Cumhuriyet Üniversitesi Fen Fakültesi
Fen Bilimleri Dergisi (CFD), Cilt:36, No: 4 Özel Sayı (2015)
ISSN: 1300-1949

Cumhuriyet University Faculty of Science
Science Journal (CSJ), Vol. 36, No: 4 Special Issue (2015)
ISSN: 1300-1949

Evaluation of the Function of Common Building Materials as External Layer of Building

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Received: 22.03.2015; Accepted: 29.05.2015

Abstract. Selection of suitable wall system is one of the most important decisions an employer must make, since the external walls have the biggest role in providing comfort for the inhabitants in a building. For example, one of the most important sources of heat energy loss within the building is through the walls. However, the use of appropriate and correct material can tremendously increase the walls' resistance against heat loss. Another important factor in this regard is the external sound control. In fact, the decrease of sound level must be as much as to keep sound level within the appropriate amount.In this paper, we introduce the most common wall system in building construction we have obtained through questionnaire. Also, we examine their heat and sound function by means of software, such as THERM and ODEN which will help to choose the appropriate and correct material in building walls through their investigation in life cycle. It is also hoped that the results from this study will be used in executive project by those involved in housing and construction.

Keywords: Building's external layer, material's heat function, material's sound function, life cycle

INTRODUCTION

Housing problem,asone of the important parts has directly essential role in people's lives.Widespread and growing needs of building and housing and Its importance in Development Programs and on the other hand, assigninglargest share of energy consumption in this sector, Necessary and appropriate use of materials has raised more than before.The highest percentage of heat transfer through the external layer of the building is constituted.So, whatever the rate of heat transfer from the external layer of the building is more, the Energy needed to provide greater comfort conditions should be increased.

The constant energy is used for heating or cooling to recompense the energy transferred from the external layer essentially. If we can take the necessary measures to reduce heat transfer from the external layer of the building, we will save energy significantly. On the other hand, external layer of the building separates residents from the external environment and maintain them. Therefore, it should be chosen in such a way that in addition to providing thermal comfort, other terms of comfort and tranquility of residents as well as provide acoustic comfort. Today, because of noise pollution has become one of the problems in the housing sector. So according to what was said, selecting the external layer become very important. Today, because of various materials used in external layer of the building are produced. The decision to choose this material should be made based on several criteria. In this study, a on various external wall systems that are common in the city of Mashhad, have been obtained through questionnaire and have been studied.In this study, a questionnaire on various external wall systems that are common in the city of Mashhad, have been obtained and studied.

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Special Issue: Technological Advances of Engineering Sciences

Type of Research

Fundamentalor Applied Research

In general, research can be divided into basic and applied categories. Fundamental research deals withgenerating knowledgeformoreunderstandingand seeking facts and cognition of phenomenonapplied research to generate knowledge for action. By providing applied research through basic research to meet human needs and develop tools and methods for development, welfare, comfort and enhance human life is used. In other words, basic research associated with theoretical issues and applied research associated with practical issues (HafezNia,2008; Beliki, 2005).
According to above definition and with respect to the purpose of present research, this research is applied research.

METHODOLOGICAL RESEARCH

Generally, this research was conducted in three phases.In the first stage, a library study of books and articles in journals at home and abroad, as well as articles and interviews have been widely adopted. At the end of this phase, introducing and familiarity with the basic building material and its properties were investigated. From the second stage fieldwork was begun.in this phase, a questionnaire about the common building material in the building market and the housing provided based onthe first phase study. The experienced and knowledgeable experts completed the questionnaire and the results of field studies were studied.Based on a statistical study of the second stage, in the final step complete study and analysis was performed by experts and specialists and Summary of the results was performed by studding of factors and their evaluation.

Society and Sample Survey

Sampling, the selection of a number of people, events and objects of a society is defined as a representative of the community.According to most scholars community is defined as all of the real or imagined members are interested in researcher's finding.so original finding of study are more important than Generalizability(HafezNia, 2008).The research groups in relation to all building materials and construction, including university professors, civil engineers, operators and contractors, employers, managers, consultants and etc.Unable to determine the population of the community cause to uncertain size of society and making the special condition for determining the Volume of the sample. In order to determine the volume of sample for distributing thequestionnairesCochran formula is usedfor the unknown population size. This relation is as follows:

$$n = \frac{pqz^2}{d^2} \quad (1)$$

In the relation nvolume of sample, d error value, is the acceptable error value in variables we are interested in, this value is selected between 0/05 and 0/1 and in this research average is selected 0/075 .z the examined standard size of level is 90% and based on normalstandard Distribution table amount of z is 1/28 and p and q are ratio or Desired conditions and sum of them is twice of one. According to unable of existing predictive ratio and for increasing volume of sample and Create a similarity with the most common research both is chosen 0/5.Put the amounts mentioned in (1) the result is equal to 8/72.It should be noted in this study collecting answered was 75 numbers.

