EVALUATION OF BAMCRETE PANEL AS AN EFFECTIVE WALLING SYSTEM

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by

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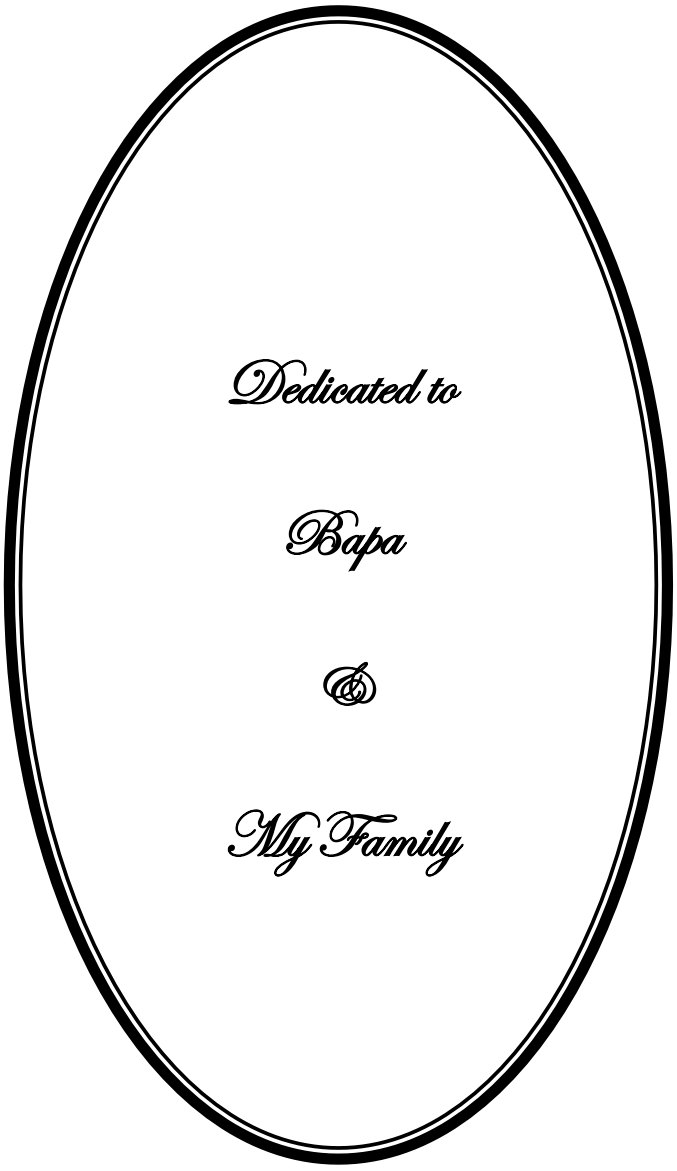
Dedicated to
Bapa
&
My Family

Certificate

This is to certify that the thesis entitled **"Evaluation of Bamcrete Panel as an Effective Walling System"** being submitted by **Ashish Kumar Dash** to the Indian Institute of Technology, Delhi for the award of degree of **Doctor of Philosophy** in Civil Engineering Department is a bona fide record of research work carried out by him under my supervision. The thesis work, my opinion, has reached the requisite standard of fulfilling the requirements for the degree of Doctor of Philosophy.

The results contained in this thesis have not been submitted, in part or full, to any other university or institute for the award of any other degree or diploma.

Dr. Supratic Gupta
Assistant Professor
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Indian Institute of Technology Delhi

Date:

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*Dedicated to you... Only You…….**Bapa***

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Ashish Kumar Dash
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Abstract

The bamboo plant and its utility to mankind in many forms, as fodder to construction, was well established across the globe since ancient time. From ancient time, the bamboo usage in wall construction for rural housing was common. The transition from mud plaster to cement based plaster was a significant improvement in the last century and it gained immense popularity in north-eastern part of India. With the ingression of modern construction technologies, all these techniques of wall making are losing its charm and presently the use is mostly being restricted to scaffolding, household items, and furniture.

