocking down would eventually cause more harm than good to the fabric, and then only hollow-sounding patches where localized and cracks were cut out and repaired with a compatible cement plaster before repainting of the whole external surface in an appropriate color matching the whitewashed facades below.

The previous structural repairs, including the insertion of tie rods in both directions at two tiers of the steeple with the tie plates visible at the façade, as well as flat iron reinforcements of the arched openings to the belfry were all cut free, cleaned of all visible rust before treatment with anticorrosive zinc chromate primer and coated with graphite oil paint.

At the entrance porch all cement render was knocked down, however, and properly restored with a new render of lime mortar and white washed similar to the rest of the facades, including a remodeling of the capitals in the original design of the Ionic Order.

[16] More details required from Manish about the origin, composition and relative quantities of the additives

Woodwork and joinery

All doors and windows were dismantled, marked and safely stored after condition assessment had been carried out with an estimate of the extent of deteriorated parts that required renewal. The door window frames in particular were in a bad condition due to rod in the part of the frame, which had been let into the wall. Any deteriorated wood have been removed and new wood carefully spliced in, and the renewal were carried out primarily by reuse of sound and solid parts of the hard wood roof beams, which were no longer put back to use and could conveniently be cut to the required measures and be brought to new use and where replacement of windows and doors was unavoidable, great care has been taken to match the original quality of workmanship and design.

Renewed to the original design complete with double louver shutters at top and solid panels at bottom as well as bi-folded glass panel shutters to the inside the frames were reinstated in the facades after proper priming with creosote oil of all the sides of the frames in contact with masonry. Knowing that these parts of the frame are vulnerable to rod caused by the impact of moisture, a building detail commonly used in Denmark was applied, which is commonly used in Denmark by which a caulking joint firmly stuffed with tar impregnated jute fibers are applied before pointing with lime mortar mixed with cattle hair. This measure prevents any moisture in the wall to affect the wood frame and the caulking joint provides flexibility and breathability. The original, as well as the new and reused timber, have been cleaned, scraped, repaired with linseed-oil putty of all defects and sanded, while saving as much of the historic paint as possible before priming and repainting with oil paint in the original reddish brown color.

The belfry, clock work and church bells.

The wooden staircase leading from the terrace roof to the two tiers of the bell tower has been repaired together with the planks of the wooden floor, whereas the beams have been replaced by new steel beams. The wooden louvers inserted at the upper part of the arched openings were likewise repaired and supplemented by additional louvers in the openings at the upper tier, where the bell frame has been reinstated together with the new clock work.

The two bells in the belfry are both of European origin. The smaller one is cast in Frederiksværk, Denmark, bearing the inscription 'FREDERICKS VÆRCK ANNO 1804', while the bigger bell originates from Germany and the inscription reads 'CHRISTIAN VOGT STUTTGARD 1853'.

The restoration of the tower bell, which has been out of order since 1986, was commissioned to the renowned Kolkata based firm M/s TR Clock, including the delivery and installation of a new automatic clockwork that will ensure automatic 12-hour chiming, as well as restoration of the clock dial, which will show the actual time. Reinstalled in the original position at the second tier of the tower the two bells and the wood frame are now fully operational, but only the small bell is used for chiming. The old derelict clockwork is kept safely and exhibited behind a transparent cover at belfry.

Church ground, wall, guard houses and gate pillars

The original gateway flanked by two pillars and the one guard house, which has been maintained, have been restored and the part of the masonry wall facing on towards the street has been replaced by a steel railing that allows a free view of the building and church ground from the street and the town square. The design is inspired from the original iron railing mounted on top of the low masonry plinth as appears from contemporary photographs (see fig. X)

The large trees growing at the church ground have all been preserved providing an ever changing play of light and shade that maintain the pleasing surroundings that will be further enhanced by the planting of a row of new Frangipani trees all along the northern façade of the church at distance of about 6 meters to allow appropriate free space for the trees to mature. In the cause of time the *Kath Champa* trees, as they are named in Bengali, are expected to add to the attractive and peaceful ambience at the large green space to the north of the church, which can also be used occasionally for large gatherings and festivities, whereas the smaller space to the south is used for construction of social facility building and a toilet block.

Conservation for the future

On 16th April 2016 St. Olav's Church was rededicated by the Bishop of Calcutta, Rt. Rev. Ashoke Biswas, at a ceremony in the presence of Chief Secretary, Sri Basudeb Banerjee, Government of West Bengal. Subsequently, in the same year the restoration was honored as a work of distinction by the *Unesco Asia Pacific Award for Cultural Heritage Conservation.*

Ole Bie's vision of a town complete with a church facing on to a public square was realized in 1805 as a culmination of a rich and prosperous period in Serampore's development. Now restored to its original glory after the lapse of more than two centuries it can be hoped that St. Olav Church will be kept in good repair from year to year, and the building will last for centuries as a church serving the local Christian community as well as remaining the prime historic monument of the historic town.

