Effects of Thermal Insulation Deficits in Famagusta Buildings

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Abstract — This paper talks about the effect of thermal insulation shortages brought about by poor consistence with mechanical techniques and human blunder over their time of utilization adversely influencing vitality aggregation and reserve funds. The impact is thermal extensions and less vitality reserve funds than foreseen in the venture arrangement period of the warm protection. The "critical thinking" and "relative" procedures of this work are we are taking a gander at an answer in a structure right now. Taking a gander at the two cases (with and without warm protection), it investigates the impact of the utilization of warm encasings on the pace of vitality utilization. Right now, data is gathered through Data Collection Technique. Information assortment strategies are: talk with, survey, appraisal and assessment of information both quantitatively through estimation, and subjectively through information translation. The cases investigation of this examination, are two condos in Famagusta in North Cyprus.

Keywords **—** Thermal Comfort, Thermal Bridge, Hot Climate, Energy Consumption and Building Envelope.

I. INTRODUCTION

Famagusta is a city on the east shoreline of Northern Cyprus. It is found east of Nicosia and has the most significant harbor of the island with a masses of around 40,920 individuals. The atmosphere of North Cyprus is a solid one, regularly Mediterranean. The summers are long and sweltering, while the winters are short with little precipitation. The coldest month is January which midpoints 10°C, while the most sweltering is July with an ordinary temperature of 40°C. The yearly mean temperature is 15°C. Structures have a noteworthy part of the vitality utilization all through the world. In areas with winning hot climatic conditions, most of this vitality is commonly used by building cooling and ventilation frameworks. The proportion of vitality used noticeable all around molding process is direct related to the structures warm burden. Warmth move by conduction through dividers and housetops speaks to a significant segment of the all out warm heap of structures. Using warm protection warm suitably could incite a basic reduction in warm loads and consequently decline in the general structure vitality needs. In hot atmospheres like those of the Gulf Countries Cooperative Council (GCCC), for example, rules were built up for using warm protection in structures which set least degrees of warm obstruction (R-estimations) of 1.35 m2 K/W and 1.75 m2 K/W for dividers and housetops, separately [1].

Be that as it may, most structures in the district are not all around introduced due to the nonattendance of execution of such rules and different measures from the dealing with experts' side similarly as the nonappearance of valuation for the practiced imperativeness hold reserves and money related increments from the customer side. In this manner structures utilize more vitality than is essential for their activity. An assessment between the ordinary vitality utilizations of a space in Dammam in Saudi Arabia to a relative one in Arizona in the USA, for example, shows that the condominium in Saudi Arabia uses twice as a ton of vitality as the one in Arizona [3]. This monstrous differentiation, paying little heed to potential assortments in the movement and possible differences in environment, shows the variety from the standard in vitality use and the unprecedented potential that exists for sparing vitality. It must be noted at any rate that this noteworthy complexity in vitality use isn't a result of the usage of warm protection yet additionally due to other vitality preservation measures including an extended structure air-snugness level.

In any case, warm protection is the noteworthy patron of vitality effectiveness especially in tight skin-load instructed structures, for instance, homes. The issue to be explored right now the impact of warm protection deficiencies, which could be brought about by different reasons. Since one of the principle reasons of high vitality utilization of the structure is the warm waste is through the outer dividers, this exploration expects to research the impact of warm protection deficiencies and give answers for vitality utilization decrease and to make warm solace in the structure. To this end, polls were utilized to explore the two example structures in Famagusta (the structure with warm cover and the structure without warm protector). There was investigation of the impact of warm protector use on

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vitality utilization. And afterward, the outside dividers of the two structures were contrasted and warm opposition and warm transmission. At last, the impact of the utilization of outside dividers with warm protectors in vitality frugality has been uncovered. It expects to give proposals for the structure and renovation of structures in Famagusta to improve warm solace conditions.