Reliability

Reliability means Credibility, accuracy and reliability are interpreted, is that if a measurement device for measuring a variable trait made, in similar conditions at other times or places used, similar results areobtained(Hafez Nia.M.R, 2008).

In fact, the aim of assessing the reliability of achieving this point is whether or not a repeat of the previous results to address? Various methods are used to determine the reliability by the researchers. In the present study, Cronbach's alpha was used to assess the validity of this study is the relationship of the Cronbach's alpha was used with Microsoft Excel. The equation is:

$$\alpha = \frac{K}{K-1}\left(1-\frac{\sum_{i=1}^{k}\sigma^2_{Yi}}{\sigma^2_X}\right)\partial \quad (2)$$

Kis the number of variables of test questionnaire; □ Yi2 is variablevariance, iand x2is the total variance of the test. Sign Data alpha value is 87% larger than 70% of the minimum amount of alpha for reliability is acceptable. Could therefore be argued that the questionnaire has acceptable reliability.

Validity

Validity means:Scale and content or subject matter of the questions contained in the instrument carefully evaluatesubject of study and the variables.it means some of needed data, related to evaluating the variables in context of instruments were not deleted, In other words, it show reality. (Hafez Nia.M.R, 2008).

In this study, these methods have been used to increase the validity of the questionnaire:
- Book study, articles and publications related to the topic
- Consultations with experts and professionals to investigate questions
- Inventory literature review
- The lack of ambiguity in the conduct of the test questions
- The non-inclusion of the subject in question to avoid confusion
- Use the same options for paying participants focus on the questions
- Ask open-end plan to introduce other barriers by the majority of respondents expressed this content on pay scale.Most of the time subjectsare restatement the existing subjects of questionnaire.

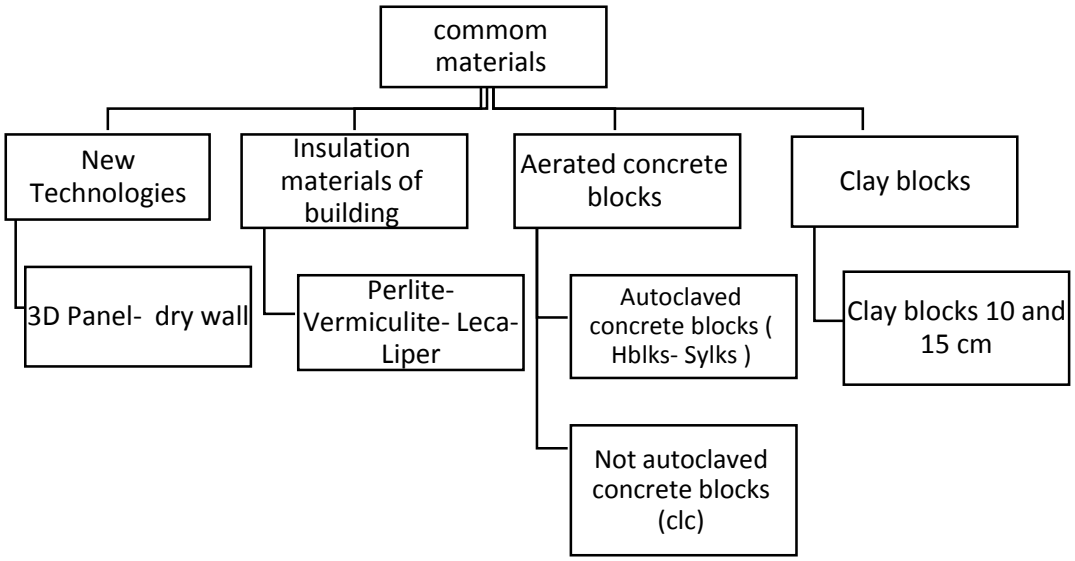
The Conclusion of Questionnaire

After collecting the questionnaires and summarizing the responses, materials research were scored in the first period.At first the answers without comment in each question was left. Then the rating of one to fiveallocated to the five optionsVery low, low, medium, high and very high.Then it was multiplied with the question of the same option and share to the Total number of responses to the five options.Thus, according to the rating of one to five, the result of this method, the barriers were ranked such thatThe more points the way to a more serious obstacle was given was a crisis.

The Results of the Questionnaire

In this study, common materials is used as external wall inConstruction is classified in four categories and is studied the most common category is obtained through questionnaire.

Table 1. Classification of common materials studied.



Criteria Decision-Making

Criteria should be considered such a way be complete and Have minimal overlap and dependence to compare choices ahead.Due to this topic, at first theNearlyIndependent choices is defined then materials in each part is evaluated and compared with each other.

Comparison of Thermal Performance

Because in recent years, especially since the late seventies we have faced to energy crisis. The thermal resistance of external wall were proposedas one of the most important parameters.In this study to evaluate the thermal performance of building materials In order to evaluate the thermal performance of building,desired materials modeling in THERM software. Then their Surface heat transfer coefficient obtained though software.

