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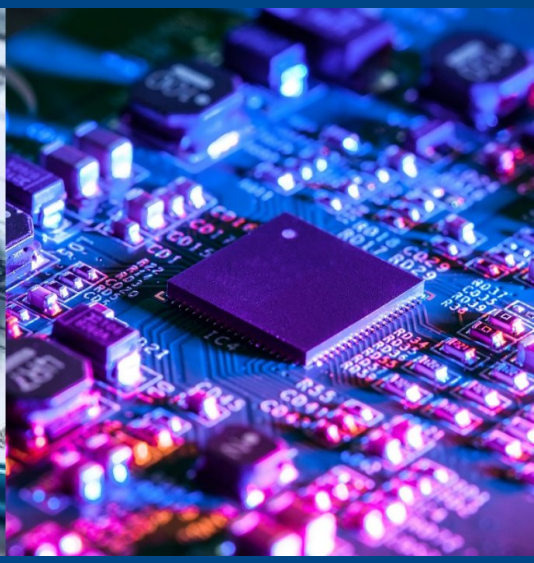

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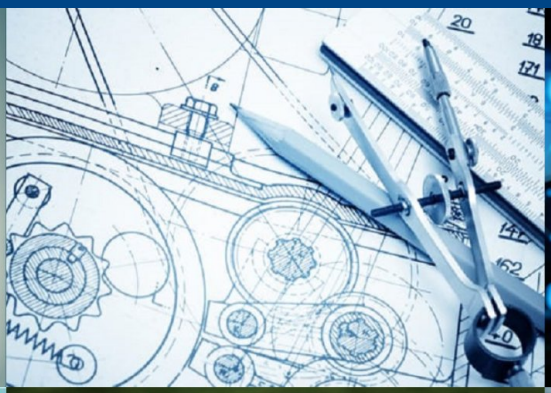

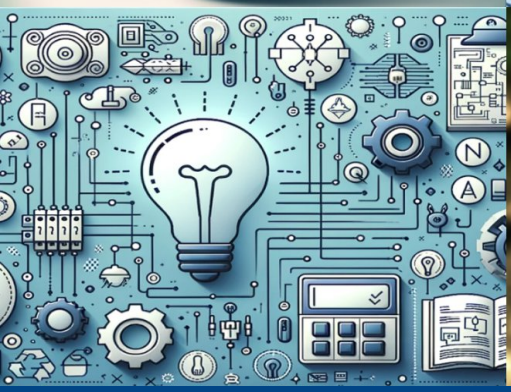

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As Built Drawing and Carbon Wrapping for Structural Rehabilitation and Accurate Construction Documentation

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ABSTRACT*:* In civil engineering, the maintenance, repair, and strengthening of existing buildings are critical in order to ensure the safety, serviceability, and durability of the buildings. Buildings and infrastructure gradually deteriorate over time due to natural causes such as aging, exposure to natural elements, overloading, poor workmanship, design changes, and natural calamities. Therefore, the actual condition of the buildings must be documented properly. Moreover, the use of reliable techniques in the retrofitting of buildings must be employed. This project has focused on two significant areas: As- Built Drawings and Carbon Wrapping.

As-Built Drawings refer to the final updated drawings prepared after the completion of the construction work. These drawings represent the actual dimension, position, and modification of the structural and architectural elements of the buildings. The structure may undergo several changes during the execution of the work. Therefore, the actual structure may be different from the original design drawing. The accurate documentation of the actual condition of the buildings is critical in order to maintain the buildings properly.

Carbon wrapping, also known as Carbon Fiber Reinforced Polymer wrapping, is the latest technique in the strengthening of buildings. The use of carbon fiber sheets and epoxy resin has the capacity to increase the load-carrying capacity, stiffness, ductility, and durability of the buildings without adding weight or size. The study has concluded that the use of accurate as-built drawing techniques coupled with carbon wrapping would be an efficient solution in order to increase the efficiency and reliability of the buildings.

I. INTRODUCTION

As-built drawings are the final revised drawings developed after the completion of constructionactivities. During construction activities, many changes are made due to site conditions, design changes, availability of construction materials, and client requirements. These changes are noted carefully so that the drawing shows exactly what has been constructed on site. These drawings are used to show the actual dimensions, levels, and locations of beams, columns, walls, doors, windows, and services such as electrical wiring, plumbing, drainage, and HVAC systems. These are used as permanent records for maintenance, repair, renovation, and extensions. Without these drawings, it is very difficult to locate services and make changes to structures safely.

