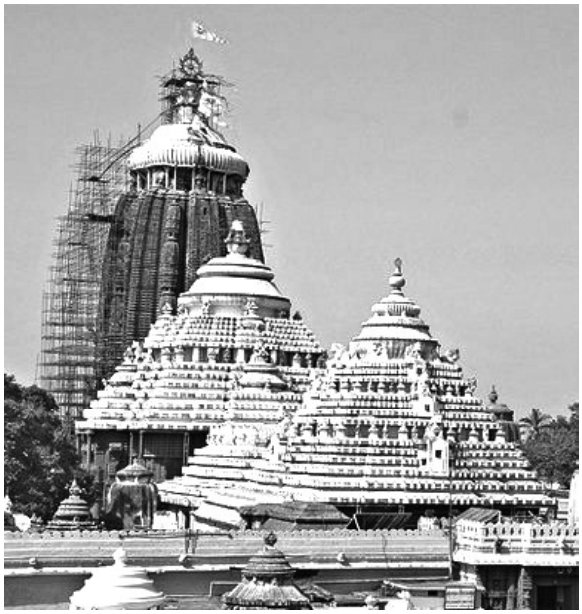
Deplastering and Conservation of *Jagamohana* of Sri Jagannatha Temple, Puri

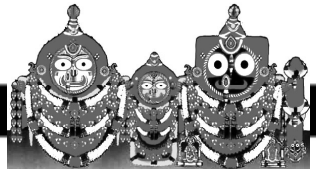
Dr. Nanda Kishor Swain

The temple of Jagannatha at Puri (Lat. 19^0 18' 17" N; Long. 85^0 51' 39" E), situated on the shores of the Bay of Bengal occupies a pivotal position in the religious history of India. The *puranas* and other Sanskrit texts refer to this holy city by various names, viz. Nilachala, Nilagiri, Niladri, Purusottama, Purusottamakshetra, Srikshetra, Sankhakshetra, Jagannathakshetra and Purusottama Puri on account of its great sanctity. According to tradition, the temple was originally built by Yayati-II of Somavamsi dynasty on the site of the present shrine. But the epigraphical records fully support that it was Chodaganga Deva (*circa* 1112-1147 AD) who built the present temple in first half of 12th century AD. The temple has two big concentric walls and four entrance gateways both in outer and inner walls. The outer wall of the temple is known as *Meghanada Prachira* (203m x 195m) and the inner wall is known as *Kurmi Vedha* (128m x 96m). The entrances on the eastern, southern, western and northern sides of the outer enclosure are known as *Simhadvara, Asvadvara, Vyaghradvara*, and *Hastidvara* respectively. The temple, as it stands today consists of a *rekha deul* (sanctum) with a curvilinear *sikhara, a jagamohana* with a pyramidal super structure, a *nata-mandira* (hall of dancing), and a *bhoga-mandapa* (hall of



offering), all in the same axial alignment. Of these, the last two structures appear to have been subsequent additions during the 15th century AD.

The *jagamohana* or *mukhasala* is the congregation hall of the Jagannatha Temple, Puri. It is a *pidha deula* similar in plan and elevation to those of others in Kalinga style of temple architecture. The walls (*bada*) of the *jagamohana* are similar to those of the main temple, except for doorways in the middle of each side. Its pyramidal roof rises to a height of 37m and consists of two tiers of *pidhas* separated by a recess and



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surmounted by the *kalasa* and a*yudha*. The tiers contain seven and six *pidhas* from below upwards. The *jagamohana* has an internal space of 11m x 11m square with an average wall thickness of 5.5m. The walls are vertical upto 7.25m from floor level, after which there are corbelled layers for 4.5m. There are all total seven pockets or niches, both lower and upper in east, north and south and only one bigger niche in the west, inside the *jagamohana*. The *jagamohana* is a lofty hall; the heavy weight of the roof is additionally supported by four free standing columns in the centre, the load transference being through eight stone beams placed in pairs. Each of these eight beams is supported in turn by one iron beam, which are received by the stone capital blocks above the stone columns. The pyramidal roof begins at a lower level than the top of these pillars and goes on ascending till it reaches the level of the capitals of these columns.

After the successful deplastering and conservation of the sanctum and other shrines of the temple complex, there was a long standing demand from the Temple Administration and State Government to take up the deplastering of *jagamohana*, *nata-mandira* and *bhoga-mandapa* in the same line of the sanctum as was done in the past. As acute distresses were observed due to development of cracks at the roots of projecting cantilevers of the *jagamohana* which are supported with props at the edges, and falling of stones and chunks of lime plaster posing serious threat to the safety of Sevayatas and the pilgrims, the Chief Administrator, Sri Jagannatha Temple Administration, Puri requested the Director General, ASI by a DO letter dated 22.06.2006 to take up the work of deplastering and conservation of the *jagamohana* of Jagannatha temple, Puri[1].

Keeping the above request in view, it was decided in a meeting held on 05th July 2006 between the Chief Secretary, Government of Odisha and Secretary (Culture), Government of India that the deplastering and conservation work of the *jagamohana* of the Jagannatha temple would be taken up by ASI in a phased manner and stressed to revive the Technical Committee constituted earlier during the conservation of the *garbhagriha* of the main temple or to constitute a fresh Technical Committee for the purpose to suggest necessary conservation measures[2]. For that purpose, a Technical Expert Committee was constituted by DG, ASI on 24th July 2006 under the chairmanship of DG, ASI with the members as follows[3]:

(I) Director General, ASI	Chairman
(II) Joint Director General, ASI	Member
(III) Director, Conservation, ASI	Member
(IV) Secretary, Works Department, Government of Odisha	Member
(V) Prof. G.C. Mitra, Ex-Secretary, Works Department, Government of Odisha	Member
(VI) Prof. A.P. Gupta, Prof. and Head, Department of Civil Engineering, IIT, Kharagpur	Member
(VII) Superintending Archaeologist, ASI, Bhubaneswar Circle	Co-ordinator
(VIII) Superintending Archaeologist Chemist, ASI, Bhubaneswar, Science Branch	Member
(IX) Superintendent, Odisha State Archaeology	Member
(X) Dr. N.C. Pal, Executive Engineer (R & B), Bhubaneswar	Member

(XI) Chief Architect,
Government of Odisha Member

(XII) Sri D.P. Mishra, Ex-Secretary
Works Department,
Government of Odisha Member

The first meeting of the Technical Expert Committee was held on the 29th October 2006 at the conference hall of Hotel Mayfair, Puri under the chairmanship of DG, ASI wherein it was decided that initially the deplastering and conservation work would be started from *jagamohana* of Jagannatha temple and the conservation work of remaining structures like *nata-mandira* and *bhoga-mandapa* would be taken up in a phased manner thereafter[4]. The work of removing of plaster should be taken up from bottom to top after supporting the cantilevers all around. The restoration work of Jaya Vijaya Dvara was to be taken up simultaneously and was to be included in the estimate for restoration work of *jagamohana*. It was decided that before taking up deplastering work of these structures, a few patches of plaster were to be removed from by 3rd week of December 2006 for accessing the thickness of plaster, condition of stone underneath, and to access the extent of intricate carvings and sculptural works. In the same meeting, Prof. G.C. Mitra, a member of Core Committee was requested to frame an estimate of the deplastering and conservation of *jagamohana*.

