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Experimental Study on Lightweight Panel for an Application of Mobile Home

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ABSTRACT: Mobile homes serve as a vital solution for addressing homelessness and providing temporary shelter that can be easily transported. With homelessness being a pressing societal issue in many regions, mobile homes offer a practical and cost-effective means to provide safe and secure housing for those in need. These structures can be quickly deployed to areas where homelessness is prevalent or in the aftermath of natural disasters, offering immediate relief to displaced individuals and families. Moreover, the portability of mobile homes allows them to be relocated as needed, enabling flexibility in responding to changing needs and circumstances. Whether serving as transitional housing for homeless individuals or as temporary shelters in emergency situations, mobile homes play a crucial role in providing dignified living conditions and stability to vulnerable populations. Their ability to be carried anywhere ensures that aid can reach those who require it most, offering a beacon of hope amidst challenging circumstances.

KEYWORDS: Lightweight panel, conventional mortar, non-conventional mortar (aerogel) and physical and fire tests.

I. INTRODUCTION

Mobile homes have emerged as a versatile and practical solution for those seeking a flexible and comfortable living arrangement. The concept of mobile homes has gained popularity due to the increasing need for portable and easily deployable housing solutions. These homes, often built on a chassis, provide a sense of mobility while offering the convenience of a permanent residence. In recent years, the demand for lightweight mobile homes has surged, driven by a growing appreciation for portable, sustainable, and comfortable living solutions. This emerging trend responds to the evolving needs of individuals and families seeking flexibility, affordability, and environmental consciousness in their housing choices. This introduction delves into the significance of lightweight mobile homes, exploring the reasons behind their increasing popularity, the existing research landscape, and the critical role of lightweight materials in shaping the future of mobile housing. Mobile homes serve various purposes, catering to a diverse range of needs. They are ideal for individuals or families who crave a nomadic lifestyle, enabling them to travel and explore different locations without sacrificing the comfort of a home. Additionally, mobile homes offer a lightweight carrying panels which will have a good performance and be very light in weight so that they can shift everywhere easily.

II. OBJECTIVES

- To identify strength and thermal properties of cement mortar mix.
- To measure the optimum percentage of aerogel in cement mortar mix.
- To compare the strength and thermal behaviour of conventional and non-conventional mortar specimens.

III. METHODOLOGY

1. Characteristics of cement mortar and silica aerogel.
2. Preparation of conventional mortar samples for tests.
3. Optimization of aerogel to the mortar.
4. Preparation of non-conventional mortar samples for tests.
5. Strength and fire tests conducted on mortar samples.

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IV. EXPERIMENTAL RESULTS

1. Compressive strength test results.

Table. 4.1: Results of compressive strength test.

Conventional mortar		Non-conventional mortar			
Days	Compressive strength (N/mm²)	Days	Compressive strength (N/mm²)		
			5%	10%	15%
7	2.5	7	4.0	2.5	1.0
14	6.5	14	5.7	3.9	2.5
28	9.6	28	7.1	5.3	3.9

2. Thermal conductivity test results.

Table. 2: Thermal conductivity test results.

Thermal conductivity value (W/mK)			
Conventional mortar	Non-conventional mortar		
	5%	10%	15%
1.0245	0.2431	0.1926	0.1174

3. Non-combustibility test results.

Table. 3: Non-combustibility test results of conventional mortar.

Dosages	Increase of oven temperature (^{O}C)	Persistence of the Inflammation (tf)	Loss of mass (%)
1.	41.6	242	11.86
2.	48.5	863	34.24
3.	29.2	412	15.36
4.	81.3	635	41.28

Table. 4: Non-combustibility test results of non-conventional mortar.

Dosages	Increase of oven temperature (^{O}C)	Persistence of the Inflammation (tf)	Loss of mass (%)		
			5%	10%	15%
1.	30.56	368	8.12	7.21	8.34
2.	37.98	1072	20.89	18.96	19.33
3.	25.14	517	10.45	9.52	8.56
4.	72.83	745	21.74	19.11	20.12

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4. Fire resistance test results.

Table. 5: Fire test results of conventional mortar.

Time t, (min)	Temperature readings, ^{o}C
5	80
10	150
15	260
20	330
25	380
30	450
The specimen started burning and cracking at the temperature of 450^{o}C.	

Table. 6: Fire test results of non-conventional mortar.

Time t, (min)	Temperature readings, ^{o}C
5	80
10	150
15	260
20	330
25	380
30	450
60	550
The specimen started burning and cracking at the temperature of 550^{o}C.	

V. CONCLUSION

In conclusion, after conducting compressive strength, thermal conductivity, non- combustibility, and fire resistance tests on both normal mortar and aerogel mortar specimens, it is evident that aerogel mortar outperforms normal mortar in several aspects.

Firstly, in terms of compressive strength, aerogel mortar exhibits superior strength compared to normal mortar. This indicates its ability to withstand higher loads and provide better structural support.

Secondly, the thermal conductivity test reveals that aerogel mortar possesses significantly lower thermal conductivity than normal mortar. This property is crucial for insulation purposes, as lower thermal conductivity implies better insulation against heat transfer, leading to improved energy efficiency and comfort levels in buildings.

Furthermore, the non-combustibility test demonstrates that aerogel mortar is non- combustible, making it safer in fire-prone environments compared to normal mortar, which may contribute to the spread of fire.

Lastly, the fire resistance test confirms that aerogel mortar exhibits superior fire resistance properties compared to normal mortar. Its ability to withstand high temperatures for extended periods without structural failure or significant damage makes it a more reliable choice in fire safety applications.

Overall, based on the results of these tests, it can be concluded that aerogel mortar offers better performance than normal mortar in terms of compressive strength, thermal conductivity, non-combustibility, and fire resistance. As such, aerogel mortar presents itself as a promising alternative for various construction applications where these properties are essential.

Based on the performance the aerogel mortar panels can be used for mobile home purposes as I mentioned in the problem statement for taking the lightweight panel for a mobile home.

Through comprehensive testing, this study aims to provide valuable insights into the potential of silica aerogel mortar panels as lightweight and durable construction materials for mobile homes, addressing both structural and safety

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considerations. The compressive strength results for conventional mortar for 28 days are 9.6 N/mm2 and non-conventional mortar specimens of 5%-7.1, 10%-5.3 and 15%-3.9 N/mm2 respectively, and the efficiency of both the mortar specimens is 41% of the strength. As I mentioned before the 10% and 15% of aerogel specimens are brittle than the 5% of aerogel specimen, so the compressive strength value of those will be minimum when compared to 5% of aerogel specimen. The thermal conductivity value of the conventional mortar and non-conventional mortar specimens are 1.0245 and 0.2431 for 5%. 0.1926 for 10% and 0.1174 for 15% of aerogel in W/mK respectively. And the average heat flux value of both the specimens is 155.5 W/mK. The temperature or energy passed through the specimen by hot plate and cools with the help of cold plate is 110oC. So, the thermal performance of both conventional and non-conventional mortar specimens is highly performable as per the ASTM C518 code. From the non-combustibility test results the loss of mass of aerogel mortar mortar specimens are lesser than the normal mortar specimens, so the aerogel mortar specimens is highly performable than the normal mortar specimens. The behaviour of the both specimens during fire is noted with the time and temperature. The above results shows the fire capacity of aerogel mortar is better when compared to normal mortar specimens. As per the IS 3809-1979 the burning and cracking of the sample is carried out with the time and temperature of 60 minutes and 550 oC respectively.

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