Terminology:

Architectural finish includes a wide range of materials and decorative treatments which have been used for surface treatment. In general the details follow a classical tradition, which was in vogue for the decoration of colonial architecture all over India during the 18th and 19th centuries.

Bargash : Hard wood batten or roofing lath 50 x 75 cm square spanning the gap between the beams and used for the construction of the terrace roof as support of the superjacent tiles

Binding medium refers to the portion of paint that forms the film and binds pigment particles to each other and to the surface to which the paint or plaster is applied (e.g., linseed oil or animal glue).

Chunam: Plaster used in India that is usually highly polished and decorated , largely used in India, made of shell-lime and sea-sand.

Clearcole: A mixture of size and whiting or white lead, formerly used as a primer for distemper. A primer (for paint) containing white lead.

*Distemper***:** A term with a variety of meanings for paints used in decorating and as a historical medium for painting pictures, usually made from powdered chalk or lime and size (a gelatinous substance). Alternatives to chalk include the toxic substance white lead. The binding element may be some form of glue or oil; these are known in decorating respectively as soft distemper and oil bound distemper.

Gomlah: Flat bucket without handle used for mixing plaster

Gunney: Jute

*Khoah or Brick bats: C*rushed over burnt bricks used as aggregates to the lime concrete for roofing and flooring and filler for road constructions.

Lagree og Gur: Sugar produced from raw sugar cane

Maund and Seer: Traditional weight unit in India and South Asia. In British India, the *maund* was first standardized in the Bengal Presidency in 1833, where it was set equal to 100 Troy pounds. After the independence the definition formed the basis for metrication, one maund becoming exactly 37.3242 kilograms. The seer equals 1/40 maund, and, like the maund, it varied considerably from one area to another. The official size in British India was equal to 15 pounds or 0.9331 kilogram; that means 1 maund = 40 seers = 37.324 kilograms (Regulation VII of 1833).

Pigment refers to the finely ground material dispersed throughout a paint film or added to a lime wash that contributes primarily color and opacity to a paint or colour wash.

Mator: Sweeper

Saulwood or Salwood: Hard wood used for making doors and windows*,* Latin name *Shorea robusta*

Sizing or size**:** To apply glue or other primer to a surface which is to be painted, using any one of numerous specific substances that is applied to or incorporated in other material, especially papers and textiles, to act as a protecting filler or glaze.

Soorkey: Pounded brick dust used in India for building purposes as an aggregate to lime for making mortars, stucco. It has the property of making lime hydraulic taking the place of the European pozzuolana and other hydraulic cements.

*Soorkey or Surkhi : P*owdered burned bricks grinded to form red brick dust that is added as an aggregate to lime putty.

Whiting: Powdered and washed white chalk (calcium carbonate), used in metal polish, putty, and whitewash, and sometimes added to paint to improve the paint's opacity

Annexes

Annex A - Files with accounts of the 1819 renovation of St. Olav's Church, National Archives of Denmark, *Det Kgl. Ostindiske Guvernement. Kolonien Frederiksnagore. 2051. Regnskabsbilag, 1815-1820.*

"Serampore the Danish Church Repairation, & out of the four side's brick wall, & new building two Durrowan's house's in Church compounds out Gate, and Painting the wooden bar's & Iron Do., and Venicion Window's, Beams & Burrogas for Sundry Expences as follows. Serampore 30th June 1819, Gour Hurry Sircar. ".

		Sa. Rs.		
11 Inches Bricks 41,550 a 5 Rs per thousand		207	12	
9 Inches Do. 2,300 a 1/14 ans. per thousand		4	5	
16 pieces Foils a 3 ps. per ca. (?)			4	
1,090 Mds. Soorkey a 10 Rs. per 100 Mds.		109		
400 Mds. Khoah a 6 ls. per 100 Do.		24		
1,275 Mds. Mugrah Sand a 4/8 ans. per 100 Mds.		57		
675 Mds. Powder Chunam a 50 ls. per 100 Mds.		337	8	
286½ Mds. Cully Chunam a 3 Mds. per Rupee		95	8	
1 Mds. Europe yellow Oaker	8			
1 Md. 2 Seers Country Oaker	1. 13. 5			

