

# Quantitative Exploration on Ecologically Responsive Architecture Guideline(ERAG)of SONA

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## Abstract

Modernization and expansion of many countries have been expedited by the industrial revolution in the developed world and developing world. Humans now require housing in order to survive, and they also want to increase their level of comfort. With the increase in economic development and economic status of people in developing countries, demands for architectural resources like land, buildings or building products, energy and other resources augments too. Also in case of Nepal there is less or no planning in case of green & sustainable. There is no proper system to check sustainable parameters in Nepal. However, some guidelines are considered for architectural development which is purposed by society of Nepalese architects. This paper seeks to explore on Ecologically Responsive Architecture Guideline (ERAG)- purposed by SONA, done by closed ended questionnaire survey. To explore upon ERAG, 20 numbers of questionnaire survey were done with sustainable practicing architects & with senior architects involved in ERAG. Initially found out the reason on not continued of ERAG, maximum architects agree upon quantifying sub points is better options to continue ERAG. This paper explains about sub points to quantify ERAG based on 2 elements of Panchatattoo air & water, which I am looking upon environmental & economical perspectives. This research may be useful to SONA and sustainable practicing architect.

## Keywords

Air, water, environmental, economical, quantify

## 1. Introduction

According to Oxford dictionary sustainable means able to be maintained at a certain rate or level. A sustainable building or green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use in energy, water and materials while reducing building impacts on human health and the environment during the building's life cycle, through better siting, design, construction, operation, maintenance and removal [1]. Nepal is one of developing country in world, there is least consideration upon sustainability. Also according to [2], Nepal government is short-term firefighting solutions rather than to focus on long-term sustainable plans and policy like lack of the government's policy and interest in the sustainable development in country context.

Energy rating Mandatory in their country like LEED, GRIHA, BREAM, etc.[3]. For each & every design there is requirement of rating system. GRIHA is

Green Rating for Integrated Habitat Assessment that addresses various concerns of green buildings through the design, construction and operations phase of any building in order to ensure minimal negative impact on the environment by using philosophy of five 'R's i.e. recycle, reuse, reduce, refuse and reinvent [4]. GRIHA is used in India for rating.

Nepal doesn't have such mandatory but have many professional that can make an efficient "green building team[5]. Although, there are some initiatives are been carried out by SONA; had purposed Ecologically Responsive Architecture Guideline (ERAG). ERAG is ecologically responsive architecture guide for Nepali context, which is initiated by Society of Nepalese Architects (SONA) by Past President Ar. Bibhuti Man Singh to provide own building guideline for Nepal. ERAG's was begun "For contextual sustainable building design in all the geographical regions within Nepal"[6]. ERAG was begun in 2012 A.D. however ERAG is not been continued till now. This research is aimed to analyze

upon ERAG purposed by SONA & draw some parameters for quantitative analysis on residential building of Nepal.

### 1.1 Problem statement

Nepal has Building code just in reference to safety measures but doesn't have any Residential Sustainable Building Rating System and it is likely to have the largest environmental impact and the largest benefit from sustainable design[5]. Although there is high energy demand with haphazard development, here no such initiation upon sustainable guideline for building design in case of Nepal. There is begun some building code and guideline by municipalities. Ecologically responsive architectural guideline (ERAG) is the guideline which is debuted by SONA. Term of ERAG was proposed by Prof. Dr Sudarshan Raj Tiwari during the 2nd SONA Committee on Green & Sustainable Architecture (SCGSA) led by Ar Bibhuti Man Singh in 2012A.D. ERAG was begun because international rating system has lengthy process, costly, intense documentation required. SONA came up with matrix of topics that comes under it which can be used as guideline for building design. According to survey, most of architect aspects that ERAG is not continued because ERAG cannot be used as quantifying tools for buildings. Also, most of aspects comes under philosophical approaches rather than implementation for building design.

### 1.2 Objective

Ecologically responsive architecture, is an approach to building that minimizes harmful effects on human health and the environment [5]. ERAG is ecologically responsive guideline proposed by SONA. At first the aim was to establish Nepal's own GSA rating system during the 1st SCGSA duration and various meetings into the subject was held among the experts, stake holders and architecture fraternity and also UN Habitat where other Government/Non-government Organizations were also involved. ERAG was begun in past year but which was not continue till now. So, this research is based continue on ERAG & explore more on ERAG.