To examine the deplastering and subsequent conservation work at regular interval in the line of the main temple as was done in the past, a Core Committee was constituted in the meeting by DG, ASI with the following members[5]:

(I) Prof. A.P. Gupta, IIT Kharagpur, Chairman.

(II) Prof. G.C. Mitra, Ex-Secretary, Works Department, Government of Odisha, Member.

(III) Dr. N.C. Pal, Executive Engineer (R & B) Bhubaneswar, Member.

(IV) Sri P. L. Mohopatra, Ex-Superintending Engineer (Electrical) as Special Invitee.

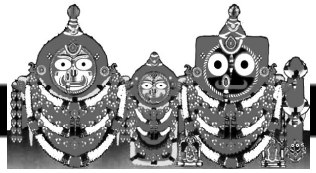
(V) Shri D.P. Mishra, Ex-Chief Engineer (R & B), Government of Odisha, Member.

(VI) Superintendent, Odisha State Archaeology, Member.

(VII) Superintending Archaeologist, ASI, Bhubaneswar Circle, Co-ordinator.

Besides above, the Works Department, Government of Odisha had already constituted a Technical Expert Committee for issuing necessary guidelines/suggestions for attending day-to-day conservation work of Jagannatha Temple.

After series of site visits and reviews, the detail estimate of Rs.1,40,82,000/- for deplastering and conservation work of *jagamohana* was prepared by Prof. G.C. Mitra, Core Committee member in consultation with ASI which got the approval of DG, ASI on 29th September 2011[6]. The sanctioned estimate had the provisions of PMC for sealing of joints and cracks, consolidation of masonry of structure by PMC injection grouting, anchoring of loose stones and corbels by stainless steel anchors with epoxy grout, stainless steel frames inside the pockets of *jagamohana*, stainless steel supporting system to augment the capacity of existing wrought iron supports. After finalising the tender process, the ASI entrusted to Ms. Nu-Pragati, Kolkata for execution of works like joint sealing, PMC grouting, drilling and anchoring of pins, etc., while the rest of deplastering and conservation work were taken up departmentally.



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Before taking up the deplastering work on the outer side vertical walls (*bada*) of the *jagamohana*, complete drawing and photo documentation with video/still/digital photography including write-up on existing carvings over the plastered surface were attended to. The two props (stanchions) supporting the cantilever roof of *jagamohana* in the north-east corner were found out of plumb. Before starting the work, they were each provided with eight vertical pipes with plates at the top and bottom which were later replaced with permanent supporting system. During the execution of work, complete barricading were provided on the working area thereby restricting the entry of public to the working zone. The deplastering work was taken up by engaging highly skilled temple artisans for careful removal of lime plaster from the underneath sculptures and decorative architectural fragments of the outer wall of the *bada* of *jagamohana.*

As a trial, the deplastering work was started in January 2012 in a one meter width vertical strip from bottom to top of the wall (*bada*) of *jagamohana* in the north-west corner near to Nabhikata Mandapa. The actual deplastering and conservation work was taken up during 2013 in the north-west corner, followed by north, north-east, south-east, south and completed in the year 2016 in south-east corner. The deplastering work, as was expected, revealed the typical features of the *bada* of an Odishan *pidha jagamohana* like Sun temple, Konark, Lingaraj temple, Bhubaneswar, etc. with exquisitely carved sculptural and architectural members like *pidha-mundis, khakhara-mundis*, *dikpalas*, *nayikas*, erotic motifs, scroll work, creepers etc. The details have been discussed in section dealing with art and architecture of this volume. The *bada* was exposed in damaged and distressed condition with large number of cracks, voids, fissures, bulged and out of plumb stones, weathered and worn out stone members which needed immediate attention as per archaeological norms and principles. The damages were more severe in the southern side as was apprehended like the main temple. After deplastering, the typical pieces of detached plaster, decomposed iron clamps and dowels, damaged and worn out architectural members were documented in detail before undertaking their restoration work. Even documentation on location of nipples for grouting, anchor pins, quantum of grout consumption location-wise, details of joint sealing, chemical preservatives/water repellant etc. were done with appropriate geometrical references to facilitate future monitoring. The damaged, worn out and missing stones were replaced with new khandolite stone blocks as per original shape and size, laid and bonded with traditional key jointing system and further strengthened with insertion of stainless steel pins/clamps and anchors. The rusted and decomposed iron clamps and dowels were also replaced with stainless steel ones. As was done in the main temple, the distressed areas and major cracks of the vertical wall were sealed and grouted, as per necessity, with polymer modified cementicious (PMC) mortar in horizontal bands of 2.5 m heights each. The unstable and bulged out architectural members and statues were pinned with stainless steel bars of S-316 grade with 25 mm diameter of 1 m to 2m length by drilling 30mm diameter holes and the pin holes were filled with PMC grouting. Minor cracks and joints were sealed with cement/lime/khandolite stone powder mixed mortar. Simultaneously chemical cleaning and preservation were also attended to.

After removal of the thick lime plaster, the remnant of lime was removed chemicho-

mechanically. Keeping in view to problems like susceptibility of the stones to weather, growth of micro-vegetations and effect of salinity on the stone surface, the chemical treatment and preservation was carried out. The preservatives measures applied were of paper pulp treatment for extraction of soluble salts, removal of dust, dirt and micro-vegetation, and application of fungicide (zinc silico flouride) to arrest further growth of micro-organisms followed by application of water repellent (Wacker H100). The weathered and worn out stones were applied with a preservative coat of poly methyl methacrylate.

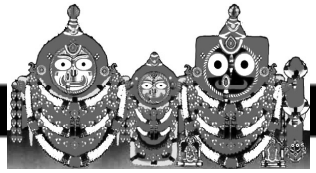
As the work did not complete within stipulated time, the time limit of the contract of M/s Nu-Pragti for PMC grouting, joint sealing, anchoring etc. was extended for a period of one year from 28.01.2015 to 31.01.2016[7] and subsequently upto 31.08.2016[8] by DG, ASI with a request from SA, ASI, Bhubaneswar Circle.

It was recommended earlier to take up the roof of Jaya Vijaya Dvara of *jagamohana* and redo the same after effecting repairs to the supporting beams or replacing the same. After inspection, the roof was found in stable condition. Therefore, only grouting was attended from both inside and outside.

The *nilachakra* and *kalasa* of *jagamohana* were repaired during the *Rathayatra* of 2013. It was detected that the damages caused to the *kalasa* were mainly due to the corrosion and rusting of the embedded metal shaft of the *asthadhatu nilachakra*. Therefore, all the 15 layers of old stones of *kalasa* were gently dismantled after numbering each stone, photo documentation, detailed drawings etc, and reconstructed by replacing the damaged stones with new stone blocks as per shape and size. The iron dowels were replaced with stainless steel pins. The iron nuts and bolts of *nilachakra* were also replaced with brass nut bolts. Before reconstruction of *kalasa,* the shaft of *nilachakra*, confined within the masonry were treated with three different layers of preventive anti-corrosion paint. For safety of the structure, lightening arrester system was provided from *nilachakra* of *jagamohana* to the ground by the Works Department, Government of Odisha.