1 Seer yellow paint 1.	10	13	5
2 Mds. 6 Seers Jagree a 1/13/6 per Md.	3	15	
368 Bamboo a 8 Rs. per hundred	46		
6 Mds. 38 Seers Jute a 1/10 ans. per Md.	11	4	9
28 Seers Jute's Rope a ¾ ans. per Md.	2	4	5
7 Seers Do. Twine a 1 anna per Piece (?) per seer		11	1
4 Gunney Bags a 1/3 Piece (?) per (?)		5	
30 Baskets a 12 … (?) Rupee	2	8	
160 Earthen pots a 3 Piece (?) per ea. (?)	2	8	
18 Do. Water pots a 6 Do. per ea. (?)		9	
41 Do. Gomlahs a Do.	1	4	6
4 Do. Do. large a 2 ans. per ea. (?)		8	
13 small earthen pots		1	8
38 earthen Molsahs		3	10
24 Do. Surrahs		1	2
20 Cubiks Guzzy (?) Cloth a 1 anna per Cubit	1	4	
Making the Iron Hatchets for cut the bricks		10	6
43 Durrah (?) matts a 24 per Rupee	1	12	3
35 ps. Mangoe Planks a 6 Rs per borge (?)	10	8	
1 Bottle of Country Rum		4	
Carried over [to page 2]	*932*	*14*	*1*
18 Ps Saulwood (?) Planks a 1 Rupee per ea. (?)	18		
18 wooden rubbers for cleaning Plaster		9	
3 ps. Soonory (?) woods for the corner		6	
2 stoes (?)	2	1	
Iron Hooks …(?) 34 1/4 Seers a 13 es. Per md.	11	2	1
1 ¼ Seers Nails		6	5
10 Earthen Gutters a 1 ans. a piece …(?)	1	1	6
5 Bundles Broom			
9 Ps. Saulwood's for the Doors 29½ Cubits a 6 ans. 6 pieces per Cubit.	11	15	9
Victuals to the Coolies for taking up the Khoah. Couries paid 17 Cahen 10 …(?) Rs.	3	3	3
Paid to Mator for cleaning			
14 Beams 6 by 5 Inches, length 8½ Cubits a 4 ans. 6 pies per Cubit being 2/6 ans. 3 p per being amt.	33	7	6
390 Cubits Burrogas a 10 Rs per Gorge (?)	19	8	
6 Mds. 31 Seers Iron bars a 14 Rs p. m.	94	13	8
186 Day's Bricklayer Mistry work being 6 month 6 Days a 6 Rs p. month.	37	3	3
2220§ Days Bricklayers work 73 months & 10½ days a 4/11 ans. p. month	343	13	3
1682 days coolies Do. being 56 months & two days a 2/12 ans. p. mth.	154	3	
256½ Days Cooly boys Do. being 8 Do. & 16½ days a 2 ans. p. do.	17		
8 pair iron hooks for venician windows	2		
12 Durmah mataa for making the Tatty		6	
1 Seer Twine for Do. Do.		2	
2 Ghurramys work for Do. Do.		4	
8 Saul woods Posts for the Bar a 2/14 ans. p. a.	23		
Paid to Mess.rs. Palmer Company's bill on acct. of 8 ps. lick (?) planks	80	8	
Do. to sawers works	15	2	7
Do. to carpenter mistry works for 6 months & 10 days a 7/8 ans. p. month	47	8	
Do. Carpenters work for 11 Do. & 29½ days a 6 rs. p. do.	71	14	5
Carried over S. Rup.	*1,928*	*12*	
636 Sewers (?) for the Rail a 10 ans. 9 pies per 100	4	1	9
344 Iron nails for do.		6	9
48 do. Hooks for do.	3		
7½ seers Bardigre (?) a 5 rs. p. seer	37	8	
3 Mds. 2 seers white lead a 16 ¼ rs. p. ms.	49	8	9
Pulgreen 5 lehn ks. (?	1		

1 Mds. Chalk a 3/12 ans. per ms.	3	12	3
2 Chu-ks Europe Black paint		8	
2 do. do. indigo	1	4	
12 do. varnish paint	1	8	
4 seers Europe red oaker	1		
Paid to Captn. Bearersen for a bill on paints	239	15	
7 cubits cloth		7	
2 seers Tarpinter (?) oil	2		
13½ do. wood oil a 12 rs. p. ms.	4		9
1 Ms Somebazar oil	16		
35 ¼ Seer Linseed oil a 3/8 ans. per. Ms.	10	1	
Ramlochun (?) painter mistry work 194 days being 6 months 14½ days a 6 rs per month	38	14	5
442 days painter works being 14 months 22 days a 4 rs p. month	58	14	11
Earthen pots for the paints		3	3
Sicca Rupees	***2,402***	***14***	***2***

Annex B –Technical notes with outline of the building restoration programme:
The provision of the consulting agreement of the assignment may be given in the following main phases, which shall be carried out according to a fixed and agreed time schedule. The planning and supervision of work shall be carried out in agreement with the architect advisor of the funding partner and the satisfying outcome of each phase shall be verified by the Building Committee.