II. LITERATURE REVIEW

Broadly speaking, the buildings ' walls transmit heat in three different ways: parts of the walls are heat conductors and have little resistance to heat transmission. This category is made of materials, which have a high capacity for thermal conduction. For instance, glass and metals rapidly pass heat and cold, and the temperature on either side is almost the equivalent. Portions of the walls act as a heat separator and forestall that transfers heat from one side to another. Such walls are made of either low conductive power or high thermal resistance materials [5]. Defects in heat insulation systems caused by in compliance with technological procedures and by human error in the course of their implementation negatively affect energy accumulation and saving. The result is thermal bridges and lower energy saving than expected in the stage of heat insulation project preparation. Below are some of these deficits:

THERMAL INSULATION DEFICITS

The following thermal insulation deficits listed below are regularly influenced by human error and incompliance with regulations and standards for installations. When these schemes are applied by the workers of structural engineering organizations, you will often go over cases without the slightest consideration of the problems of misuse of touch heat safety in the future for the structure proprietors. Safety of future building occupants can be undermined by decreased fire safety wellbeing of the constructions.

- Board glueing,
- Board glueing on Circular sections of buildings,
- Window and Door opening treatment.

The current viable standards and guidelines stipulate requirements for board gluing which in many cases are not followed by representatives of the construction team. An absence of their systematic observance adversely influences energy accumulation. Standards for board sticking include:

- The glue should be applied manually or m on the mechanically on the back of the board along the boards borders and to the center as butts (in any event three for every board);
- In the instance of mechanical application in the form of an irregular bead;
- In the instance of ETICS connected with the base with the paste just in any event 40% of the foam polystyrene insulation board surface must be stuck to the base, except if generally indicated in the structure documentation.

Figure 1: Incorrect glueing of heat insulation boards. Source, [6]

On the off chance that the above prerequisites are not followed and the protection sheets are stuck other than as showed by the rules, (Figure 1) would bring about off base façades being performed and hurt. A considerable abatement in attachment and immovability may make the veneer be destroyed. Inaccurately stuck sheets can in like manner be needy upon cyclic twists (kept hanging) causing distending of the mortar and headway of parts in the reasons for board contact.

As a result of insufficient getting ready and absence of information on delegates of development associations executing establishment of warm protection frameworks, wrong kinds of warm protection are much of the time used for protection of roundabout portions of structures. Edges of individual sheets are confined from the divider shaping openings between the divider surface and the protection material (Figure 2). The results of that are warm scaffolds. Regardless, this isn't the key vitality sparing issue. A substantially more significant issue occurs all through mortar leveling. As the divider is bended and can't be really leveled by pounding, the layer is thicker in places. This moreover realizes warm extensions, with following increment of relative clamminess in the internal parts, headway of wet maps and form. In such cases the surface completing of the structure can be hurt or completely debased, the

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difference in contact warm protection material properties occurs. Warm scaffolds could negative impact the internal microclimate. [3], [4]

Figure 2: Inappropriate heat insulation of circular sections of building. Source, [6]

Window and passage openings are commonly bigger than the windows and entryways that are intended to mount. PUR froth by and large fills the ensuing contrast among openings and uncover. The hole ought to associate with 2-3 cm. Greater varieties aren't exceptional, up to 10 cm normally. (Figure 3)

Figure 3: Gap size between the window and the reveal 10 cm. Source, [6]

The connection gap is where the window is tied down to the wall. The gap likewise represents the transition of the window opening to the brickwork of the wall. The user places greatest interest on thermal specialized requirements for these spaces.

III. EFFECTS OF THERMAL INSULATION DEFICITS

Keeping up adequate temperatures in structures (by warming and cooling) utilizes a lot of vitality use. Little caught air-cells, for example, fiberglass, cellulose, rock fleece, polystyrene froth and so on., are likewise generally utilized in building protections. When well insulated, a building:

- Is energy-efficient, thus saving money.
- Provides more constant temperatures throughout the interior space. There is less temperature gradient both vertically and horizontally from exterior walls, ceilings and windows to the interior walls, thus producing a more comfortable indoor environment when outside temperatures are very cold or hot.
- Has minimum recurring expense. Unlike heating and cooling equipment, insulation is constant and does not require maintenance, upkeep, or adjustment.
- Reduces the carbon footprint of a building.

Warm protection deficiencies may prompt warm extensions and lower vitality sparing than anticipated in the period of warm protection venture arrangement.