While submitting the estimates for deplastering and conservation of *jagamohana* during 2007, Prof G.C. Mitra, Advisor, IIT Kharagpur, Bhubaneswar campus and member of the Core Committee had recommended that before the conservation works were actually started, the condition of pockets of *jagamohana* were to be physically inspected for arranging adequate supports and for taking up preservation works in the pockets, particularly because fall of stones in the Sun temple, Konark and Sri Gundicha Temple, Puri were started from the pockets[9]. Further, it was also decided to thoroughly examine the interior of *jagamohana*, particularly the pockets and niches during the Core Committee meeting held on 15th February 2012 under the chairmanship of DG, ASI[10].

The interior of *jagamohana* was jointly inspected by the members of the Technical Expert Committee, ASI officers and Temple Administration engineers during the 2015 *Navakalevar-Rathayatra* on 22nd and 23rd July 2015. After inspection it was observed that many interior locations of *jagamohana* were in critically distressed condition with falling down of four pieces of stones from the ceiling of pockets – one from south lower pocket and three from the western pocket. Two main beams were found resting on the north-west column in a dangerous



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condition and the column head had given way. The ceiling and some supporting beams were also found cracked. The plaster was noticed in a weak and dead condition. Corrosion induced cracks were found in the wrought iron beams and clamps. The visual observation of distress noticed during the inspection (before removal of interior lime plaster) gave clear signs of structural deterioration which cautioned the experts and ASI authorities concerned and activated them for immediate action for ensuring the structural stability of the *jagamohana*. Some temporary supporting arrangements were made to support the beams resting on the cracked stone column on the north-west side to avoid any accidental failure.

Subsequently a meeting of Core Committee was convened on 31st July 2015 to assess the gravity of the situation and to finalise long term structural conservation measures for the stability of the *jagamohana*. The committee unanimously recommended to completely deplaster the surfaces of the interior walls and pockets of *jagamohana*[11]. It was also decided to repair and strengthen the damaged columns of the interior and to provide the stainless steel frames in the pockets, as per necessity.

After going through a series of meetings and discussions with the Sevayatas, Niyogas and other stakeholders of Sri Jagannatha temple, finally the Temple Administration allowed the ASI to start work inside the *jagamohana* on 27th January 2016 with condition that deities would not be shifted from *garbhagriha* and working hours were limited to 11 am to 6 pm rescheduling the remaining hours of the day for performing rituals and *niti*s as per convention. Before deplastering was taken up, ASI erected a multipurpose tubular scaffolding system inside the *jagamohana* along with adequately safe and strong staging to reach all heights for close observation to all the overhead members of roof, columns, pockets, etc.

The dead lime plaster from all the interior locations of *jagamohana* like stone columns and beams, walls, corbelled portions of walls and roof, niches of pockets, etc. were gently and carefully removed exposing the original stone surface for detail examination of the extent of damages and for taking up appropriate conservation measures. Removal of the plaster brought to light innumerable structural cracks and hidden damages in the main stone beam-column system, which supports a significant part of *jagamohana* loading. Wide structural-through-cracks at mid-point (flexural cracks) in all the eight supporting stone beams besides structural cracks near support (shear crack) in those beams were also found. Splitting tensile cracks in all the four load bearing columns were also observed. The capital on the north-west corner column was the most distressed with significant cracks and dislodged blocks. The cause of distress of this column might be differential settlement of foundation due to seepage of water around the column from the active drain nearby. Widening of stone joints with out-of-plane deformation at many locations were noted in the walls, corbels and pockets. The fascio stones of pockets showed separation from the main body of the wall due to mainly falling of stones and development of cracks due to rusting of iron dowels. The strengthening of pockets was found absolutely necessary to retain its geometrical and structural stability.

It was considered imperative to carry out urgent repair and conservation measures with appropriate structural and chemical intervention so as to prevent further deterioration of the monument while ensuring its global stability and longevity for future. The ASI carefully taken out

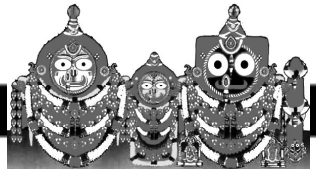
all cracked and damaged stone members from walls, corbels and pockets and replaced those by newly dressed stone blocks with stronger bearing capacity as per shape and size. A total number of 59 damaged, dislodged and falling stones were replaced including 7 from the pockets. Sealing of stone joints on masonry and grouting by gravity to fill unknown voids inside stone masonry were taken up. Broken stone capital of north-west corner pillar was repaired and strengthened by resetting broken parts, pinning by stainless steel rods, grouting and finally confined the entire capital by using stainless steel plates and rods. The rusting and corrosions from the iron beams were gently removed and applied with coats of anti-corrosive paints for preventing further rusting. Temporary support frames were provided on east, north and south sides to support the distressed/cracked beams.

For repairs and retrofitting to cracked pillar capitals and stone beams atop the stone columns, expert advice from ASI headquarters as well as from the National Centre for Safety of Heritage Structures of IIT, Madras were sought by ASI. There were recommendations for a well designed supporting system around stone column on north-west corner, confinement of broken stone capital of column using stainless steel plates, rods, etc., improving and water tightening to the existing old drain near the north-west column, and taking up some important structural Health Monitoring System for better understanding of the structural behavior of *jagamohana*, cathodic protection or sacrificial anode for safeguarding iron beams against rusting. In addition, member-level repair and strengthening techniques, such as stainless steel stitching, post-tensioning or fibre-wrapping could have been explored.

Remedial measures and recommendations made by IIT, Madras as well as ASI headquarters were placed before the Core Committee which met on 18th March 2016[12] and 29th March 2016[13] for finalisation of works as well as action plans. After reviewing the available options recommended by IIT Madras and others, interaction with other stakeholders and taking into account similar nature of problems vis-s-vis conservation measures as adopted by ASI and other agencies in the restoration work of *garbhagriha* of Jagannatha temple, Puri and *jagamohana*s of Lingaraja temple, Bhubaneswar, Sun temple, Konark, and Sri Gandicha temple, Puri, the following recommendations were given by the Committee for conservation and strengthening of each of the structural elements under distress[14].

1. The capital of all the 04 columns showing series of distress/dislocation were to be confined by stainless steel plates of 12mm thick.
2. Local jacketing/confinement of all the four distressed columns by stainless steel plates, matching to the existing architectural ambience.
3. Introduction of stainless steel portal frame inside all the seven pockets.
4. An integrated stainless steel support system with portal box frame near the four central columns to support the cracked stone beams with provision of necessary foundation by cutting the floor.

During the meeting ASI requested the Core Committee to prepare the design for structural stainless steel box frame system to support the cracked beams and it was decided that the work would be taken up by the state Public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Works Department. The design submitted by the Core Committee was forwarded to DG, ASI by SA, ASI Bhubaneswar Circle on 09th April 2016 for necessary approval.

The DG, ASI constituted a Technical Committee under the chairmanship of Jt. DG (Monuments) to examine the designs of proposals for providing stainless steel framed support under stone beams and pockets of *jagamohana* received from SA, ASI Bhubaneswar Circle which was prepared by the Core Committee. The meeting of the Technical Committee was held on 05th May 2016. After going through the provisions made in the said proposals and discussing various related issues, technical parameters etc., the Committee was of opinion that such kind of intervention by placing stainless steel portal frame support under cracked stone beams should be avoided[15]. Even the Committee raised the question on the stainless steel support system proposed for the pockets and niches. The Committee recommended that a comprehensive study of the existing cracks in the beams might be conducted by a reputed agency such as IIT, Madras who would examine the distress pattern and movements within the structure, if any. Based on their analysis and recommendations, a permanent solution/intervention might be worked out[16].

