

## A REVIEW - ENERGY SAVING THROUGH GREEN RATING SYSTEM FOR CIVIL STRUCTURE COMMISSIONING

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### ABSTRACT

Determining remedy for energy sparing has gotten one of the most critical issues confronting practically all the administrations, leaders and partners everywhere in the energy fraternity. Energy sparing strategies in building industry could be applied in all the development stages – Before-plan, during plan, pre-development, during development, and post-development. Energy management in the post-development (operation) stage - specifically - is the central issue for energy sparing. This paper focuses on utilizing green rating frameworks to manage the procedure of the authorizing for structures to spare energy during the O&M of structures.

In addition, the investigation features on the significant processes that ought to be mulled over during different stages. LEED (Leadership for Environmental and Energy Design) is recommended and examined here to be utilized in such manner. The LEED essential commissioning framework is talked in detail while a point by point clarification for the processes, assignments and duties of every partner in building ventures is introduced. Commissioning assists with looking into Design Documentations and make proposals to the plan group and relating to usefulness and functionality of commissioned frameworks. Furthermore, it helps to audit Owner Project Requirements (OPR) and Basis Of Design (BOD). This guarantees the accomplishment of significant levels of demonstrable skill and details in the distinctive development periods of structures. The paper presents toward the end a planned outline for the whole commissioning procedures that can help the way toward guaranteeing energy efficiency in structures.

**Keywords:-** Operation and Maintenance (O&M),Basis of Design (BOD),Owner Project Requirement (OPR), Leadership for Environmental and Energy Design (LEED), Commissioning Team member (CTM).

### I. INTRODUCTION

Structures devour the biggest part of energy among the various sectors everywhere in the world. In ongoing investigations, it has been affirmed to organize the energy utilization in structures. Zheng et. al. referenced that enormous amount public structures represents practically 35% of the energy utilization by common structures in China. Mutani et. al. affirmed that energy efficiency in structures is one of the critical needs for European low carbon development. Tardioli et. al. uncovered that private and business

Structures represent about 14% of ozone harming substance outflows and 40% of all out energy utilization of the manufactured climate as indicated by the reports on the energy end-use utilization in the EU 27 for 2011. Tibermacine et. al. referenced that alone the private structures in Algeria devour 40% of all out power utilization on the national level. Wu et. al. likewise uncovered that building energy request is the biggest - with about 40% - among all sort of power consuming industries. Green rating frameworks can help the development business during its all stages. Rating frameworks are intended to incorporate some guidelines for ventures. These prerequisites are termed as credits and ventures earn their points by meeting the credit's requirements. This determines the level of LEED certification to the respective ventures. The points in the credit are determined on the basis of impacts, for example, indoor ecological performance, ozone harming substance outflows, petroleum product use, air and water contaminations on human and environment in planning, construction and post-construction stages.

In order to measure the impact of each type, various methodologies are used such as life cycle assessment, energy consumption modeling and transportation analysis.

The building commissioning verifies that the project requirements are whether met. This is a quality oriented exercise which keeps going on throughout the life time of the project, ideally from pre-planning stage to post construction and till the decommissioning of the building. In the building commissioning procedure, the authority performs number of various tasks during each stage of development of the

project. LEED rating framework divides the commissioning processes broadly into two principle categories; 1) Fundamental Commissioning and 2) Enhanced Commissioning. The fundamental commissioning ensures that all energy consuming devices in the building are properly installed and calibrated from time to time for working in energy efficient manner. The structure essential charging is required for to help the structure development periods of an undertaking that meets the owner's project requirements (OPR) for Indoor Environment Quality (IEQ), energy, water, and toughness. Commissioning targets improving the nature of frameworks stir up and help in the organized exchange of frameworks to the Owner's useful use [15].

This guarantees the proprietor/administrator that the commission frameworks have been introduced in the endorsed way, and work as per the basis of design (BOD). As per ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers). Commissioning is characterized as "A quality-centered cycle confirming and recording that the office and the entirety of its frameworks and gatherings are arranged, planned, introduced, tried, worked, and kept up to meet the OPR."

The Commissioning Authority ensures the project under development, develops as per the owner's requirements for indoor environment quality (IEQ), energy, water and durability.