### 1.3 Relevance and Importance of Study

In Nepal, design and construction of green buildings are still considered to be not so common and most of the customers/builders are not aware about the

effectiveness and performance of those kind of buildings[7]. Also, there is no such strike building rules and regulations in our country context. So, might be that is a reasons why users of residence are less focused in sustainable parameters for building construction. By continuing upon Ecologically Responsive Architecture Guideline (ERAG) we can target upon making building towards sustainable. By continuing upon ERAG Nepal would have its own guidelines for building design that provides green buildings for society & would support national energy crisis.

## 2. Literature review

On literature review study of sustainable architecture, LEED, GRIHA, SDGs'. In case of architecture, sustainability concept reflects Green architecture, development of architecture according to naturally suitable, living favorable conditions and that condition which affects least impact toward living animals, plants and other environmental factors[1]. Building ought to be sustainable from plan, develop, construction in field to operation and upkeep stage. Use of proper planning in design, site wise suitable planning & design and easy on phase of operation and maintenance. Consideration of nature & natural parameters provides green features for living parameters. Financial, natural, cultural and social sustainability are like column for all sustainability concept; combination of these measures in appropriate way gives way better sustainable society. Sustainable architecture is designed to decrease the by and large effect of the built environment on human wellbeing and the natural environment by efficiently using energy, water, and other resources, securing inhabitant wellbeing and progressing worker efficiency and Decreasing squander, contamination and natural degradation[8]. LEED & GRIHA are rating system, used in sustainable building. LEED is Leadership in Energy and Environmental Design which consists of a set of performance standards used in the certification of commercial, institutional and other building types in both the public and private sectors with the intention of promoting healthy, durable, and environmentally sound practices. Green Rating for Integrated Habitat Assessment that addresses various concerns of green buildings through the design, construction and operations phase of any building in order to ensure minimal negative impact on the environment by using philosophy of five 'R's