Warm extensions are described as a component of the structure envelope where the in any case uniform warm opposition is fundamentally adjusted by the total or fractional entrance of the structure envelope by materials with a particular warm conductivity as well as an adjustment in texture thickness or potentially a contrast among inside and outside zones, for example, divider/floor/deck intersections [12].The linear thermal transmittance of the thermal bridge (ψ) is calculated according to Equation (1).

$$\psi = L_{2D} - \sum_{j=1}^{N_j} U_j \cdot l_j$$

Equation 1, Source [12].

Awful gauges of transmission heat move through the structure envelope will prompt expanded warming interest, raising the general warming limit that can have critical peripheral impacts in light of the fact that the force request will be high as the vitality request is as of now high in a warming commanded condition. What's more, thinking little of the exchange of warmth will bring about modest warming frameworks, poor indoor condition and vitality costs that outperform desires. The subsequent results might be uneconomical for the customer, the manufacturer and additionally the specialist.

The point warm transmittance of the warm extensions (χ) is determined as in Equation (2)

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$$\chi = L_{3D} - \sum_{i=1}^{N_i} U_i \cdot A_i - \sum_{k=1}^{N_k} \psi_k \cdot l_k$$

Equation 2, Source [12].

As the measuring of areas and lengths may be conducted in three different ways (Figure 4), the specific values for thermal bridges may differ.

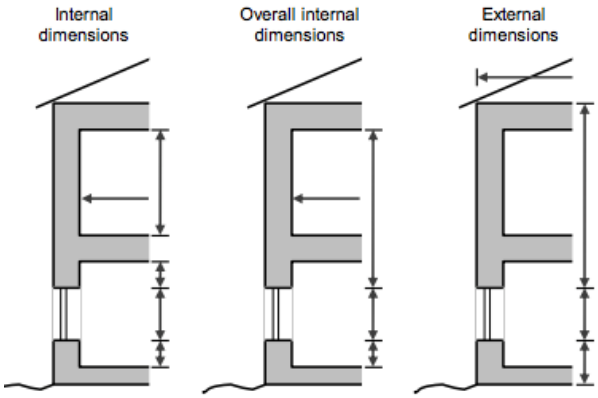

Figure 4 Three different methods of measuring, Source [12].

There are numerous techniques demonstrated to limit warm spanning, contingent upon the reason, area, and type of development. The point of these techniques is either to make a warm break, where a structure segment would some way or another range from outside to inside, or to decrease the quantity of building parts from outside to inside. These techniques spread:

- A continuous thermal insulation layer in the thermal envelope, such as with rigid foam board insulation. [13].
- Lapping of insulation where direct continuity is not possible [13].
- Double and staggered wall assemblies [13].
- Structural Insulated Panels (SIPs) and Insulating Concrete Forms (ICFs) [13].
- Reducing framing factor by eliminating unnecessary framing members, such as implemented with advanced framing [13].
- Raised heel trusses at wall-to-roof junctions to increase insulation depth [13].
- Quality insulation installation without voids or compressed insulation [13].
- Installing double or triple pane windows with gas filler and low-emissivity coating. [13].
- Installing windows with thermally broken frames made of low conductivity material [13].

Lessening the vitality interest for structures is a significant goal as the development and control of structures contribute fundamentally to worldwide CO2 discharges, representing very nearly a fourth of worldwide CO2 outflows [14–16]. Contingent upon the structure's vitality utilization structure, the warm exhibition of the structure envelope is the primary factor influencing vitality utilization, along these lines, the thermally protected dividers can decrease the vitality utilization of the warming or cooling framework [17–19]. Notwithstanding improving warm solace, the structure will likewise profit by design changes by outer divider protection. Certain points of interest of introducing the protection outwardly incorporate decreased tenant clamor, form evacuation and diminished support. Building protection is one of the simple and viable approaches to moderate the power. Mounting protection content in the structure is principally planned for lessening vitality utilization for warming or cooling by expanding the structure envelope's warm opposition.

IV. RESEARCH METHOLOGY

The "critical thinking" and "relative" strategies of this work are right now, look in a structure for a goals. Taking a gander at the two cases (with and without warm protection), it investigates the impact of the utilization of warm separators on the pace of vitality utilization. Right now, data is amassed by means of Data Collection Technique. The used strategies are: meeting, survey, and perceptions. All of them will be explained in the accompanying.