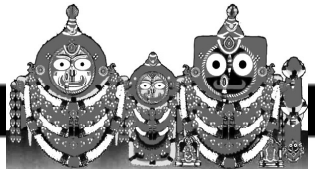
After receiving the minutes of the above meeting, Prof. G.C. Mitra tendered his resignation to DG, ASI from the Core Committee by a letter dated 12th May 2016 without citing any reason[17]. But the motive behind the resignation was to protest the ASI's inactiveness in the Technical Committee meeting held on 05th May 2016 in finalising the stainless steel box type portal frame for supporting the distressed beam-column system. With the resignation of Prof. Mitra, the controversy surrounding the repair of *jagamohana* of Jagannatha temple was deepened.

Local TV Channels and leading national and local dailies including the social media made the issue viral. There was great hue and cry that the *jagamohana* of Jagannatha temple was in great danger and its structural stability was a matter of great concern. The Indian Express, on the basis of interview of Prof. Mitra, highlighted the dangerous condition of *jagamohana* on its 16th May 2016 issue with a caption "Heritage under scanner: repairing of *jagamohana* of Puri temple faces fresh setback"[18]. The Samaja, a leading Odia daily reported, "Srimandira may go in the same way as the Sun temple, Konark had gone: says Core Committee member after resignation"[19].

Shri Naveen Patnaik, Chief Minister of Odisha by a DO letter dated 13th May 2016 addressed to the Prime Minister of India brought the distressed condition of *jagamohana* to his immediate notice and emergency intervention[20]. He wrote,

"I have been informed that the condition of the inside of 'Jagamohana' is alarming due to severe distress/deterioration in its critical structural components resulting in dislodging/cracking of capitol stone layers atop the pillar head of the four central columns besides extensive structural cracks in the stone beams over these columns supporting the pyramidal roofing structure. Incidents of falling of stones from the pockets have also been reported. Temporary supports are only provided now to avoid any accident and the devotees are not allowed to enter the Jagamohana premises from safety point of view.

I would, therefore, request your kind personal intervention in the matter to save this



monument before any unfortunate incident. The Director General, ASI may be instructed to reconsider the proposal of stainless steel supporting frames and come up with a concrete solution as early as possible in the interest of safety of this holy shrine."

After seeking the Prime Minister's intervention to ensure immediate repair of *jagamohana*, Shri Naveen Patnaik, Chief Minister of Odisha visited the Jagannatha Temple, Puri on 18th May 2016 for a first hand assessment of the damages in *jagamohana*[21].

The matter was so sensitized that a PIL Writ Petition (WP(C)(PIL) No. 9098/2016, Abhishek Das Vrs. Union of India and others) was filed in the High Court of Odisha, Cuttack by one Abhishek Das on 19th May 2016 alleging delay and inaction of ASI in the implementation of conservation measures in the *jagamohana* of Jagannatha temple to protect it from collapsing which was in great danger[22]. The petitioner prayed to the High Court to issue appropriate directions to ASI for completion of the repairing works of the temple within stipulated time so that it could be saved for posterity.

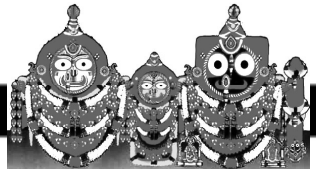
The High Court of Odisha took up the case seriously and kept on watching the latest developments and the progress of the conservation work carried out by ASI at the *jagamohana* till its completion in June 2017. The High Court regularly monitored the work by directing ASI to submit time to time status/progress report of work by filing affidavits. It fixed timeline to ASI and other executing agencies like PWD and Temple Administration to complete all the conservation work by June 2017.

As a follow up action, Ministry of Culture, Government of India through the ASI promptly responded to the issues raised particularly in the DO letter of the Chief Minister, Odisha to ensure conservation measures for the structural stability of the *jagamohana*. A team headed by N. K. Sinha, Secretary (Culture), Government of India with D.G, ASI and other senior technical officers was deputed on 20th May 2016 to undertake inspection of the temple and to finalise the necessary remedial measures[23]. After examining the condition of the temple, the matter was reviewed in a high level meeting, co-chaired by Secretary (Culture), Government of India and Chief Secretary, Government of Odisha held on 20th May 2016 at 4.00pm in the State Secretariat, Bhubaneswar to take the urgent decision for a permanent solution to address the structural safety of *jagamohana* and ensure longevity of that great temple. Besides the senior technical officers of ASI, the joint inspection and the meeting was attended by the members of the Core Committee, Professors of IIT, Madras, IIT, Bhubaneswar and NIT, Rourkela, Principal Secretary (Works), Government of Odisha, Principle Secretary (Law), Government of Odisha, Chief Administrator, Sri Jagannatha Temple Administration, Regional Director (East), ASI , etc. The Secretary (Culture) discussed with all stakeholders, ASI officers, reputed academic institutions, etc. on the proposals of the Core Committee which were as follows:

(i) Strengthening the inside pockets of *jagamohana* by stainless steel space frames, and

(ii) Supporting the distressed stone beams by stainless steel portal box frames.

The opinion of professionals on the proposed interventions to the distressed conditions of the *jagamohana* was divided as



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the system appeared stable with readjustment of load paths and interlocking even with the cracked system.

Initiating the deliberations on the proposals of Core Committee, Prof. G.C. Mitra informed that the proposal of pocket frame was in line with the intervention strategy as implemented inside *garbhagriha* of Jagannatha temple during 1992-93 restoration works and in Sri Gundicha Temple, during 1993-94 restoration works. The proposal of pocket frame was, in fact, a part of the earlier estimate, sanctioned by the DG, ASI during 2011. Accordingly, provision for funds was made based on actual quantity of steel required as obtained from the physical measurement of the pockets. These pockets could not be visualised earlier as the inside of *jagamohana* could not be inspected due to ritualistic restrictions. Prof. Mitra informed that during inspection of those seven pockets in July 2015, falling of cantilever stones from the inside corbelled profile of the pockets was noticed after taking out the veneering and decorative ply sheets fixed on the face of the pockets. He explained that the stability of the four inclined plates depends on maintaining the geometric profile of these pockets and saw crucial for stability of the *pidha* structure. Falling of corbel stones disturbed the geometrical profile and such localised instability were a precursor to global stability problems. He gave similar examples of instability in the partial failure of *jagamohana* of great Sun temple at Konark, where 'cave in failure' of the southern and western pockets, collapse of four central columns and supporting beams possibly occurred, as recorded by Mr. Bishen Swaroop, who was an engineer of the project during 1903 restoration works. As a result, the British engineers had to fill up the inside with rubble masonry retaining walls and sand, making the *jagamohana* permanently closed. He further explained that similar situation of closing the inside was however avoided, in the *pidha deula* at Sri Gundicha temple, Puri, when 27 stones from the interior pockets and corbelled roof fell down suddenly without any warning during February 1994. These pockets and corbelled roof were supported by similar steel frames during 1994 restoration works, which are functioning very well. Clarifying a query of Secretary (Culture) regarding the safety margin that might be achieved by introducing the pocket frames, Prof. Mitra informed that those frames should address 50% of the present instability situation of the slopes. Dr. N.C. Pal, member of the Core Committee, suggested that the pocket frames should contribute to the global stability and the proposed scheme was reversible in nature.