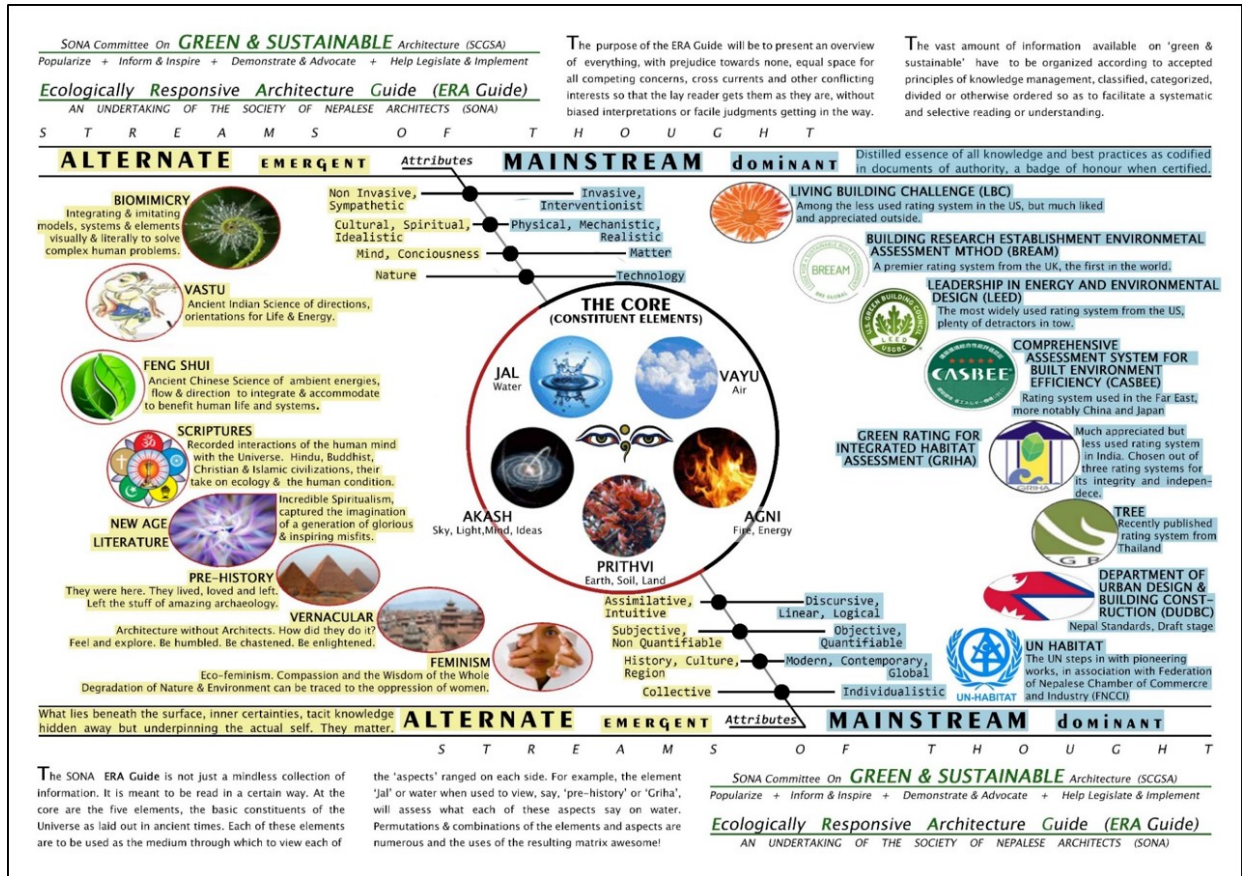


Figure 1: ERAG framework

i.e. recycle, reuse, reduce, refuse and reinvent[4]. SDG 11 is a dedicated goal that focuses on cities and human settlements and is built around urban sustainability. ERAG is ecologically responsive architecture guide for Nepali context, which is initiated by Society of Nepalese Architects (SONA) by Past President Ar. Bibhuti Man Singh. ERAG’s major objective is rating guideline for “For contextual sustainable building design in all the geographical regions within Nepal”. ERAG is started because international rating system has lengthy process, costly, intense documentation required. SONA came up with matrix of topics that comes under ERAG. It consist of three sections: the middle section or core, basic constituent of the universe were placed i.e. Jal, Vayu, Agni, Prithvi and Aakash. According to society of Nepalese Architects each of these elements were to be used as the medium through which to view each of the ‘aspects’ ranged on each side.

### 3. Methodology

This research falls under post-positivist paradigms. According to the post-positivist paradigm believes

that reality can be measured, which is believes as truth but not absolute. This research talks about evidences based facts on case study. According to ontological claim post-positivist paradigm talk about reality but only imperfectly and probabilistic, in this research by case study method facts will be identified by direct field observation. For epistemology, post-positivist paradigm talks about finding probable truth, facts of research where case study with analysis and observation will be done to meet research purpose. For objective to explore on ERAG, I will do 20 numbers of questionnaire survey, from architects practicing green. From this I will be familiar about architect perception upon national building design guideline.

Research methodology includes various sequential steps to find out result of given problem on a specific content. This research will be done through study of perceptions of architects and methodology will be:

To continue ERAG, I had done survey on why ERAG is not continue and what can we be done to continue ERAG. A quantitative questionnaire had been designed to obtain the answers to evaluate the

perception of architects upon ERAG & know how we can make ERAG in quantifying way. The major focus will be to address the questions that can withdraw the desirable objectives on “To explore on ecologically responsive architecture guide (ERAG) system purposed by SONA.” For this 20 numbers of Architect had been chosen for closed ended questionnaire survey. Numbers of architects had been decided by sample size calculation.

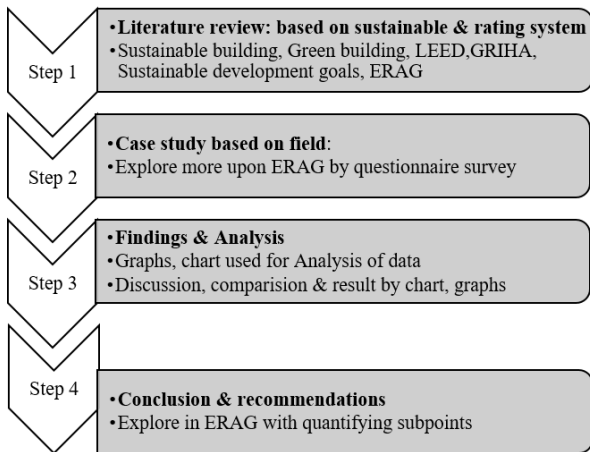


Figure 2: Methodology framework

#### 4. Data Collection

Let’s consider,

Sample size calculation

Maximum margin of error (€) = 5

Confidence level= 95

So,  $z = 1.960$  The number of sustainable practicing architect are roughly 60 numbers.

So,

$$n = N * P(1-P) / \epsilon^2 * Z^2$$

Therefore,

$$n = 20.28 \approx 20$$

Data had collected primarily from the questionnaire among the selected architect which is further processed to give suitable output.