Figure 5: Situation of Betsa 2 Apartment Building on Salamis Street.

The assessment tests of this examination are two private lofts. The primary loft as showed up in figure 5 is Betsa 2 Apartment on Salamis Street, which is four-flabbergasted and has six private units on each floor.

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This condo needs appropriate warm protection of the outside dividers.

The second example is the Uzun 16 Apartment, which is five-floored and has six units on each floor. The outer walls of these units are 5cm polystyrene insulated. This building can be seen in figure 6.

Figure 6: Situation of Uzun 16 Apartment Building on Salamis Street.

The two condos have equivalent space to accomplish progressively precise outcomes, and both are associated with free space on four sides. This test centers on the outside dividers and breaks down the vitality utilization. A short depiction of the environment and atmosphere conditions in Famagusta is given toward the start. Survey was the essential procedure to be utilized. The poll structure was "requested and non-disquid" and the inquiries were "available." These inquiries were spread out in 48 arrangement (every one review unit) comprising of four inquiries. An answer the inquiries were recorded the inhabitants of the two lofts. The principle question was about warm solace in the winter and the accompanying inquiry was about the expense of power neglected a very long time of the year. Since the glow of the structure is generally given by electric radiators, power costs address the necessity for electric warming frameworks, and moreover vitality utilization pace of the cool a very long time of the year in the two structures.

The third inquiry expanded the structure's typical inside temperature, presented to the cool a long time of the year without warming frameworks. Likewise, the fourth inquiry related with the degree of warm solace in within space after the usage of warming utensils stop. Obviously the need to utilize warming frameworks lessens as these trustworthiness increments. Right now cost of intensity will be decreased. Precise investigation of the data assembled ought to uncover the job of warm protector in the pace of vitality utilization. In the second step of information assortment, talk with strategy was used. The sort of the gathering was "eye to eye" and the philosophy was "open finished inquiry" from two gatherings of proprietors and engineers. The essential information in regard of the material utilized in the external divider was obtained in the primary meeting with the proprietor. The materials utilized in the external dividers were 20-centimeter mud blocks, 2-centimeter concrete mortar on each side and a downpour and sodden safe paint coat on the façade, considering what the proprietor said.

Figure 7: Clay Block (photo taken by author)

The relating meeting was led with the structure's contractor, who has warm protection. So as to do as such, the development organization's work environment in Famagusta was visited and one of the provisional laborers was posed a couple of inquiries about the materials and warm encasings utilized in the structure. As demonstrated by this specialist, the squares used right now the 20-centimeter earth squares, and the warm protection used outwardly dividers is polystyrene-with the thicknesses of 5. Initial, 20 cm block square ought to be utilized to make the structure's outside divider with a polystyrene cover, at that point spread the outside piece of the divider with a unique glue, and in the end include the polystyrene sheet. In the first place, spread it with

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screen and 2 cm solid mortar-which will decrease costs relying upon what the manufacturers have guaranteed, and it will be utilized in a couple of houses.

The data accumulated from this segment would be utilized to decide the warm opposition and warm transmittance of the two structures ' outer dividers (with and without outside divider warm protection). As expressed before, different outside divider materials have a scope of warm opposition and warm transmission, which assume a recognizable job in the cheapness of interior vitality. Right now the investigation, the case condo was visited and the façade, outside dividers and the inside spaces were caught. The two example structures are appeared in figure 8 and 9.

Figure 8: Betsa 2 Apartment (Picture taken by author)

Figure 9: Uzun 16 Apartment (Picture taken by Author)

V. FINDINGS AND DISCUSSIONS

FAMAGUSTA

Famagusta is a port city with a quiet Mediterranean climate located in northern Cyprus. S hot and dry late spring, then rainy winter. In Famagusta the normal temperature is 19.5 Centigrade. July is the most blazing month of the year, with 34 Centigrade, and January is the coldest month with 11.5 Centigrade. The average annual downpour is 403.5 mm, and the usual daylight is 3328 hours per year [7]. The town area and normal temperature are shown in Figures 10 and 11.

Figure 10: Famagusta, Cyprus. Source, [8].