Carbon wrapping, or simply Carbon Fiber Reinforced Polymer wrapping, is a new method for strengthening or repairing old structures. The structures deteriorate over time due to natural aging, cracks, corrosion of reinforcing bars, excessive loads, or effects of earthquakes. In this method, thin carbon fiber sheets are bonded to beams, columns, or slabs using epoxy resin as additional strengthening to these structures. This method increases the load-carrying capacity and extends the life of old structures. This method is light in weight, corrosion-resistant, and quick to apply.

II. MOTIVATION

Existing structures are also in a state of deterioration and thus require proper evaluation, repair, and strengthening to ensure the structure's durability and safety. Most structures also have original drawings different from the actual structure built. This has created the need to generate accurate as-built drawings to provide precise information on the structure. However, the process of demolition and rebuilding is expensive and time-consuming. There is also the use of carbon wrapping (CFRP) in structural strengthening, which increases the structure's durability and resistance to seismic

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activity without adding size to the structure. This study was inspired by the desire to integrate accurate documentation with modern methods of retrofitting structures to enhance the structures' durability and safety..

OBJECTIVE

1. To understand the concept and importance of as-built drawings in construction and rehabilitation projects.
2. To understand how changes on site affect the accuracy of original design drawings.
3. To understand methods for site inspection, measurement, and documentation for as-built drawings.
4. To identify structural elements and service lines as shown on as-built drawings.
5. To analyze as-built drawings for their role in maintenance, repair, and renovation work.
6. To understand the importance of accurate documentation for future expansion and safety.

SCOPE

7. To understand the importance of strengthening existing and aging concrete structures.
8. To understand the concept of carbon fiber reinforced polymer wrapping.
9. To understand the materials used in carbon fiber reinforced polymer wrapping.
10. To understand the step-by-step procedure for carbon wrapping.
11. To analyze how carbon wrapping increases strength, stiffness, and durability.
12. To understand the role of carbon wrapping in improving seismic resistance.
13. To analyze the advantages of carbon wrapping.
14. To analyze the economic benefits of retrofitting instead of demolishing and reconstructing.

The scope of the project is based on the documentation and strengthening of existing structures through the use of as-built drawings and carbon wrapping techniques. This includes the study of techniques used in collecting data from the site through inspections, measurements, and verification of structural elements. The use of as-built drawings involves the collection of data through the measurement of dimensions, levels, location of beams, columns, slabs, walls, and other facilities like electrical, plumbing, drainage, etc. This helps in laying a foundation for future use.The other part of the project involves the evaluation of structural deficiencies like cracks, corrosion, reduced load capacity, damage due to environmental conditions, etc. After evaluating these conditions, the next part of the scope is based on the study of carbon fiber reinforced polymer wrapping techniques. This involves the use of carbon fiber materials for strengthening the structure by wrapping them around the structure. This technique is based on understanding the materials, surface preparation, epoxy coating, wrapping, and curing techniques used in practical applications.Another part of the study is based on the advantages of carbon wrapping techniques, like increased strength, durability, light weight, and increased size of the structure**.**

III. LITERATURE REVIEW

1) In the study by R. Sacks et al., the importance of accurate as-built documentation in construction projects was investigated. In this study, the application of Building Information Modeling, laser scanning, and digital surveys in the creation of accurate as-built documentation was discussed. This study proved that accurate as-built drawings help in minimizing maintenance costs.

2) In the study by C. Eastman et al., the application of Building Information Modeling in the creation of accurate as-built documentation was discussed. This study proved that accurate as-built drawings help in improving the efficiency of architectural, structural, and MEP services coordination in buildings.

3) In the study by P. Tang et al., the application of laser scanning technology in the creation of accurate as-built documentation was investigated. This study proved that accurate as-built drawings can be created in a faster manner using 3D scanning technology.

4) In the study by Love & Edwards, the impact of missing as-built documentation in infrastructure projects was analyzed. This study proved that missing as-built documentation increases costs in infrastructure projects.

5) In the study by K. Daniel et al., the application of accurate as-built documentation in facility management was discussed. This study proved that accurate as-built documentation helps in improving the efficiency of facility management.

6) In the study by A. Nanni et al., the application of FRP materials in the strengthening of reinforced concrete structures was discussed. This study proved that CFRP wrapping increases the load-carrying capacity of reinforced concrete structures.

7) In the study by Teng J.G. et al., the application of CFRP wrapping in the strengthening of reinforced concrete

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columns was discussed. This study proved that CFRP wrapping increases the compressive strength of reinforced concrete columns.

8) M. Shahawy et al. examined the application of CFRP sheets in strengthening bridges. According to their findings, CFRP enhances the flexural strength of the structure, reduces cracking, and increases the service life of the structure.

9) Triantafillou & Plevris investigated the efficiency of FRP wrapping in the shear strengthening of RC beams. According to their research findings, CFRP sheets have the capacity to enhance the shear strength of the structure while avoiding sudden failure.