Out of the different applications, the use of bamboo in wall construction using cement plaster can effectively decrease the dependency on the usage of non-green, non-renewable wall material resources. In this aspect, the rejuvenation of modern ekra wall or bamboo concrete composite wall of 'Assam type house' which prevailed widely across north-eastern part of India, has the potential to replace the mostly adopted construction technique of conventional non-green brick masonry wall. This system is easy to build and effective against earthquake forces. Despite all positive features, this technology is in dying phase due to lack of scientific research and some traditional flaws in the construction technique.

Hence, this research is an attempt to understand the worthiness of **Bamcrete** (bamboo and concrete) walling system from the basic level of its construction process. In order to understand this system precisely, a **40 years old Bamcrete panelled** house which was in good condition was studied.

Following the same Bamcrete wall's construction process, panels were fabricated. In comparison to wooden frames, options of a bamboo frame and metal frames were considered. W-shaped metallic framing helped to create a double wall system providing the possibility of

concealed electric wiring. In the plastering process, options for design mix mortar and spray mortar were examined. The study was extended to different structural and non-structural tests for scientifically validating the Bamcrete panels.

To understand the strength and energy absorption capacity of the Bamcrete panel, impact test and monotonic load/ static load test were performed. For the performance grade of Bamcrete partition wall, small hard body impact, large soft body impact, stiffness test, lightweight, and heavyweight anchorage tests were studied. In case of non-structural functional study of the Bamcrete panel, thermal and acoustic insulation properties were studied in comparison to the other walling materials. In case of thermal study, the thermal transmittance (**U-value**) behaviour of the panel through heat-flux sensor method was performed. Similarly, the in-situ acoustic study was conducted to understand the **sound transmission class** through a single sound rating number of Bamcrete panels in comparison to other wall materials. These technical studies of Bamcrete walling system were performed to understand the benefit of this walling system. It was found that this panel technology has sufficient energy absorption capacity undergoing larger deflection. In building science performance, the twin meshed Bamcrete panel showed a better level of thermal and acoustic performance compared to other walling systems.

Keywords: *Bamcrete panel, impact test; monotonic test; anchorage test, thermal transmittance (U-value); sound transmission class.*

सार

बांस के पौधे और मानव जाति के लिए इसकी उपयोगिता, प्रकृति के लिए चारा के रूप में, प्राचीन काल से पूरी दुनिया में अच्छी तरह से स्थापित की गई थी। प्राचीन समय से, ग्रामीण आवास के लिए दीवार निर्माण में बांस का उपयोग आम था। मिट्टी प्लास्टर से सीमेंट आधारित प्लास्टर में संक्रमण पिछले शताब्दी में एक महत्वपूर्ण सुधार था और इसे भारत के उत्तर-पूर्वी हिस्से में अत्यधिक लोकप्रियता मिली। आधुनिक निर्माण प्रौद्योगिकियों के प्रवेश के साथ, दीवार बनाने की ये सभी तकनीकें अपना आकर्षण खो रही हैं और वर्तमान में इसका उपयोग ज्यादातर मचान, घरेलू सामान और फर्नीचर तक ही सीमित है।

विभिन्न अनुप्रयोगों में से, सीमेंट प्लास्टर का उपयोग करके दीवार निर्माण में बांस का उपयोग गैर-हरे, गैर नवीकरणीय दीवार सामग्री संसाधनों के उपयोग पर निर्भरता को प्रभावी ढंग से कम कर सकता है। इस पहलू में, 'आधुनिक प्रकार की दीवार' की आधुनिक आकाश दीवार या बांस कंक्रीट समग्र दीवार का कायाकल्प जो भारत के उत्तर-पूर्वी हिस्से में व्यापक रूप से प्रचलित था, में परंपरागत गैर-हरे ईंट चिनाई दीवार की अधिकतर गोद लेने वाली निर्माण तकनीक को बदलने की क्षमता है । यह प्रणाली भूकंप बलों के खिलाफ निर्माण और प्रभावी बनाने में आसान है। सभी सकारात्मक विशेषताओं के बावजूद, यह तकनीक वैज्ञानिक अनुसंधान की कमी और निर्माण तकनीक में कुछ पारंपरिक खामियों के कारण मरने के चरण में है।