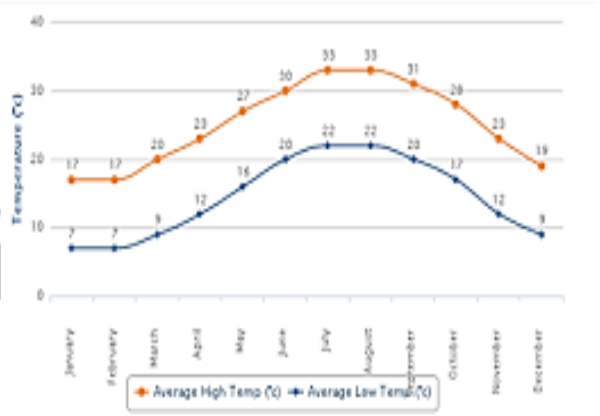

Figure 11: Average High/Low Temperature for Famagusta. Source, [9]

QUESTIONNAIRE EVALUATION

According to the answers gotten from the questionnaire of which the occupants of the two apartments were tasked to reply, the outcomes are appeared in the diagram.

- The individuals' average satisfaction of interior space thermal comfort in every one of the two examples (with and without thermal insulator of the exterior walls) is appeared in diagram 1:

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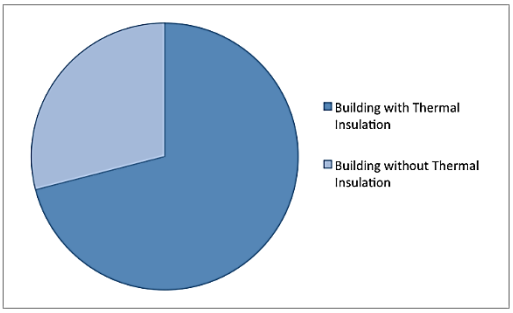

Chart 1: Members' Average Satisfaction of Interior Thermal Comfort (drawn by author)

As it seems, 71 percent of apartment residents with external wall thermal insulation were satisfied with thermal comfort during the cold months of the year, while 29 percent of apartment tenants without outside wall thermal insulation were happy with thermal comfort during the cold months of the year. Investigating the electricity expenses of each building, the outcomes are appeared in diagram 2:

- Taking into consideration the diagram, the normal electricity cost of the building without thermal insulation is higher than the building with thermal insulation in the cold months of the year. This implies a more significant need to heating system

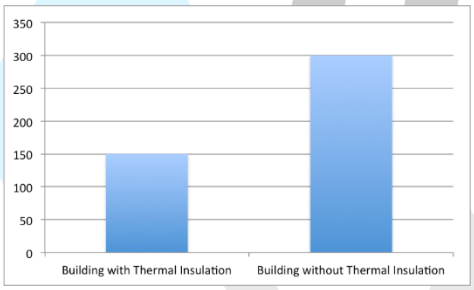

Chart 2: The Average Electricity Cost (Turkish Lira) in cold Moths (drawn by author)

- The results for average interior temperature in the cold months of the year without using electrical systems in each building is shown in chart 3:

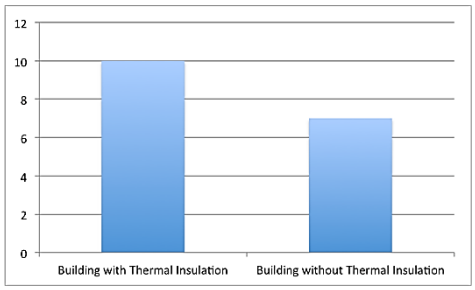

Chart 3: The Average Indoor Temperature in Cold Months without using heating (drawn by author)

As it is observed, in view of the appropriate responses in questionnaire, the average temperature of the coldest month of the year in the building with thermal insulator is 10 centigrade and without thermal insulation is 7 centigrade.

- The fourth question related with the stability duration of thermal comfort in the interior space after the utilization of heating utensils stop in the cold months of the year. The results are shown in chart 4

In view of the gathered answers of the two examples, the stability rate of thermal comfort after the radiator stops in the building with thermal insulation is 3 hours and in the building without thermal insulation is 1 hour.