1. Programme phase, including all decisions and contractual agreement
2. Proposal phase, including the preparation of condition survey, survey drawings and building archaeological investigations
3. Planning phase, including preparation of tender documents
4. Execution phase, actual construction work according to plan
5. Operational phase, including one year and five year review of quality of work

The tender documents shall be divided into well defined construction phases with a break down of building cost into specified budget lines for each activity separately, including the following items.

Initially, as basis of all subsequent work, the Church and ground with related structures were surveyed and measured by Total Station Survey. Subsequently, drawings of floor plan, roof plan, sections and elevations were prepare , including condition survey of all construction details and drainage system.

List of construction works:

1. Establishment of building site, signage and public information, scaffoldings, technical provisions, accommodation and the required amenities for the workers during the construction period.
2. Structural consolidation, renewal of wooden beams and restoration of the roof.
3. Restoration of the portico and the steeple, including the belfry, clock and clockwork.
4. External restoration of the facades of the nave and choir, including possible installation of moisture barrier in foundation and external drainage around the building.
5. Interior restoration of nave, aisles, choir and vestry, including colour scheme
6. Restoration of fixed joinery.

7. Restoration of pews and detached furniture, including inside finish of the vestry according to agreement about new use.
8. Renewal of electrical installations, including new interior lighting fixtures and lightning conductor at the steeple as well as loudspeaker installation.
9. Sanitary installations, including water supply, toilet facilities and drainage.
10. Restoration of the surrounding wall and landscaping of the church ground as a public recreational botanical garden or playground for children, including the possible construction of shelters, which may form pleasant amenities to the visitors or be required for a permanent guard on site
11. Artistic adornment
12. Miscellaneous, unforeseen expenses including the possibly installation of an organ

The financial contribution to the restoration was based primarily on the following conditions:

- Commitment to the project from all key constituents, in addition to public involvement by all concerned stakeholders in the restoration process.

- Dissemination of information about the scope and purpose of the project to ensure transparency, public awareness and full support of the area residents and the general public

- The restoration shall be carried out in compliance with local legislation and principles set out in the international charters on conservation following the highest technical and theoretical standards for conservation of cultural heritage.

- The project shall include the restoration of the church and redevelopment of the church ground as a recreational garden including the adoption of a management programme that ensure a sustainable future use as a church for the congregation and the Serampore College, as well as a heritage building with public access and use for cultural activities.

- Review and approval of all plans, tender documents, and selection of consulting architect, contractor and the actual implementation of work at all stages in the restoration process by the Steering Committee to ensure the highest standards of work. The National Museum of Denmark maintains an absolute veto on decisions concerning the execution of the project.

- Liabilities for the execution of the project according to the stipulated quality of work rest with the proprietor as the contracting authority appointing the consulting architect and engineer, who have the overall responsibility for the planning, tender procedures and supervision of all works on site, including verification of all disbursements before payment is being affected. The account of the project shall be reviewed and audited biannually by an external registered accountant firm and be submitted to the National Museum of Denmark.

- The Danish funding is subject to a Memorandum of Understanding and a separate contract between the The Calcutta Diocesan Trust Association of the Church of North India and the National Museum of Denmark verified by the Legal Adviser to the Danish Government.

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- *Tværsnitsanalyse på prøver fra eksteriør på St. Olav Kirke og South Gate i Serampore* , Bevaring og Naturvidenskab, Nationalmuseet, 12.maj 2014, Sagsopgavenr. 11041763 sign. MCC/gha. English summary: *Analysis of paint cross-sections from the exteriors of St. Olav Church and the South Gate in Serampore,* translated by Vibeke Rask, The National Museum's Conservation Department.

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Manish Chakraborti, *St. Olav Church restoration Progress Reports 01-08* covering the project period extending from 22.4.2014 to 15.9.2015.

Manish Chakraborti, *2016 Unesco Asia-Pacific Awards for Cultural Heritage Conservation, St. Olav Church restoration project description,* 2.9.2016.