Commissioning systems- Different frameworks are enforced to different projects for different set of requirements and budget of different owners. All commissioning requirements are carried in accordance with ASHRAE guidelines for renewable energy, mechanical, electrical and plumbing systems and assemblies related to indoor quality air, energy, water and durability.

The commissioning basically deals with three key systems.

1. Renewable energy system which includes hot water system and photovoltaic system.
2. Electrical system which includes variable frequency devices for HVAC system, stand-by power source and illumination control system.
3. Mechanical system that includes exhaust, supply and pressurization fans, ventilation handling units, pipe and piping system.

As indicated by ASHRAE [26], Figure 1 illustrates the connection between the authorizing cycle and coordinated individual energy-proficiency measures which will be clarified later in subtleties.

## **II. COMMISSIONING TEAM**

Team includes all representatives from different sections involved in planning, design, construction and operations. commissioning authority interacts with owner/end users/ to have better understanding of their requirements and designers/architects/consultants/contractors/sub contractors/material suppliers/mechanical/electrical/plumbing/renewable energy/equipment suppliers to brief them about the requirements and keep involved at every stage of project development to ensure their directions are followed. The commissioning authority make strategy to implement guidelines to ensure incorporation of necessary directions into the documents ,prepare the check-list for material and equipments and verify the execution before handling to owner.

## **III. COMMISSIONING PLAN AND STAGES**

This process may be classified into following stages.

1. Planning Stage
2. Design Stage
3. Development Stage
4. Operational Stage

This paper will explain in details, the activity, scope, plan, requirement and documentation of each stage mentioned above.



**Fig-1**

### 1. Planning Stage

This is the first stage where the commissioning process starts with review of OPR. The commissioning authority maintains 'issues record' to track the status of the issues related to the project, action taken and outcome. The commissioning plan addresses the OPR and defined scope and budget for commissioning process with details of each member of commissioning team. An 'issues record' maintains the brief descriptions of issues related to drawing, installation and performance and are updated by commissioning authority. The commissioning authority periodically, issues report describing the status of each problem encountered in the commissioning process, OPR and first round of commissioning plan. In planning stage itself, the 'issues record' is created.

### 2. Design Stage

During the design stage, the construction worksheet is prepared based on OPR. The commissioning authority issues the appraisal of the contract documents. At this stage, the design and techniques are included that can help saving significant amount of energy and this includes enclosures for solar panels, solar heater meant for hot water requirement, mechanical air-ventilation system and other renewable energy devices.

Commissioning authority's activities are as following.

- To develop commissioning specifications and to insure that correct cross references are made to all concerned sections.
- Commissioning authority helps design team to create BOD as per OPR. The BOD includes all assumptions for structural load, occupant load, noise level etc.
- To identify the specific training requirements to the involved personnel in construction, maintenance and operation.
- To present the overview of the commissioning procedure and emphasis on areas where exceptional work is expected from contractor.

Documents at the end of the design stage include-

- Design analysis remarks
- Updated OPR
- Updated BOD
- Commissioning requirements

- Updated 'issues record'

### 3 DEVELOPMENT STAGE

The systems and equipments are inspected, tested, installed and put in use during this stage to meet the OPR. This process starts with notice to proceed and ends with the completion of development activities. After almost the two months of notice to proceed, the commissioning authority calls for meeting to introduce contractors and suppliers to OPR. The periodic work progress meetings are called by commissioning authority and all concerned personnel are notified well in advance about the schedule. commissioning authority inspects submittal report for any deviation from OPR and BOD for negative or positive impacts on the project. Some checklists are static for systems and equipments that require preparation like oil level, fan belt tension, calibration etc. and some are dynamic such as testing of voltage measuring devices, rpm of the shaft, rotation of fan for their desired function before first operation. Compilation of objective and requirement (O&R) data is one of the requirements of commissioning procedure and submitted by the contractor to the commissioning authority immediately after the approval of submittal report. Construction checklists are important to ensure the proper functioning of systems and equipments during development process. These are prepared by contractor and submitted to the commissioning authority. The contract documents require contractor to hold pre installation meetings with commissioning authority. The test and balance meeting is one of the crucial meetings where the contractor has to demonstrate the proper functioning of all his systems and equipments before the commissioning authority. Contract documents require the contractor to submit the quality assurance and quality control testing report of all the systems and equipments to be used in construction and installed in the project to the commissioning authority. The systems are tested for different operational loads, temperatures, r.p.m., failures in all the sequences. All the tests are scheduled and conducted as per the procedure developed by the commissioning authority. The commissioning members analyze the testing report and submit to commissioning authority with necessary remarks. When any issue is encountered during functional test, the contractor is issued a corrective issue notice with additional related information and corrective measures to be taken. Various facility manuals are prepared by the commissioning authority that include all information about operation, maintenance of the systems and commissioning procedure with suitable indexes and cross references. The contractor submits a separate form that all the operation personnel were provided with necessary information to operate and maintain the facility. The training session with approved agendas are held as required by the commissioning process. The document created at the end of the development stage include test reports, corrective issues report, QC&QA reports, final commissioning process, updated design OPR and manuals.