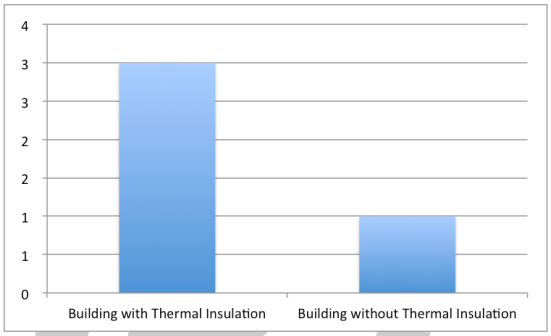

Chart 4: Permanent Hours of Thermal Comfort after Switching off the Heater (drawn by author)

The people who live in buildings without thermal insulation said that the created heat by means of the thermoelectric utensils was wasted. So to keep the heat inside, they ought to definitely utilize radiators continually which cause high electricity bills. Obviously, there are different components successful on the energy waste; and the outer wall is one of them. Since the best elements in the improvement of these distinctions are thermal resistance and thermal transmittance of the outer walls, defined equations to calculate thermal resistance and thermal transmittance are utilized. Initially, the measures of thermal insulation and U-value of the walls without thermal insulator are determined, and afterward they are contrasted and the wall with thermal insulation to uncover the impact of thermal insulator.

VI. RESULTS

Based on the evaluation of the questionnaire and the comparison of the two samples, it was concluded that thermal insulation of the wall has a significant role in energy consumption reduction of the building. After

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evaluation and comparison of thermal transmittance, the results were shown in chart 5:

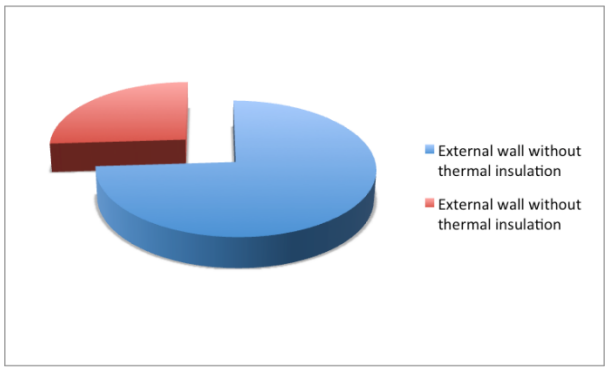

Chart 5: The rate of energy saving (drawn by author)

As specified, the wall without thermal insulation prevents energy waste 26% while the wall with thermal insulation prevents energy waste in the building up to 72%. Therefore, using thermal insulation can prevent energy waste in the building three times more than the wall without thermal insulation.

VII. CONCLUSION

Aftereffects of building vitality reenactments uncovered that legitimate utilization of warm protection in the structure envelope diminishes the yearly vitality utilization as well as makes lower top burdens. Working just as beginning expense of HVAC gear can hence be diminished because of the littler gadget limit expected to give solace to the protected structures. Other than that, positive effects on the atmosphere would likewise profit by less reliance on fake warming and cooling frameworks. Building protection is one of the simple and viable approaches to preserve the room. Legitimate structure treatment can fundamentally improve warm execution especially for SLD structures, for example, living arrangements and little workplaces with inward warmth gains in light. In structures in all atmospheres, divider protection is prescribed for all the more thermally agreeable space, with less vitality necessities.

Mounting protection content in the structure is principally planned for decreasing vitality utilization for warming or cooling by expanding the structure envelope's warm opposition. There are numerous criteria that can be helpful in vitality frugality and proficiency in a structure task and this work has been worried about the utilization of warm protection. In light of the assessment of the two examples (with and without warm protection of the outer divider) through survey, the arrived at result was that utilizing warm protection has a critical job in power cost decrease and warm solace enhancement. As per led examines, the warmth in the structure with warm protection stays more and diminishes the vitality utilization. Subsequently, vitality utilization pace of the structure and the impact of warm protection of the divider are uncovered by assessment and examination of the two structures. Results from this examination have exhibited the impacts of utilizing warm protection outwardly divider. So it can support planners and modelers utilize warm covers outwardly divider to attempt to utilize it in the structure more than previously and eventually plan a vitality productive structure.

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