The Professors from IIT, Madras, however opined that the falling of corbel stones were mainly due to rusting effect of the wrought iron beams and dowels leading to tension cracks and, therefore, those were of localised nature. Therefore, the matter could be attended to without providing such frames within those pockets. On a query from the Secretary (Culture), whether such pocket frames would be detrimental to the global safety of the structure, the Professors from the IIT, Madras opined that they were not in a position to offer any observation without a detailed study. Secretary (Culture) and Chief Secretary, Government of Odisha requested IIT, Madras to complete that study within two months and to submit a proposal at the earliest. Professors from IIT, Bhubaneswar and NIT, Rourkela agreed to the observations and the proposed study of IIT, Madras.

The Joint Director General, ASI observed that such a framing system might not be necessary.

He observed that different types of stones, from soft to hard rock type, had been used in the columns and beams and the present distress and cracks were in some form of balance. He opined for observation of those distresses and cracks for some more days, before going for any major interventions.

The Director (Conservation), ASI observed that the present distress/cracks were old, in a state of equilibrium after the initial differential settlement and cracks, and their monitoring was required to ascertain the load distribution mechanism. It was mentioned during the meeting that the cracks noticed in the beams perhaps existed for more than a century which were hidden beneath the plaster layer and were first noticed only after the plaster was removed. It was also mentioned that the cracks were believed to be stable and not active at that time as there was no crack visible on plaster surface over these beams. He opined that solution to the problem might be taken after a detailed study by IIT, Madras. On a query by Secretary (Culture), whether introduction of such frames should lead to any further instability by disturbing the delicate balance, the Director (Conservation) observed that while it might not create any such problem, but could address nearly 10% of the problem.

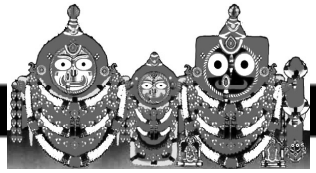
The Superintending Archaeological Engineer, ASI observed that introduction of the framing system might not be required and would only add to the load on the existing structural system as well as cost. He opined that that was not a new problem and all khandolite stone structures face similar issues from time to time and were given localised repair treatment which was effective.

The Chief Administrator, Sri Jagannatha temple informed that proposal of installing pocket frame was, in principle, approved by the DG, ASI in the 2011 estimates and ASI had requested the Temple Administration to take up the assignment as a deposit work. Accordingly, the Temple Administration had taken action in placing orders for procurement of stainless steel frames and contractors were given work order. In view of above, he requested the Union Secretary to kindly allow the Temple Administration to go ahead with the pocket frame work immediately. The Chief Secretary also opined in support of the proposal to start the work of pocket framing.

After detailed deliberations and considering the views of all present, on the balance of considerations, the co-chairs suggested that the Temple Administration should go ahead and complete the pocket framing work urgently[24]. However, the Secretary (Culture) indicated that that would be subject to the condition that IIT, Madras would examine the proposal also and if any advice from them was against that decision, suitable follow up action for removal of the frame could be taken, that work being reversible in nature.

Thereafter discussion on the proposed provision of stainless steel box frames was taken up. Secretary (Culture) expressed his apprehension on putting the foundations below the existing floor level by excavation and suggested to explore the possibility of placing the frame atop the present floor level by putting a plate covering the area of the four columns[25].

Co-chairs thereafter suggested that proposal of the Core Committee available with the ASI was to be referred to IIT, Madras for their study and to give their observations within two months. The ASI and the Core Committee might be taken into confidence before giving the final report[26].



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Prof. G.C. Mitra expressed his apprehension on the proposed post tensioning scheme of IIT, Madras for strengthening the cracked stone beams due to inherent weakness of the stone beams to accommodate the induced compressive stress from the pre-stressed tendons, which might result in local failure/crushing of the distressed stone blocks at the zone of stress transfer and the creep in soft stone material[27].

The co-chairs endorsed this observation and advised ASI, the Core Committee members and IIT, Madras to jointly work for the same. Secretary (Culture) also observed that proposal of the Core Committee and IIT, Madras to confine the dislodged column capitals by stainless steel plates and confinement of cracked columns, in the form of local jacketing by stainless steel plates, could also be considered for being taken up along with the pocket framing work.

The DG, ASI by a DO letter dated 25th May 2016 denied the resignation of Prof. Mitra and requested him to continue as a member of the Core Committee for better conservation of the holy shrine[28]. The proposal of providing stainless steel frames inside the pockets of *jagamohana* was approved by DG, ASI on 31st May 2016 in pursuance of the decision taken in the above meeting dated 20th May 2016. To decide the location for resting for foundation of stainless steel box type portal frames, core samples of stones from floor of *jagamohana* were collected by core drilling up to a depth of 1.8 meter during *Rathayatra* 2016 and load carrying capacity of these samples were tested in laboratory of Research Development and Quality Promotions (R & B), Bhubaneswar, Odisha which submitted report on 12th September 2016. The test results revealed two layers of each 75mm thick lime concrete which were points of weakness and the first layer of khandolite below the top most floor was also weak[29].

As per decision taken earlier and also suggestions made in inspection reports of SAE, ASI, New Delhi as well as IIT, Madras, works started during *Rathayatra* 2016 for improvement of existing drain near north-west column of *jagamohana* and waterproofing to its surroundings to arrest stagnation and ingress of water into the column base and floor. Entire stretch of the drain including the portion within the wide masonry wall was assessed with the help of MS tubes and steel flats. Huge quantities of debris were removed from the drain which had been accumulated there for several years and had become solid resulting to reduction in effective diameter of the drain and seepage of water into the structure. Remains of accumulated debris were removed by using strong jet of water and repeated beating by pipes and flats, etc. A flexible polypipe was inserted inside the drain at the stretch within the wide wall to eliminate any future possibility of seepage of water into the structure. The area around the base of northwest column was adequately waterproofed.

The ASI completed primary/secondary grouting and chemical cleaning of all the seven pockets during the *Rathayatra* 2016 also and made the pockets ready for fixation of pocket frames by Sri Jagannatha Temple Administration.

As per decision taken in the meeting dated 20th May 2016, ASI headquarter closely monitored the ongoing emergency works to the *jagamohana* by deputing senior officers of and above the rank of Directors to Jagannatha temple, Puri every week commencing from the last week of May 2016 till the completion of work in June 2017. The ASI reported the progress of work to

the Ministry of Culture regularly which were reviewed by Secretary (Culture) every week also.

In the meeting held on 20th May 2016 under the co-chairs, it was agreed upon by State Government to provide 10 dedicated state level civil engineers to assist ASI towards carrying out conservation works of *jagamohana*. Such identified civil engineers were trained by ASI to undertake conservation works considering archaeological principles and norms.