Table 2. Thermal properties of building materials.

Kind of wall	Dry density (kg/m3	Thicknes (cm)	Effective thermal conductivity (w/m.k)	Thermal resistance (m2.k/w)	Surface heat transfer coefficient (w/m2.k)
Clay blocks	2100 to2200	15	0/92	0/16	1,81
Hblks	700	15	0/17	0/88	0,95
Sylks	600 to 700	15	0/17	0/88	0,95
CLC	450	15	0/22	0/68	1,17
perlite	400 to 600	15	0/24	0/62	0,26
leca	900	15	0/20	0/75	1,08
3D panel	–	13	0/08	1.62	0,55
LSF	_	13	0/07	1.85	0,50

Comparison of Audio Performance

The sound of the 3/1 octave bands in the application materials have been ODEON modeling and evaluation. It is noteworthy that in this model the three sources of sound with intensity 85 dB sound built around the model is considered.

In the chart below, the sound pressure level (SPL) at any frequency within the building will be shown. As you know, the sound intensity level, criteria for evaluating human perception of loudness of sound.If we ideally consider the permissible sound pressure level of 35 dB for residential building, about the clay blocks can be said that these blocks are performed relatively poorly in the frequency range 63 to 1000 Hz and 500 Hz in particular.

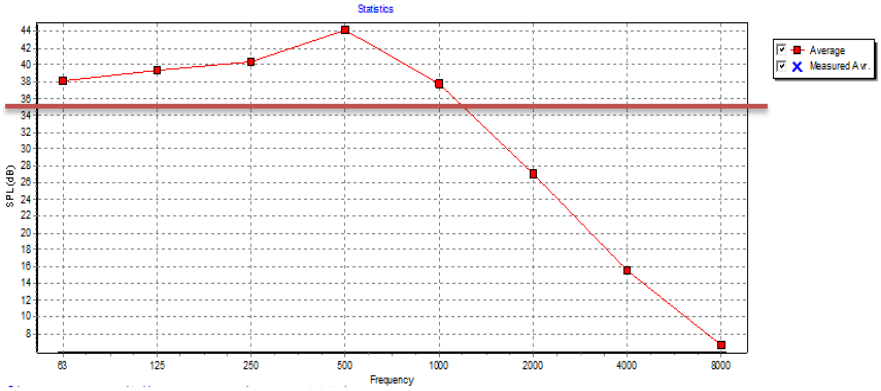


Figure 1. Sound pressurelevel diagram of Potteryblock.

Chart sound pressure level (SPL) to block the frequencies of 250 Hz Hblksare as follows and the just are weak in the frequencies of 250 Hz. with comparing to clay blocks of soundThis value is very good.

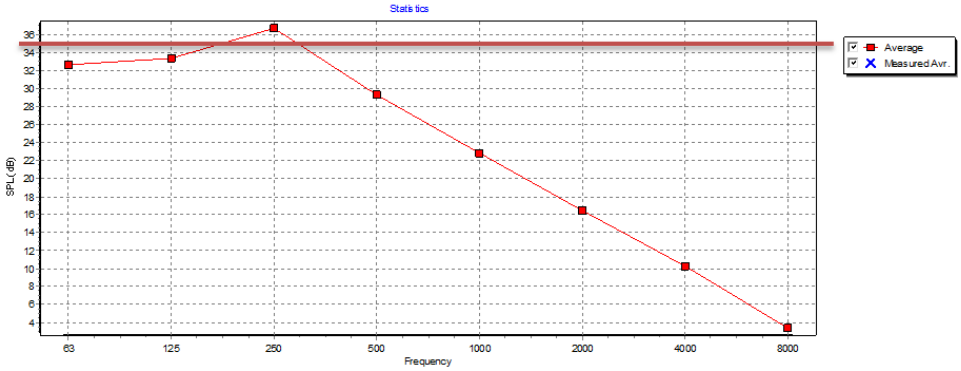


Figure 2. Sound Pressure Leveldiagram of Hblks block.

In the chart below for perlite blocks the maximum amount of sound pressure level is at frequencies of 63 and 125 Hz.but in frequencies Energy distribution chart from source have their minimum amount there are these maximums.Therefore it can be concluded that this block is very good audio performance.