इसलिए, यह शोध अपनी निर्माण प्रक्रिया के मूल स्तर से बामक्रेट (बांस और कंक्रीट) दीवार प्रणाली की योग्यता को समझने का प्रयास है। इस प्रणाली को ठीक से समझने के लिए, एक 40 वर्षीय बामक्रेटेपनेडेल हाउस जो अच्छी हालत में था, का अध्ययन किया गया था।

उसी बमकिन दीवार की निर्माण प्रक्रिया के बाद, पैनलों को बना दिया गया। लकड़ी के फ्रेम की तुलना में, एक बांस फ्रेम और धातु के फ्रेम के विकल्प पर विचार किया गया था। डब्ल्यू-आकार के धातु फ्रेमिंग ने एक डबल दीवार प्रणाली बनाने में मदद की जो छुपा इलेक्ट्रिक तारों की संभावना प्रदान करता है। प्लास्टरिंग प्रक्रिया में, डिजाइन मिश्रण मोर्टार और स्प्रे

मोर्टार के विकल्प की जांच की गई। अध्ययन को बैमकिन पैनलों को वैज्ञानिक रूप से मान्य करने के लिए विभिन्न संरचनात्मक और गैर-संरचनात्मक परीक्षणों तक बढ़ा दिया गया था। बामक्रेट पैनल की ताकत और ऊर्जा अवशोषण क्षमता को समझने के लिए, प्रभाव परीक्षण और मोनोटोनिक लोड / स्थिर भार परीक्षण किया गया। बामक्रेट विभाजन दीवार के प्रदर्शन ग्रेड के लिए, छोटे हार्ड बॉडी इफेक्ट, बड़े मुलायम शरीर के प्रभाव, कठोरता परीक्षण, हल्के वजन, और हेवीवेट एंकरेज परीक्षणों का अध्ययन किया गया। बामक्रेट पैनल के गैर-संरचनात्मक कार्यात्मक अध्ययन के मामले में, अन्य दीवारों की सामग्रियों की तुलना में थर्मल और ध्वनिक इन्सुलेशन गुणों का अध्ययन किया गया था। थर्मल अध्ययन के मामले में, ताप-प्रवाह सेंसर विधि के माध्यम से पैनल के थर्मल ट्रांसमिशन (यू-वैल्यू) व्यवहार का प्रदर्शन किया गया था। इसी प्रकार, अन्य दीवार सामग्रियों की तुलना में बैमकिन पैनलों की एकल रेटिंग रेटिंग संख्या के माध्यम से ध्वनि संचरण वर्ग को समझने के लिए इन-सीटू ध्वनिक अध्ययन आयोजित किया गया था। इस दीवार प्रणाली के लाभ को समझने के लिए बाम्रीट दीवार प्रणाली के इन तकनीकी अध्ययनों का प्रदर्शन किया गया था। यह पाया गया कि इस पैनल प्रौद्योगिकी में बड़ी विक्षेपण से गुजरने वाली पर्याप्त ऊर्जा अवशोषण क्षमता है। विज्ञान प्रदर्शन के निर्माण में, जुड़वां मेहेड बाम्रीट पैनल ने अन्य दीवार प्रणालियों की तुलना में थर्मल और ध्वनिक प्रदर्शन का बेहतर स्तर दिखाया।

कीवर्ड: बैमकिन पैनल, प्रभाव परीक्षण; मोनोटोनिक परीक्षण; एंकरेज परीक्षण, थर्मल ट्रांसमिशन (यू-वैल्यू); ध्वनि संचरण वर्ग।

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