The Secretary (Culture), Government of India took a review meeting on 26th July 2016 in his chamber at Shastri Bhawan, New Delhi to discuss various issues related to the strengthening measures particularly the suggested introduction of stainless steel space frame for strengthening of the pockets and box type portal frame under the cracked beams required to be adopted for the *jagamohana* of Sri Jagannatha temple, Puri[30]. Besides the DG, ASI and other senior technical officers of ASI, the meeting was attended by the Core Committee members, Professors of IIT, Madras, Administrator, Sri Jagannatha temple, etc. Secretary (Culture) invited suggestions on the proposals from Prof. Arun Menon representing IIT Madras, and others present in the meeting.

Dr. Menon expressed his reservation about the necessity to introduce such type of frame for strengthening of the corbelled pockets. He expressed that the corbelled system of the pockets was self-stable and there was no need for such introduction of 'A' type space frame. He opined that that was not necessary locally and should not have much contribution globally, rather it would be detrimental to the fabric by superimposition of dead weight and transference of the same by use of stainless steel threaded rods. He further stated that introduction of such frame would prevent access to the corbelled projections thus preventing any scope for further repairs/ replacement of decayed stones.

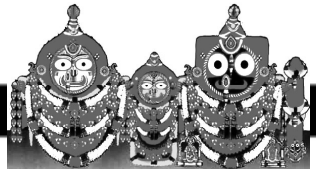
The IIT, Madras also indicated their disagreement for introduction of box type portal frame as that would be non-commensurate to new system of load distribution after development of cracks in the beams. Further it was stated that the proposed intervention, even though was claimed to be reversible, would not be removed thus adding a permanent additional load.

The Joint Director General (Conservation), ASI expressed that introduction of portal frame support with more reliance on steel columns would be very heavy intervention and visually distractive.

However, members of the Core Committee like Prof. G.C. Mitra and Dr. N.C. Pal reiterated their proposal for introduction of pocket frame and box type portal frames in the *jagamohana*.

After thorough discussion on the various aspects, the consensus evolved for the following line of action[31].

1. For strengthening of pockets only base members would be fixed in position and 'A' type frame proposed to be introduced above the base should be kept standby which could be fixed in position as and when necessity would arise.
2. Keeping regard to the availability of limited space, it was agreed that portal box frames to support the beams should be redesigned by introduction of stainless steel columns on either side of the stone columns by placing the new columns along with north-south axis. That could be interconnected as well as framing could be done at upper level to ensure



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the desired support to the distressed stone beams.

3. For confinement of stone column capitals by using stainless steel plates, it was observed that system provided at north-west column was not contributing effectively. IIT Madras was requested to submit appropriate design for confinement of column capitals.

A detailed structural analysis and design including associated drawings for the proposed stainless steel portal box frame for retrofitting of the existing distressed stone beam-column system inside *jagamohana* was prepared by the Core Committee members of ASI after several rounds of review and site visits and handed over to ASI on 3rd November 2016. It was redesigned in the light of decisions taken in the meeting chaired by Secretary (Culture) in his office chamber at New Delhi on the 26th July 2016 and subsequent joint inspection and meeting taken by Director (Conservation), ASI on 16th and 17th October 2016. The Core Committee had earlier calculated the load on each of the four columns was to be 450 tonnes. Subsequently the IIT, Madras calculated the same was to be 600 tonnes. Therefore, the Core Committee designed the frames for both the loading i.e. 600 tonnes/column and 450 tonnes/column without the foundation designs. Thought it was decided in the meeting held on 20th May 2016 co-chaired by Secretary (Culture) and Chief Secretary, Government of Odisha to place the portal frame on the existing floor to avoid any risk of localised disturbances by opening of the floor, the Core Committee suggested two alternatives to ASI to decide on placing the founding levels of the columns either on the floor level or 500mm below the existing floor levels. The Core Committee was of the view that the placement of founding frame on the existing floor would create technical problems and functional issues. Providing of foundation on the floor would not be technically feasible as there were two weaker layers of lime concrete and a layer of weak khandolite stone immediately below the floor within the initial 500mm depth which would affect the stress distribution pressure bulb. Besides, keeping the frame on the floor would entail a raising of the floor in *jagamohana* by about 500mm to conceal the inverted foundation grillage. It would also need raising of adjacent floors including the Anasarapindi, etc. That would affect the functional aspects of *jagamohana* as far as the rituals were concerned including the drainage of water from the single drain located close to the north-west column, besides interfering the 'line of vision' from the *nata-mandira* due to people standing on the raised platform.

In view of the earlier decision taken, the above said designs and drawings for the proposed stainless steel portal box frames along with the supporting documents were sent to National Centre for Safety of Heritage Structures, Department of Civil Engineering, IIT, Madras for vetting on 4th November 2016. The IIT, Madras after duly vetting the designs of proposals returned to the ASI with their comments on 15th November 2016[32]. Once again, the IIT, Madras reiterated that the installation of a massive portal frame was not completely warranted. It was of the view that the portal design might be fine, but that was designed as an alternate load path making the old original structural system redundant. That was a heavier intervention which might never be removed even though technically being a reversible one. The report stated that the load estimate for the design of the portal frame was revised by the IIT Madras to 240 tonnes during

the joint visit of 16th-17th October 2016 to review the progress of various conservation works. However, the design was prepared to carry out a load of 450 tonnes. Therefore, the portal frame was overdesigned. The report further stated that the design was not minimal one and did not confirm to accepted principles of conservation world-wide that profess minimal intervention and monitoring before any implementation. The IIT Madras, therefore, did not give any comment on the portal frame design at that stage as it was not in favour of its installation.

The report of IIT, Madras gave certain alternate recommendations to explore. It also suggested taking up monitoring work/installation of advanced instruments, in case the portal frame was installed ignoring the decision's of IIT, Madras. It suggested (1) installation of load cells to monitor the quantum of load carried by the portal over time, (2) providing neoprene rubber padding in between stainless steel members and stone-beam surface, and (3) geodetic measurements through Total Station survey prior to excavation of floor up to 500mm as a precautionary measure. However, the IIT, Madras left the decision to install the portal frames with ASI and Core Committee.

The proposal along with the vetting report of IIT Madras was submitted by SA, ASI, Bhubaneswar Circle to DG, ASI on 16th November 2016 for final approval. The DG, ASI approved the designs on 19th November 2016 with the condition that it should incorporate the suggestions/recommendations of IIT, Madras and modify the design accordingly[33]. The DG, ASI also requested to the Principal Secretary, Works Department, Government of Odisha on 24th November 2016 for early submission of modified designs.

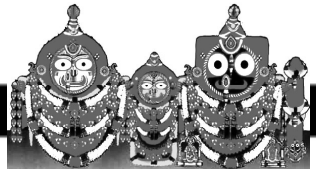
For finalisation of the design proposal of the box type portal frame, the Director (Conservation), ASI visited the temple on 15th December 2016 and held formal meetings with the members of the Core Committee and Regional Director (East) on 16th and 17th December 2016[34]. After long deliberation and discussions on both the days the Core Committee of ASI finalised the design and drawings of the box type portal frame by placing the founding level about 50 cm below the existing floor level in view of the following two valid reasons:

1. The placement of frame on the floor would create functional problems related to various rituals associated with daily *nitis*, special mandatory *niti* during 'Anasara' at the time of *Rathayatra* and *sevas* throughout the year which had strong reservations from Sevayatas as well as devotees, hence not possible.
2. As established by the core testing reports of the flooring, technically it was also not safe to place the portal frame on the floor.