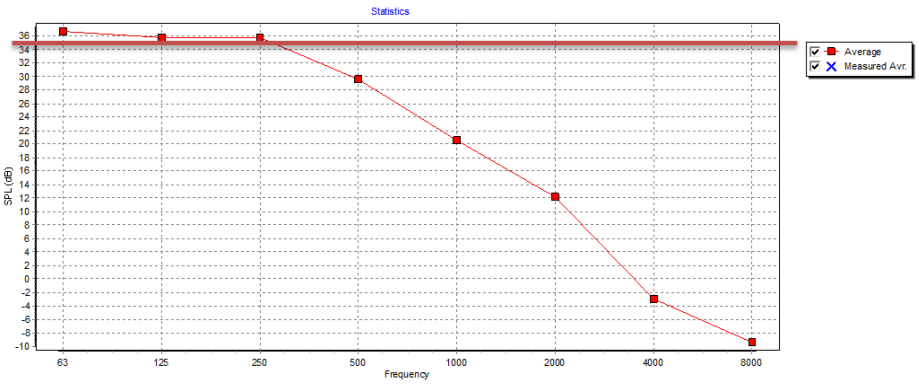


Figure 3. Sound pressurediagram of perliteBlock.

It is received from Leca block this blocks are weak in the Frequency of 63 to 250 Hz.And since the maximum energy distribution curve from the frequency of 250 Hz; soSolution should be provided for these frequencies.

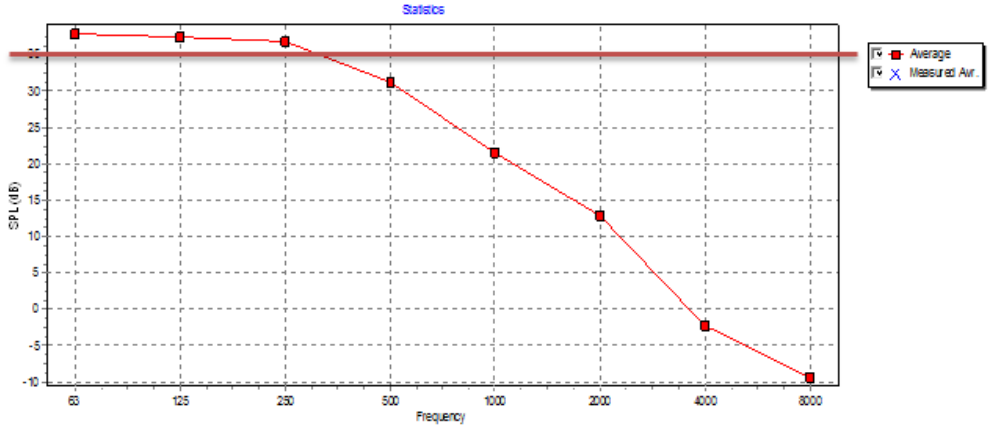


Figure 4. Sound pressure level diagram of LecaBlock.

In The sound pressure level diagram of 3d panelsound pressure level is 35.7 dBat a frequency of 500 Hz and is located on the border line maximum taken energies occurred in that frequency.

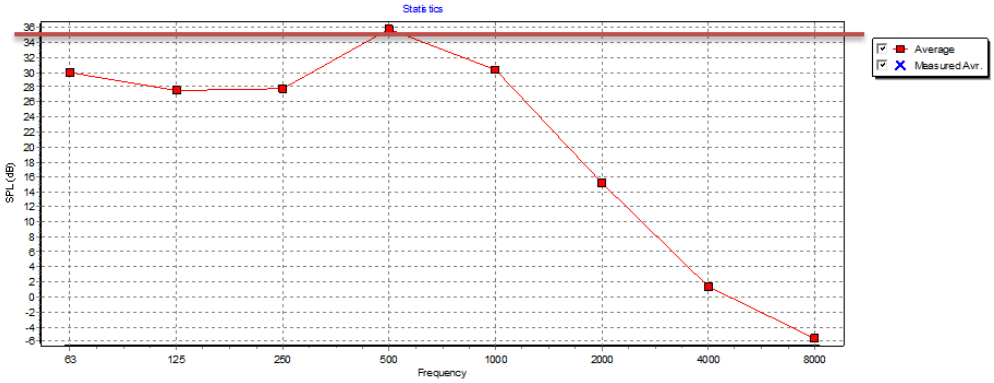


Figure 5. Sound pressure level diagram of 3D panel.

As you see, the sound pressure level diagram of the walls, the walls can be seen as a good performance at high frequencies and the frequencies of 125 Hz weakness.

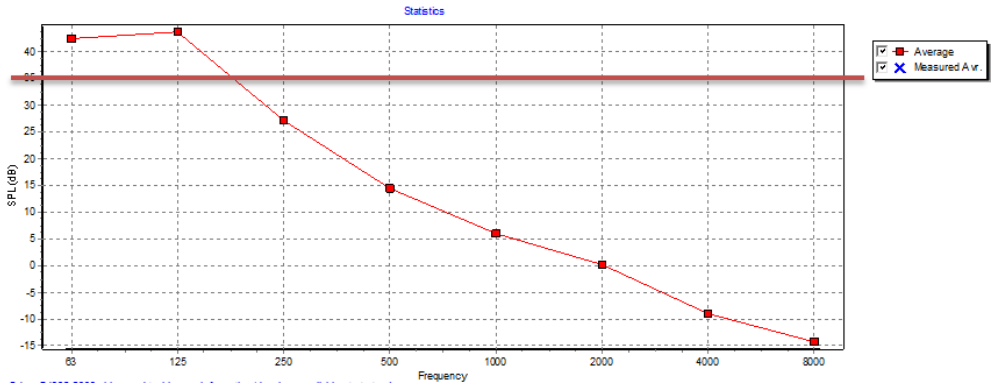


Figure 6. Sound pressure level diagram of light steel structure.