### 4 OPERATIONAL STAGE

The post construction or development stage, the activities of commissioning authority continue and include the seasonal testing of systems. The final commissioning report is issued to owner for the record of commissioning process by the commissioning authority. The documents generated at the end of this stage are final commissioning report and summary of project.

## IV. CONCLUSION

The current paper surveyed and analyzed the key authorizing measures during the various periods of building development.

This can guarantee energy saving in structures and conclusions could be drawn from this investigation that:

- Commissioning framework is essential piece of the operational lifetime to accomplish the highest order of energy productivity.
- Commissioning is a methodology that begins from the pre-plan stage and end by meeting OPR.
- Commissioning is a holistic approach to meet the OPR with energy efficiency being the core issue.

- Commissioning is not just the duty of the commissioning team member or commissioning authority but it is also the responsibility of all stock holders such as investors, owners, users, designers, contractors and suppliers.
- Issues of Passive design and techniques for solar panel, air tightness, facility solar water heater for domestic use, proper air ventilation should be addressed at the initial planning stage.

## V. REFERENCES

- [1] USGBC. Understanding the LEED v4 Commissioning Requirements 2019 [Available from: <https://www.usgbc.org/education/sessions/understanding-leed-v4-commissioning-requirements-5951258>].
- [2] Lomas KJ, Cook MJ, Short CA. Commissioning hybrid advanced naturally ventilated buildings: a US case study. *Building Research & Information*. 2009; 37:397-412.
- [3] Turner SC, Jung MH, Hwang SH. Commissioning design/build projects. *ASHRAE Journal*. 2012;54(10):54.
- [4] Doty S. Quantifying Commissioning Benefits. *Energy Engineering*. 2007;104(3):20.
- [5] Lillie ET. What we have learned from 20 years of HVAC system commissioning. *ASHRAE Transactions*. 2012;118(2):122.
- [6] Leafstedt M. What is Building Commissioning? ; 2017.
- [7] Reid SS. READY FOR SERVICE 2017 [Available from: <http://www.ssr-inc.com/services/commissioning/commissioning-service/>]
- [8] McFarlane D. Technical vs. Process Commissioning: Owner's Project Requirements. *ASHRAE Journal*. 2013;55(8):32
- [9] Schumacher J, Pietruschka D, Eicker U. Commissioning and Operational Control of Photovoltaic Power Plants through Online Simulation. *Energy Procedia*. 2014; 57:152-60.
- [10] Djuric N, Novakovic V. Review of possibilities and necessities for building lifetime commissioning. *Renewable and Sustainable Energy Reviews*. 2009; 13(2):486-92.
- [11] Tseng PC. Commissioning Sustainable Buildings. *ASHRAE Journal*. 2005;47(9):S20.
- [12] Himpe E, Van de Putte S, Laverge J, Janssens A. Operational Performance of Passive Multi-family Buildings: Commissioning with Regard to Ventilation and Indoor Climate. *Energy Procedia*. 2015;78:2983-8.
- [13] ASHRAE Standard Project Committee 202. Cognizant TC: TC 7.9 BC. Commissioning Process for Buildings and Systems. In: COMMITTEE AS, editor. USA: American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); 2012.
- [14] Babaian P, Hopps E. Finding Value in Building Enclosure Commissioning 2014
- [15] Mutani G, Delmastro C, Gargiulo M, Corgnati SP. Characterization of Building Thermal Energy Consumption at the Urban Scale. *Energy Procedia*. 2016;1 01:384-91.