10) Bisby & Stratford investigated the durability of CFRP-strengthened structures subjected to environmental exposure. According to their research findings, CFRP enhances the corrosion resistance of reinforced concrete members while improving fatigue performance.

11) Bank L.C. investigated the long-term performance of FRP composites. According to their research findings, FRP composites have the capacity to provide structural members with the advantage of being light in weight, high tensile strength, and easy installation compared to other strengthening materials like steel jacketing.

12) Lam & Teng investigated the application of CFRP wrapping in the seismic retrofitting of buildings. According to their research findings, CFRP confinement enhances the capacity of the structure to absorb energy while ensuring structuralstability during earthquakes.

13) Hollaway & Teng investigated the different techniques of strengthening concrete structures using FRP materials. According to their research findings, CFRP is one of the most effective techniques in strengthening aged infrastructures.

14) ACI Committee 440 developed guidelines on the design and application of FRP systems in concrete structures. According to their research findings, standard procedures have been developed for the safe use of CFRP wrapping.

15) Recent research studies have emphasized the combined application of as-built drawings and CFRP retrofitting techniques in structural rehabilitation projects.

Accurate as-built data helps engineers in identifying structural deficiencies while enhancing the effectiveness of carbon wrapping techniques.

If you want, I can also provide the list of References page in APA/IEEE style, which can be attached after this.

IV. METHODOLOGY

A) Procedure of As-Built Drawings (Simple & Point-wise):

1. **Collect original drawings**

Approved designs and construction drawings are taken as reference.

2. **Visit the site**

The construction site is checked when construction is complete.

3. **Take actual measurements**

Measurements are taken for walls, beams, columns, doors, windows, pipes, etc.

4. **Note all changes**

Note all changes made during construction from original designs.Additions and deletions are marked on the drawings (by red line markups).

5. **Update all services**

All services, including architectural, structural, plumbing, and electrical changes, are updated.

6. **Prepare final drawings in CAD/BIM**

Corrected drawings are converted into neat digital drawings.

7. **Add notes and legends**

Materials used and revision details are mentioned.

8. **Check and verify**

The engineer/architect checks the drawings according to the site condition.

9. **Submit final as-built drawings**

Final approved drawings are given to the client for maintenance and future **work.**

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C49	0.53	0.23
C50	0.53	0.25
C51	0.55	0.25
C52	0.55	0.25
C53	0.55	0.27
C54	0.55	0.27

Dimensions	
Total Height (m)	3.426
Beam Ht (m)	0.462

Windows	Length	Height	Width
W1	1.805	1.119	0.3
W2	1.824	1.205	0.3
W3	1.821	1.2	0.3
W4	1.82	1.224	0.3
W5	1.81	1.19	0.3
W6	1.819	1.187	0.3
W7	1.817	1.191	0.3
W8	1.838	1.17	0.3
W9	1.819	1.86	0.3
W10	1.823	1.211	0.3
W11	1.83	1.204	0.3
W12	1.83	1.207	0.3

Fig .1. SAMPLE AS BUILD DRAWING

B) Testing for Carbon Wrapping (CFRP Strengthening)

These tests are for verification purposes to ascertain whether the strengthening has taken place properly or not.

1. **Surface Pull-Off (Adhesion) Test**

Verification of bonding between concrete and CFRP.

2. **Visual Inspection Test**

Verification for presence of bubbles or improper wrapping.

3. **Tap Hammer / Sounding Test**

Verification for presence of hollow areas or debonding between CFRP wraps.

4. **Load Testing of Strengthened Member**

Verification for increase in strength after wrapping.

5. **Strain Gauge Monitoring (Optional)**

Verification for strain on the structures after wrapping.

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Fig: SAMPLE CARBON WRAPPING & SITE VISIT

V. FUTURE SCOPE

The future of as-built drawings is related to the digital construction sector. As-built drawings will be developed using BIM, drones, laser scanning, and AI techniques. This will enable the production of accurate digital twins for facility management. This will be done through cloud storage, which will enable engineers to share information in real time. Carbon wrapping is expected to grow in the strengthening of aging bridges, buildings, and earthquake-resistant constructions due to their high strength and light weight. Research is expected to improve their durability, fire resistance, and cost-effectiveness.

VI. CONCLUSION

This project concludes that As-Built Drawings and Carbon Wrapping are vital tools in the maintenance and retrofitting of structures. As-Built Drawings give an accurate account of the finished structure, including changes that were incorporated during the building process. This is helpful in the repair, renovation, and assessment of the structure in the future. Carbon Wrapping is a recent technique used in the retrofitting of structures. It increases the strength, stiffness, and durability of beams, columns, and slabs without the addition of weight or the alteration of the dimensions of the structure. It is therefore vital in the improvement of the performance of civil engineering structures.

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