In conclusion it can be stated briefly that in these materials, light steel structurehave the best audio performance in the simulation if theirweakness is resolved. Perlite block have good audio performance after that, Due to the economic aspects of the block to light steel structure, is much more appropriate. The following table summarizes the net weighted sound pressure level A for materials are modeled.

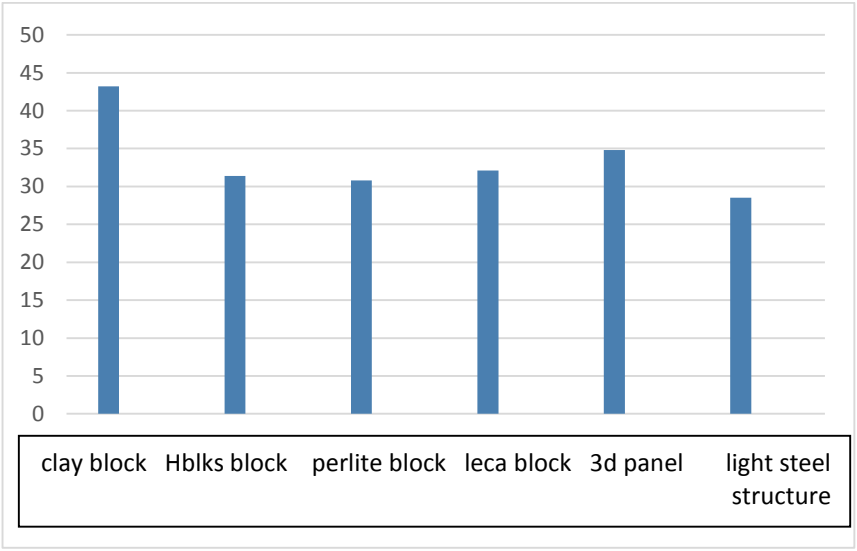


Figure 7. Comparison of modeled audio performance materials.

Comparison of Environmental

Most of the time,choosing of building materials, is notable trend. Because the materials are important impacts on the environment and the building's residents. Thus, so choosing of building materials of environment lead to increase the value of building project and decrease its adverse effects on environment. In this study, materials are investigated in term of Environmental in The life cycle.

Evaluation of Life Cycle

Evaluation or analysis of the life cycle is the way in which all of the relatedEnvironmental impacts of one product in whole of life cycle from Phase extraction or collection of Raw materials toTaking the stageand then Recycling and Elimination of waste of that ,is evaluated.(Rafie, Reza, A.S. Mahini& N.Khorasani,2009).

Materials in this cycle can be studied in four main categories as follows:

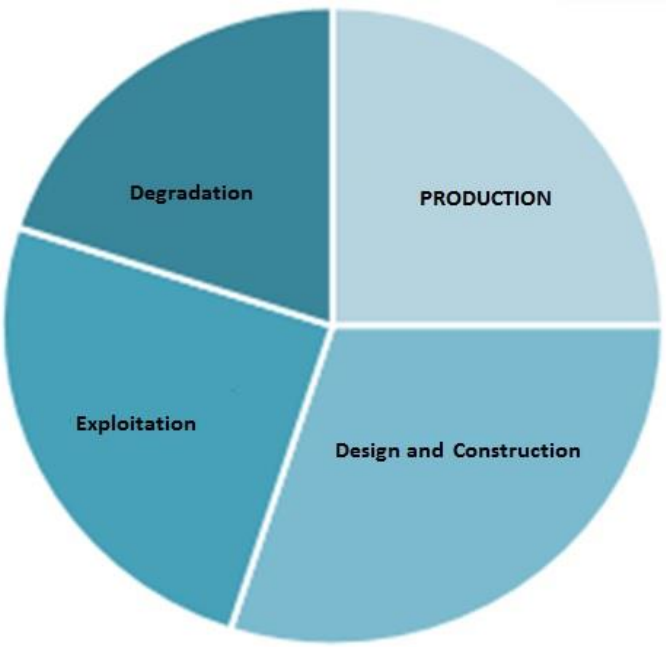


Figure 8. The life cycle of a product

This cycle starts from environment and other steps includes production, design and construction, exploitation, and degradation. Finally, it goes back to the environment.

To have a successful design, the individual components of building must be considered. In this section, common materials that are used as the external wall in the life cycle and compare them. It is notable for scoring, materials have been evaluated and the results are shown in the diagram below.