Fig . 1. A contemporary painting of St. Andrew´s Church in Kolkata testifies that a similar original colour scheme could have been used for St. Olav with a pale ochre colour applied to the walls and all architectural details standing out in white. Notably the clock tower and the spire were treated in the same way as the main building and this factual information can justify the restoration of a similar palette at St. Olav Church. Credit: *A view of the Scotch church of St. Andrew's in Kolkata from the gate of the Tank Square* by James Baillie Fraser, 1826, detail of painting, British Library painting collection

Fig. 2. A hand-colored photograph taken by Frederick Fiebig in 1851 of St. Olav Church provides some clues to the exterior appearance by the mid 19thcentury. At this time the whole building has been colored in a pale cream or yellow ochre colour with no special treatment of the architectural detailing. The same indiscriminate use of pale ochre colour was also used for the Main Gate of the Government Compound during the British period, as testified by a similar hand colored photo. The gate pillars and adjoining walls are white, however, possibly a reminiscence of an earlier treatment. Photo credit: The Fiebig Collection at the British Library, London).

Fig. 3. The application of a uniform ochre color scheme as depicted in 1851 (see fig 2) has continued up to the present, apart from the entrance porch, clock tower and spire, which were painted all over in a grayish white colour at a renovation carried out in the 1990s, leaving no traces of any previous treatment of these parts of the external facades. Photo: Flemming Aalund

Fig. 4. In conclusion of the paint research it was decided to restore the original colour scheme and treat the external walls with a pale yellow ochre lime wash and accentuate the architectural details by a plain white lime wash. The photo shows the test colors applied to the north façade. Photo: Flemming Aalund.

Fig. 5. Appearance of the south façade after completion of final lime wash of the façade and painting of all woodwork. Photo: Flemming Aaund

Fig . 5. View of the upper part and ceiling of the apse before change of colors and completion of the restoration. The Neo- classical interior decoration with the fluted half columns, Corinthian capitals, pilasters and stucco garlands, as well as a dental cornice and plastered ceiling with stucco décor, was designed by Armstrong in 1806 (cf. fig X). In conclusion of the paint research the architectural details will be accentuated in white against a pale blue color of the wall niches. Photo: Flemming Aalund.

Roofing

Fig. 6. For reason of safety steel scaffolding was put up to support the roof beams as the very first intervention before dismandling of the entire roof construction. Photo: Flemming Aalund.

Fig. 7. The roof slab has been removed exposing the deteriorated wooden beam spanning the south aisle. The precarious condition of the roof structure is due to termite attack of roof beams and *barghas*, and the deterioration has aggravated further due to water leakage caused by cracks in the concrete screed . Photo: Flemming Aalund.

Fig 8 New roof construction Two layers of tiles are placed on top of each other and pointed with lime *surkhi* mortar supported by *borgas* and beams. Photo: Manish Chakraborti.

Fig. 9. The roof is being cast with traditional lime concrete in phases starting with the roof above the vestry. The second phase was cast on 21 April 2014 as shown on the photograph. Photo: Manish Chakraborti

Fig 10 The ramming and compacting of lime concrete is carried out continuously using wooden *trapies*. The workers sit close together, and beat the surface lightly and in rhythm and move forward gradually. The beating will normally have to be carried on for at least seven days until the *thapi* makes no impression on the surface and rebounds readily from it when struck. Photo: Flemming Aalund.

Fig. 11. After laying of the lime concrete, the roof is compacted properly by uniform beating, hardened and finished by adding a slurry of traditional admixture of *khayer and molases.* Photo: Flemming Aalund

Fig. 12. Additives of Jaggery, Molases, Yeast and other traditional admixtures ? More info required !

Fig. 13. The roof is left for curing under a cover of moist straw. Photo: Flemming Aalund

Condition of external facades

Fig. 14. Part of the northern façade with deteriorated render and the lower section of windows cut away and bricked up. Photo: Flemming Aalund

Fig. 15 Detail of the façade with large areas of decomposed render. The many successive layers of plaster and lime wash are clearly visible at the edge where the render is missing. Photo: Flemming Aalund

Remodeling of architectural details

Fig. 16. Cutting of the brick tiles used for remodeling of the capitals above the pilasters. Photo: Flemming Aalund

Fig. 17. Remodeling the capitals of the pilasters at the north façade. Photo: Flemming Aalund

Fig. 18. The architectural decorative features were all in a deteriorated condition and were renewed by masons from Mushidabad, who are well versed in traditional bricklayer's craft. Photo: Flemming Aalund

Fig. 19. The new window frames are primed with creosote oil before installment in the façade. Furthermore, the gap between the frame and the masonry is packed with a bitumen and jute fiber filling before sealing of the joint with lime mortar. Being a common construction detail in Denmark this precaution is being introduced to minimize risk for accumulation of dampness and subsequent development of rod in the wooden frame, which has proved to be a great risk in the past. Photo: Flemming Aalund.