The decision to keep the foundation of the frame at 50 cm below the existing floor level was also taken during the meeting held on 16th and 17th October 2016 in presence of Director (Conservation), ASI based on the recommendations of IIT Madras.

The Core Committee worked out design load on each column as 450 tonnes whereas IIT Madras revised it to 240 tonnes for each column. The Core Committee opined that keeping regard to the Odishan temple architecture and their behaviours, it would be more appropriate to go for a design load of 450 tonnes on each column.

The Core Committee submitted the final design and drawings, duly signed and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authenticated, on 17th December 2016. The SA, ASI, Bhubaneswar Circle forwarded the same with his recommendations for early approval of the designs and drawings. He further stated that the date of hearing of the case in Odisha High Court in this regard was on 20th December 2016 for which necessary affidavit had already been filed on 15th December 2016 and modified affidavit would be submitted on 19th December 2016 as per the order of High Court.

As distress was there in the cracked stone beams, the DG, ASI approved the designs and drawings of the box type portal frame to support the beam system on 19th December 2016 by overruling the observations of IIT Madras[35]. However, it was agreed by ASI to take up monitoring work/ installation of advanced instruments as was suggested by IIT, Madras in its reports dated 15th November 2016 in this regard. The ASI requested the Works Department, Government of Odisha on 22nd December 2016 for executing the work of the frame for which it agreed to place the requisite funds[36]. The DG, ASI approved on 5th January 2017 an estimate for Rs. 3,71,71,255/- for providing the stainless steel portal box frame to the distressed beams of *jagamohana*[37].

Before opening the floor and making space for foundation of box frame, acceptance from all the stakeholders were obtained and all possible care was taken to ensure that no damage would take place during the implementation of such an action. After opening first layer of floor stones in two locations, near north-east and south-east columns in *jagamohana* for founding the portal box frames at 500mm below the floor level, a finished floor level was came out at 330mm below the existing floor level which was appeared to be good for founding the portal frame. A Core Committee meeting was held on 4th March 2017 where the details of the exposed floor level and the result of testing core samples were studied and finally advised by the members that grouting should have done to the exposed floor level at 330mm below the existing floor level for founding the box frame instead of 500mm below the floor level[38]. The DG, ASI approved on 7th March 2017 to place the box frame base at about 330 mm below the existing floor level[39].

As per the directions of the High Court of Odisha, the conservation work of *jagamohana* became complete in all respect by ASI and other executive agencies before June 2017. The conservation of *jagamohana* was a joint effort of ASI, Works Department and Sri Jagannatha Temple Administration of Government of Odisha. The ASI itself executed required structural and chemical conservation works at the *jagamohana* whereas the necessary strengthening measures were got executed through the Temple Administration and PWD as deposit works.

The fabrication of pocket framing by stainless steel frames were completed in all the seven pockets of *jagamohana* by February 2017. The total weight of such frames for all the total seven pockets is 19 metric tonnes. The space frames are so designed that it would retain the internal geometry of pockets by preventing the local dislodging and falling of stone pieces, which are crucial to the stability of the *pidha* temple. It would remain passive till any impending movements around the pockets make them active. Moreover, the space frames are reversible in nature which can be removed in anytime.

All the four stones columns supporting the roof of *jagamohana* inside were strengthened

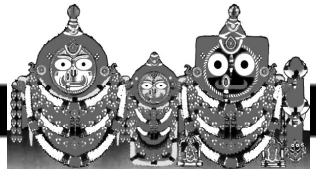
with stainless steel jacketing, comprising of four strips at an interval of about five feet one above the other. The work was completed by April 2017. The four lower and four upper capitals of all the four columns, which were cracked and out of plumb, were confined with stainless steel plates by April 2017. Before confinement the upper capitals were shaped square by fixing required size additional stone blocks at the grooves and cuttings, besides anchoring the dislodged column capital stone by stainless steel pins and epoxy grouting. For confinement of lower capitals only stainless steel plates were provided over the plane surfaces with strengthening arrangements at the meeting points without going for the filling of corners by using stone blocks. The corner strengthening was achieved by properly designed struts. The cracked stone beams/slabs were strengthened by providing appropriate stainless steel box beams, filled with the stainless steel plates prepared to the size as per the exact space available at the site which were secured to the masonry wall with the four stainless steel anchors inserted to a requisite depth.

The erection of stainless steel portal box frame for retrofitting the existing distressed stone beam-column system inside Jagamohana was completed by June 2017. Like the space frame, the box frames would also remain passive. In case of impending failure, this provision would share the load of existing system by progressively transferring the load from stone columns to the adjoining steel columns, and stone beams to underneath steel beams, avoiding most critical locations of the existing column heads. With this system, the pressure bulb in founding strata would also not get disturbed. The system is also reversible and can be taken out in case of better options in future.

Installation of load Monitoring Cells in *Jagamohana*

After installation of box portal frames of *jagamohana*, it was felt essential for monitoring structural safety evaluation of frame structures for any undesirable load/strain input encountered as well as any other distress observed and for strengthening of vulnerable structural components, if any. The Technical Committee suggested for installation of load monitoring cells in the *jagamohana* of the temple. The issue was discussed in the weekly meeting of the Secretary (Culture) on 5th May 2017 and it was agreed that the CSIR-Central Building Research Institute (CBRI), Roorkee who had been assigned with the work of studies and investigations of Sun temple, Konark, could also be given the work of installation of load monitoring cells of *jagamohana*. CBRI send two proposals for consideration of ASI. The first proposal was online automatic data collection and installation of instruments/load cells with a total cost of Rs.2.45 crore. The other proposal was offline collection of data and installation of load cells/instruments with a total cost of Rs.1.25 crore. The second proposal which was economical was considered and approved by the Secretary (Culture) on 20th September 2017[40]. The work would be implemented in two phases with a total time frame of five years. Phase- I would be implemented in one year with the cost of Rs.40 lakh and Phase-II would be implemented in a time frame of four years with the cost of Rs.85 lakh.

The CSIR-CBRI installed total eight Vibrating Wire Strain Gauges (VWSG) sensors on the selected critical locations of steel box portal frame inside the *jagamohana* of Sri Jagannatha temple, Puri on 20th July 2018 by arch welding and covered with protection boxes. All sensors



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were connected to the data acquisition system which was installed at a height above southern entrance of *jagamohana*. The data is recorded in 24-hour interval for all the sensors. The ASI officials were trained by CSIR-CBRI team at site to extract sensor data from data acquisition system. The extracted data was shared by ASI with CBRI on regular basis.

The CSIR-CBRI has been submitting interim reports on monitoring of steel portal box frame installed in *jagamohana* to ASI on monthly basis. However, no significant loading was observed on the box portal frames, as of June 2020[41].

Acknowledgement

I would like to thank the authorities of Archaeological Survey of India for allowing me to go through the files and documents related to the deplastering and conservation of *jagamohana* of Jagannatha Temple, Puri enabling to prepare the paper.

References:

1. DO letter number 8611, dated 22nd June 2006, the Chief Administrator, Sri Jagannatha Temple Administration, Puri to the DG, ASI, New Delhi.