Production

Production is the first step in Cycle Environment. In fact, at this stage, the materialsare received from nature and delivered to the industry.Delivered to the industry. But before choosing the raw materials have many items should considered such as foodAvailability,etc.

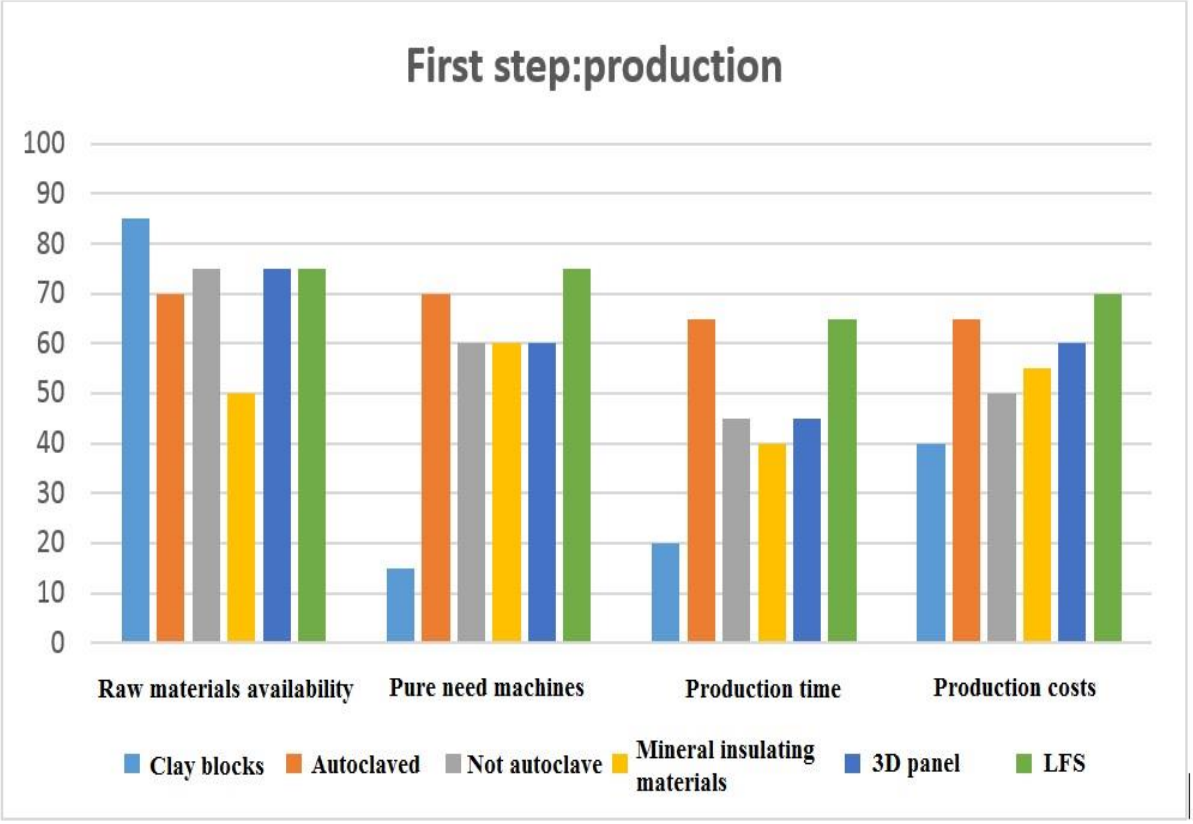


Figure 9. Comparison of construction materials in production.

DESIGN AND CONSTRUCTION

Design and construction stage should be made by considering four increased operating efficiency, quality, and customer satisfaction and be durable. One of the basic requirements of an environmentally friendly product, is saving energy needed for production.