Fig. 20 Different external paint color samples of redish brown on wooden panels and ochre color wash of the facades in search of the single best hue of the final paint. Photo: Flemming Aalund

Fig. 21. The contractor, Mr Asherjee Muchadjee, is expecting the newly laid sandstone floor in the nave. Photo: Flemming Aalund.

Fig. 22. Repair of the church furniture - pews, pew boxes and chairs, at site before installment in the original position inside the central nave. Photo: Flemming Aalund

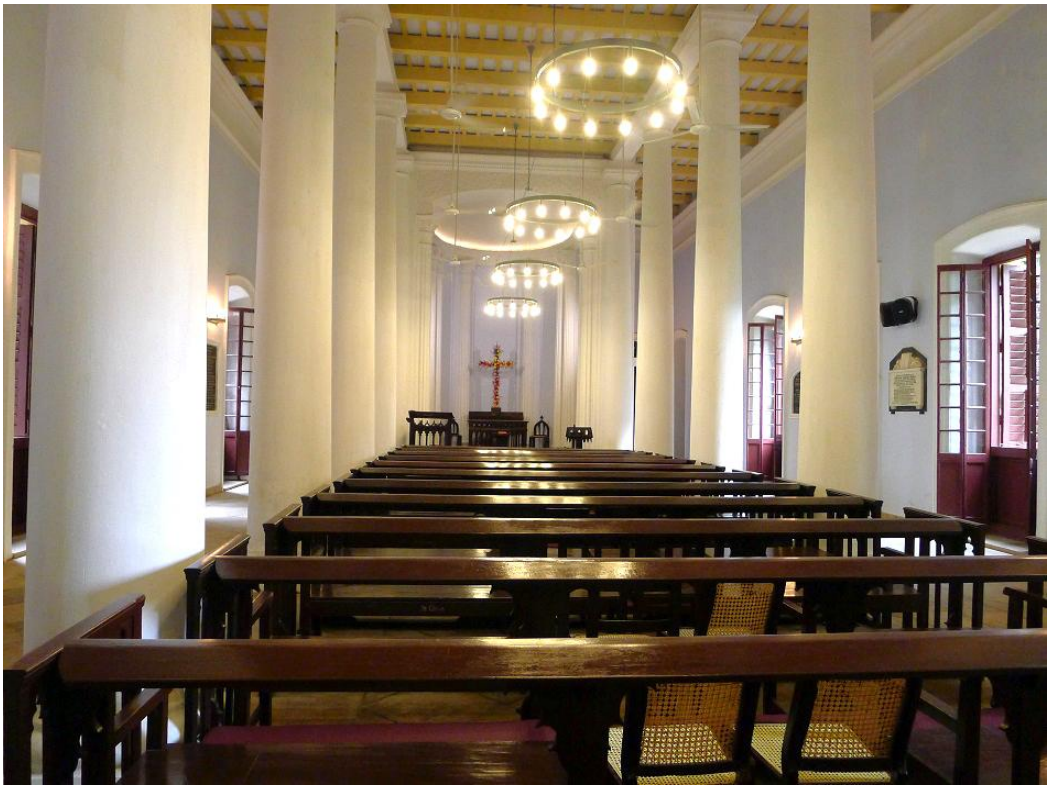
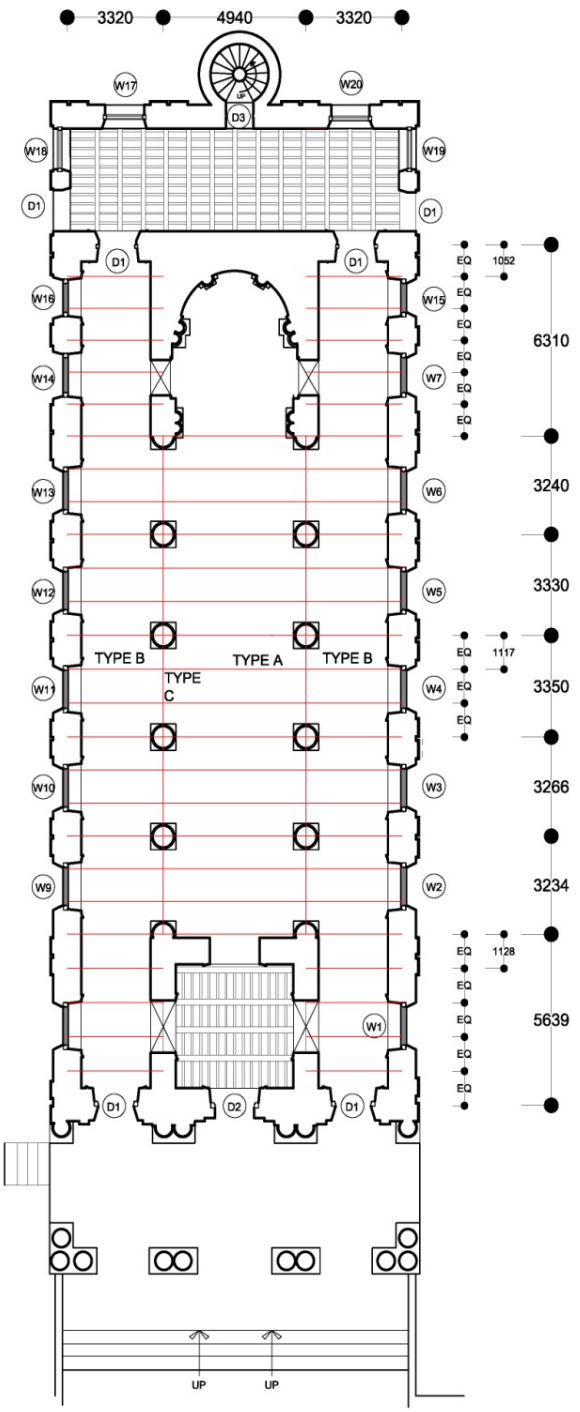
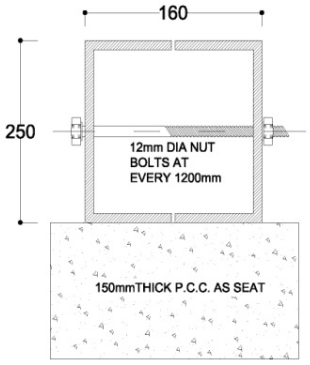