   ASI Headquarters File No. 38/10/2004-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P-9.

2. Proceedings of the meeting held on 5th July 2006 at 4:00 pm to discuss on the preservation and promotion of Cultural Heritage of the State of Odisha under various schemes of Government of India.

   ASI Headquarters File No. 38/10/2004-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP 37-43.

3. Letter no. 38/10/2004-C, dated 24th July 2006, the DG ASI to the SA, ASI, Bhubaneswar Circle.

   ASI Headquarters File No. 38/10/2004-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P.25.

4. Proceedings of the Technical Expert Committee meeting held on 29th October 2006 at the Conference Hall of Hotel Mayfair, Puri on Deplastering and Conservation work of *Jagamohana, Natamandapa, Bhogamandapa* of Lord Jagannatha temple.

   ASI Headquarters File No. 38/10/2004-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 31-34.

5. Ibid.

6. ASI Headquarters File No. 38/07/2007-C (Estimate for the Deplastering and Conservation of *Jagamohana* of Sri Jagannatha temple, Puri), Note Sheet Page No. 17.

7. Letter no 38-7/2013-C, dated 07th October 2015, the DG, ASI to the SA, ASI, Bhubaneswar Circle.

   ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P. 74.

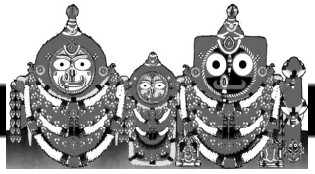
8. Letter no. 37/7/2013-C (pt.1), dated 05th July 2016, the DG ASI to the SA, ASI, Bhubaneswar Circle.

   ASI Headquarters File No. 37/7/2013-C (Pt. I) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P. 11.

9. Letter No. IIT-(BBSR)-04/2007-1288, dated 07th May 2007, Prof. G.C. Mitra, IIT Kharagpur, Bhubaneswar Campus to the SA, ASI, Bhubaneswar Circle.

   ASI Headquarters File No. 38/07/2007-C (Estimate for the Deplastering and Conservation of *Jagamohana* of Sri Jagannatha temple, Puri), PP. 73ff.

10. Proceeding of the Core Committee meeting held under the Chairmanship of DG, ASI on the 15th February 2012 at Puri on deplastering and conservation of *Jagamohana* and *Simhadwar* of Sri Jagannatha Temple, Puri.



ASI Headquarters File No. 38/07/2007-C (Estimate for the Deplastering and Conservation of *Jagamohana* of Sri Jagannatha temple, Puri), PP. 123-27.

11. Proceedings of the Core Committee meeting held on the 31st July 2015 at 3.30 pm in the chamber of the SA, ASI, Bhubaneswar Circle on conservation and deplastering of *Jagamohana/Simhadwara*.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 49-52.

12. Proceedings of the Core Committee meeting held on the 18th March 2016 in the office of SA, ASI, Bhubaneswar Circle on repairs of *Jagamohana* (Inner side) of Sri Jagannatha Temple, Puri.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 187-8.

13. Minutes of Core Committee meeting held on 29th March 2016 in Sri Jagannatha Temple Administration office, Puri under the chairmanship of Prof. A.P. Gupta, IIT, Kharagpur.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP-189-90.

14. Ibid.

15. Minutes of the meeting of Technical Committee under the chairmanship of Jt. DG (Monuments) to process the proposals for providing the stainless steel framed support under the stone beams and niches of *jagamohana.*

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 139-40.

16. Ibid.

17. Letter No. Nil dated 11th May 2016, G.C. Mitra, Ex-EIC-cum-Work Secretary, Govt. of Odisha to the DG, ASI, New Delhi.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 158-59.

18. The Indian Express, dated the 16th May 2016.

19. The Samaja, dated the 16th May 2016.

20. DO No. UM-01/2016-138/CM, dated 13th May 2016, the Chief Minister of Odisha to the Prime Minister of India.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP 212-13.

21. The Indian Express, dated the 19th May 2016.

22. WP(C)(PIL) No. 9098/2016 filed by Abhishek Das Vrs. Union of India and others.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 21-30

23. Minutes of the Review Meeting held on the 20th May 2016 at 4 pm in the State Secretariat, Bhubaneswar under the co-chairmanship of Secretary (Culture), Government of India and Chief Secretary, Government of Odisha on repair and restoration of *Jagamohana* of Sri Jagannatha Temple, Puri.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP 232-37.

24. Ibid.

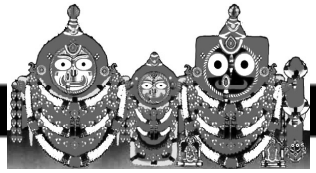
25. Ibid.

26. Ibid.

27. Ibid.

28. DO No. 38-7/2013-C, dated 25th May 2016, the DG, ASI to Prof. G.C. Mitra, Bhubaneswar.

    ASI Headquarters File No. 38/7/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P. 203.



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29. Letter No Lab. T-15/2016/2355, dated12th September 2016, the Deputy Director, Research, R.D. & Q.P. (R &B), Bhubaneswar to the SA, ASI Bhubaneswar Circle –"Test results of khandolite stone core collected from *Jagamohana* of Sri Jagannatha Temple, Puri.

    27B.ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 27-31.

30. Minutes of the meeting taken by the Secretary (Culture), Government of India on 26th July 2016 at Shastri Bhawan, New Delhi on Strengthening Measures for *Jagamohana* of Sri Jagannatha Temple, Puri.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 222-24.

31. Ibid.

32. Note on design of steel portal frame of *Jagamohana* of Sri Jagannatha Temple, Puri, Odisha, Dr. Arun Menon, IIT, Madras to the SA, ASI Bhubaneswar Circle on 15th November 2016.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP. 307-8

33. Letter No. 38-7/2011-C, dated 19th November 2016, the DG, ASI to the SA, ASI, Bhubaneswar Circle.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P.19

34. Letter No. 3/162/10 M-5354, dated 17th December 2016, the SA, ASI, Bhubaneswar Circle to the DG, ASI.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), PP-287-88.

35. ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), Note Sheet Page No. 26, dated 19th December 2016.

36. Letter No. 38-7/2013-C (Part-III), dated 22nd December 2016, the DG, ASI to the EIC-cum-Work Secretary, Govt. of Odisha.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of Jagamohana of Lord Jagannatha Temple, Puri), P. 363

37. Letter no. 38-7/2013-C, dated 05th January 2017, the DG, ASI to the SA, ASI, Bhubaneswar Circle.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P. 107

38. Minutes of the meeting held in the office of the SA, ASI, Bhubaneswar Circle on 04th March 2017 on conservation of *Jagamohana* of Sri Jagannatha Temple, Puri.

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P-369

39. Letter no. 38/07/2013-C (Part-III), dated 07th March 2017, the DG, ASI to the SA, ASI, Bhubaneswar Circle .

    ASI Headquarters File No. 38/7/2013-C(Part-III) (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), P. 367.

40. ASI Headquarters File No. 38-10/2013-C (Correspondence regarding Deplastering of *Jagamohana* of Lord Jagannatha Temple, Puri), Note Sheet Page No 46.

41. E-Gov File No. T-15/38/Oct/19/1681928/Con of ASI Headquarter.

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