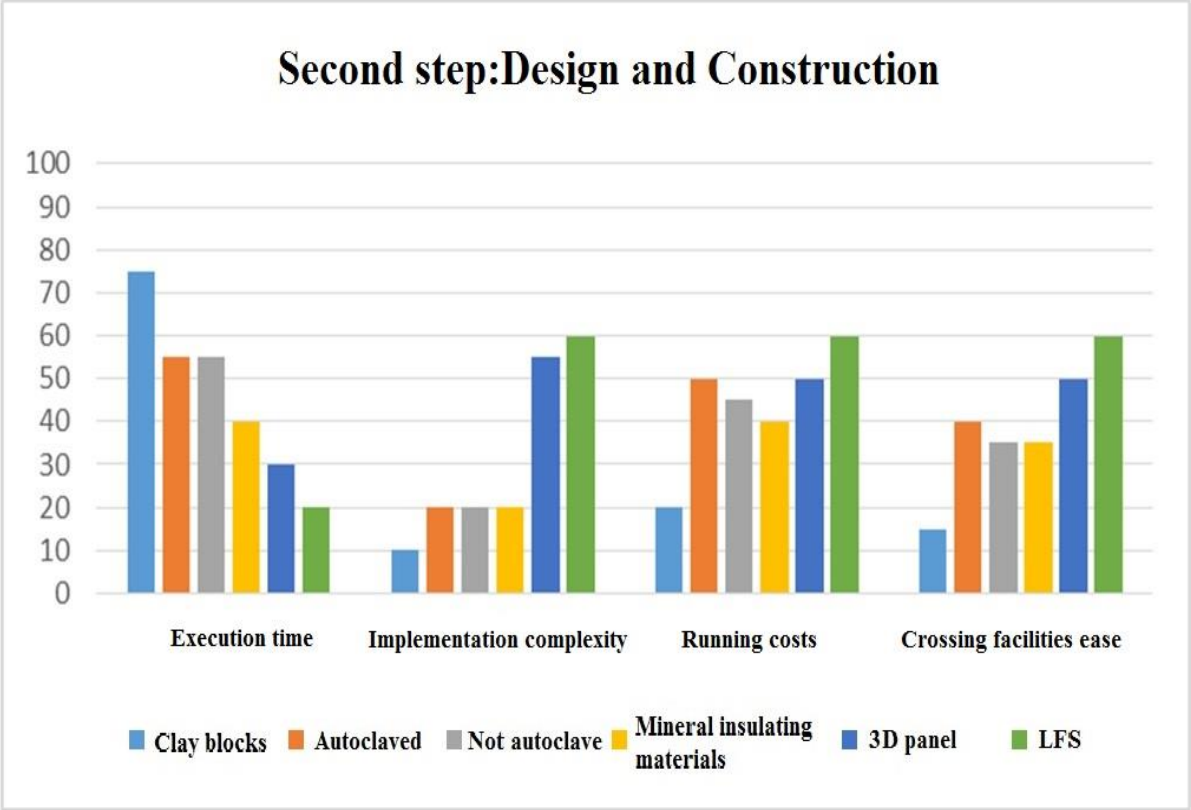


Figure 10. Comparison of construction materials in the design phase and construction.

Operation

We tried to increase the length of the building is used. During use of the building is worth it, and we should try to raise its value.

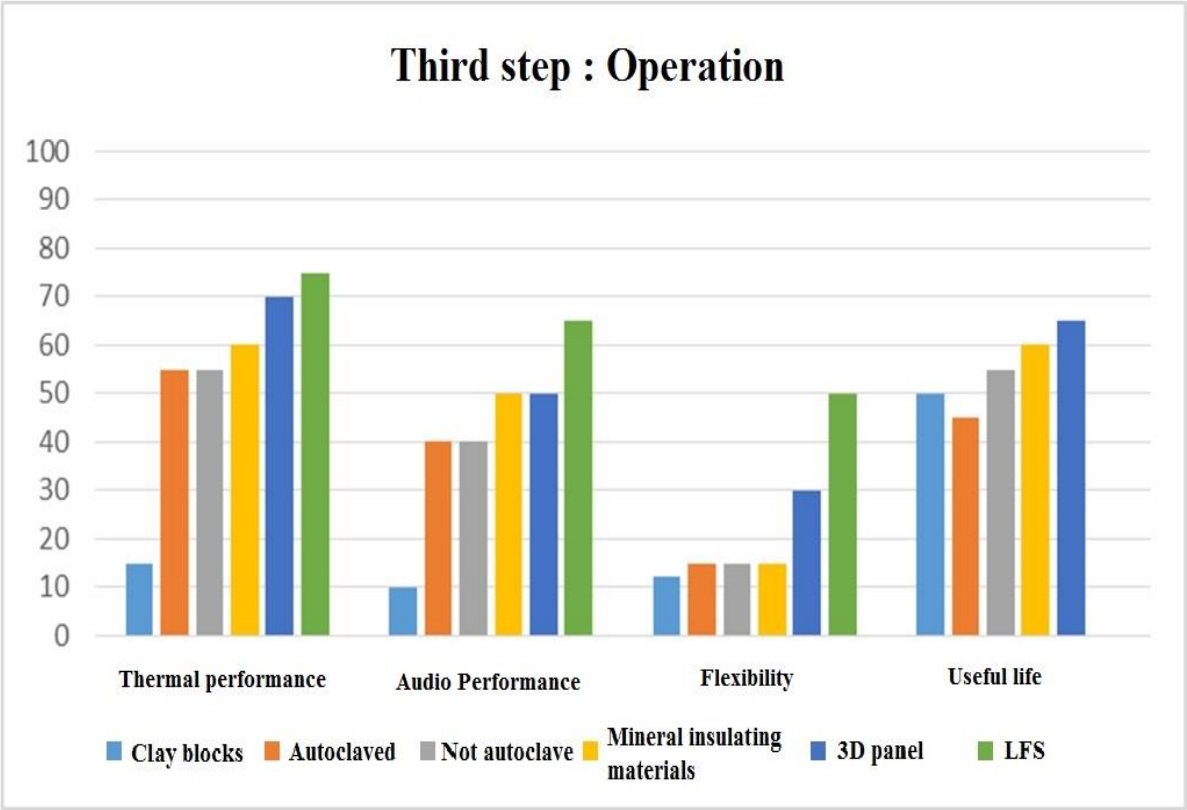


Figure 11. Comparison of construction materials during operation.