Fig. 23. After safe custody in Serampore College the church furniture have been repaired and put back in the original position. New custom designed circular ring pendant lighting fixtures are hanging from the ceiling of the nave, and half circular lighting fixtures are mounted on the walls of the aisles. Photo: Flemming Aalund.

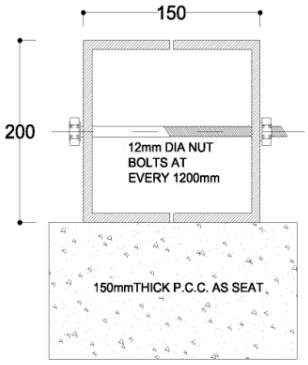
Fig. 24. Front of the church with the brick wall surrounding the church ground. Photo: Manish Chakraborti

Fig. 25. Front of the restored building with the previous brick wall replaced by a steel railing providing a free view to the church ground. Unfortunately the raised street level has reduced the number of steps leading up to the entrance porch of the church. Photo: Manish Chakraborti

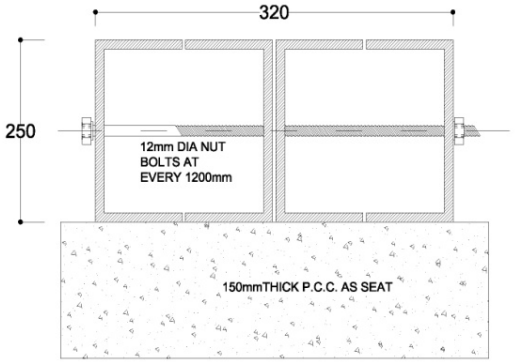




TYPE A : 250X160 — 2 Nos. ISMC Channel, Flange to Flange d = 250, b = 80,



TYPE B : 200X150 — 2 Nos. ISMC Channel, Flange to Flange d = 200, b = 75,



TYPE C : 250 X 320 — 4 Nos. ISMC Channel in 2Nos. box assembly d = 250, b = 80,

NOTE:
a)The bottom level of all the beams should be same
b)The beam should be painted with epoxy primer like Friazinc R of Sika or equivalent for protection against corrosion.
c) The beams should be wrapped with dense chicken wire mesh while placing the channels for tiles. It should be then plastered and chamfered at the edges at 45 degrees with a line on plaster to replicate the existing wooden beams.

Sl. No.	Beam Type	No. of beams	No. of ISMC per beam	Total No. of ISMC	Length of each Beam(m) approx.	Total Length of ISMC (m)
1	A	16	2	32	5	160
2	B	50	2	100	3.3	330
3	C	10	4	40	3.3	132

PROJECT NAME	DRAWING	PROJECT OF	STRUCTURAL CONSULTANT			NOTES/ REMARKS	CONSULTANT	
CONSERVATION OF ST. OLAV CHURCH, SERAMPORE	STEEL BEAM LAYOUT	CALCUTTA DIOCESE TRUST ASSOCIATION (P) AND NATIONAL MUSEUM OF DENMARK	HIMADRI GUHA		DRAWN: DIPIKSHA CHECKED: MANISH SCALE: 1:150, 1:5 DATE: 28/02/14		Continuity	01

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

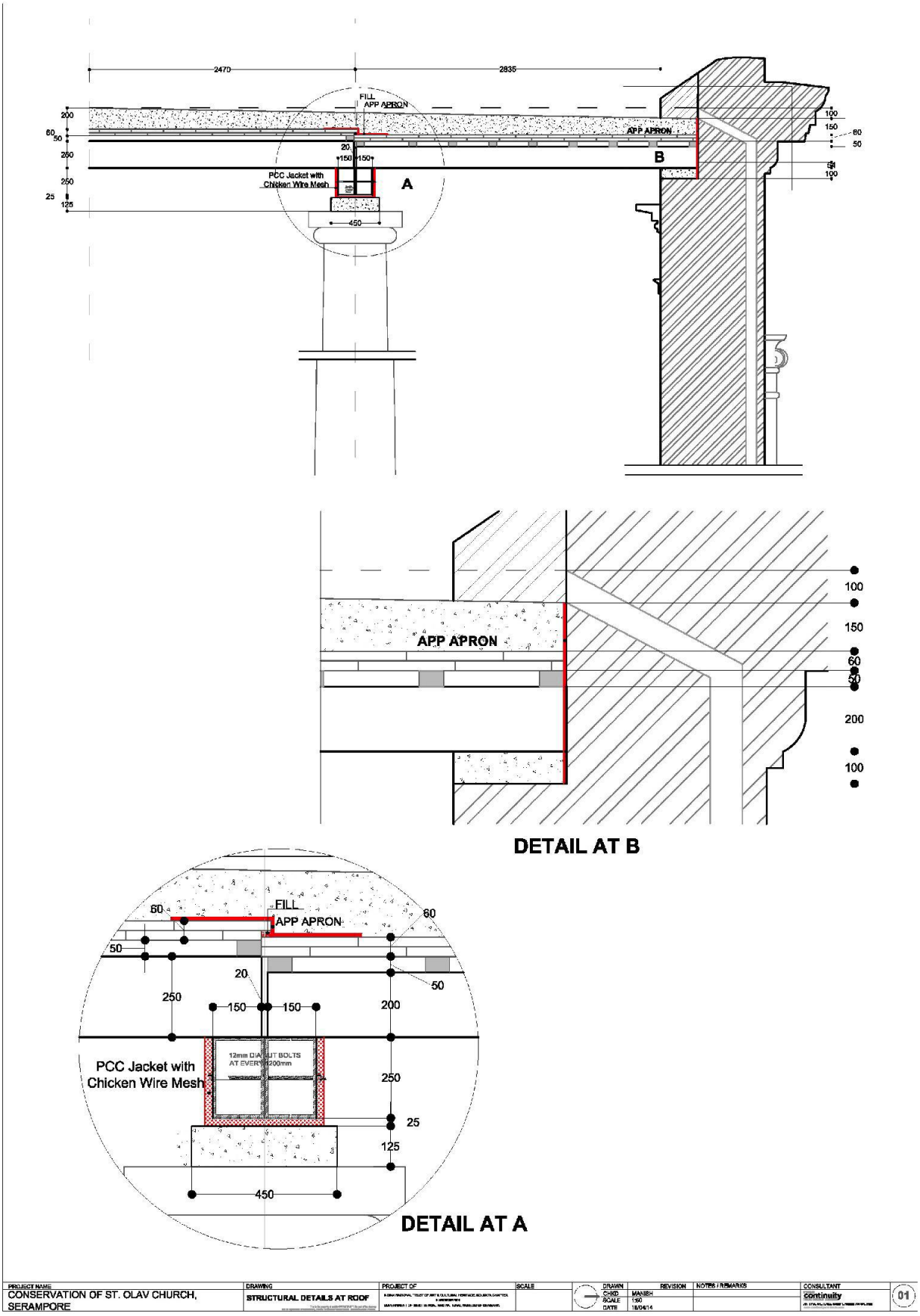


Fig. 27. Drawing of roof construction, section and details A and B. Conservation architect Manish Chakraborti.