DESTRUCTION

In developing countries, a large proportion of municipal solid waste, are included by construction waste, in addition to the high cost of disposal, have adverse consequences on the environment. The volume of construction waste to the extent that this issue is not only in developed countries but also in social and environmental problems. The table below shows the rate at this stage we are building.

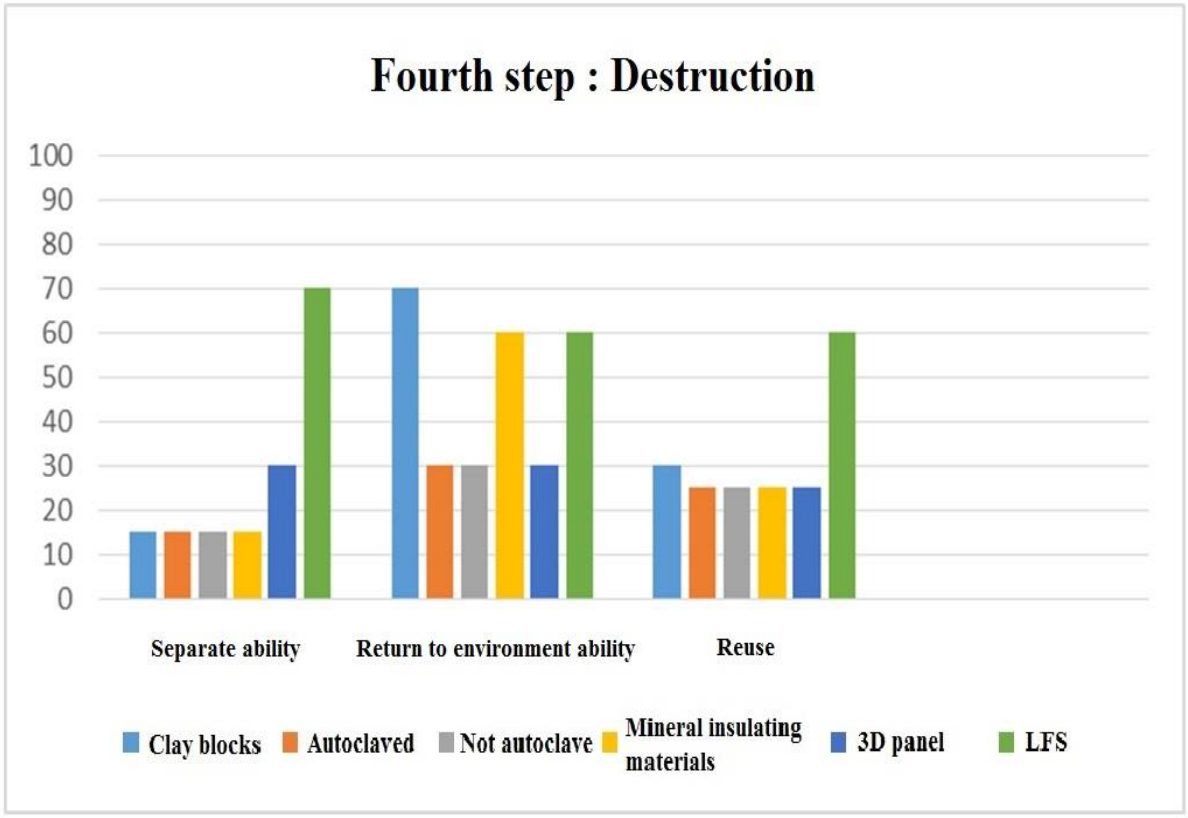


Figure 12. Comparison of construction materials during demolition.

CONCLUSION

Before analyzing the results presented,it should be noted that however the most obtained information through interviewees Comments but the final result and data are not attributable. This is one of the perennial challenges the decision-makers always faced, increasing the reliability by increasing the population, selecting more accurate and more appropriate interviewees, and creating equal conditions. In addition, the employer is entitled to according to your requirements such as economic conditions, weather, speed, etc., weight coefficient change the criteria that it will have a large influence on the results. According to a study done,among the systems studied wall, external wall systems with gas concrete blocks is the most suitable system. Also Leca and Liper walls are next in line.

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[4] This article is adapted from the author's MA thesis entitled "Evaluation of thermal and acoustic behavior of common building materials for residential buildings in Mashhad," which was performed on September 2014.