#### 5. Findings and Analysis

##### 5.1 Reason to begin ERAG

Out of the 20 surveyed Architects, in reason to begin ERAG while proving multiple choice of selection 13

points comes under Nepal needs own ERAG, 5 points comes on other country context rating system does not match, 18 points comes on difficult to take grade of other rating system and 2 points shows agree to expensive in use option. As of international rating system their conditions are not easy to rate Nepali buildings.

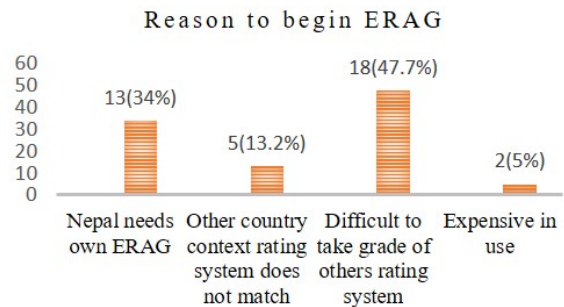


Figure 3: Reason to begin ERAG

##### 5.2 Reason to ERAG not continued

ERAG while proving multiple choice of selection 13 points comes under Nepal needs From the survey of reason to ERAG not continue some respondent explain about not familiar and not required. Most of architect aspects about technically not feasible to further continue.

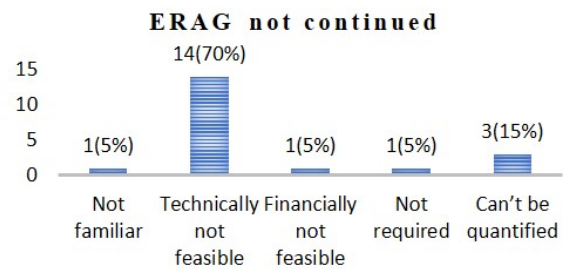


Figure 4: Reason to ERAG not continue

##### 5.3 Better way to continue ERAG

From the survey of better way to continue ERAG, it was seen that 11 people aspects about giving knowledge on ERAG, 6 architect aspect upon providing appreciation to users and 3 aspects upon giving awards & credits. Most of architects aspects about making familiar on ERAG is by giving knowledge upon ERAG. After survey it was found that quantifying ERAG is the better point to continue ERAG. To quantify ERAG elements of Pachatato air & water had been chosen based with energy efficiency

& environmental aspects.

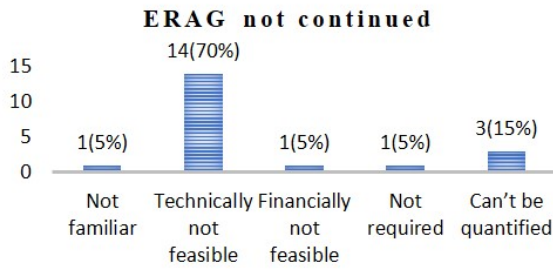


Figure 5: Better way to continue ERAG

5.4 ERAG can be quantify

From the survey of how ERAG can be quantified, it was seen that 1 respondents Aspect about providing rating system, 12 talk aspects about adding quantified sub points, 7 aspect about providing knowledge on ERAG. Most of people aspects about adding quantified sub points. That quantifying points gives to possible points for further continue of ERAG.

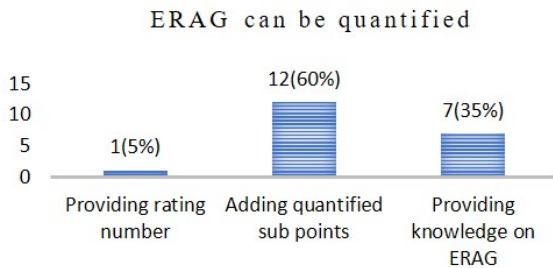


Figure 6: ERAG can be quantify

5.5 Energy Efficiency based on water, rate out of 1-5

While looking upon energy efficiency based on water, most of Architects gives water demand reduction, wastewater treatment, ground water recharge, these are most prioritize points.

S.No.	Indicators	Points
a.	Outdoor & indoor water use reduction	5
b.	Water metering	4
c.	Water demand Reduction	5
d.	Wastewater Treatment	5
e.	Ground water recharge	5

Figure 7: Energy efficiency based on water

5.6 Environmental Efficiency based on water, rate out of 1-5

According to survey, environmental efficiency based on environmental parameters had been prioritize upon biophilic design in residence design, that is natural things have to priorities in have to considered highest point in ERAG guideline.

S.No.	Indicators	Points
a.	Water makes green consideration in trees	3
b.	Consideration on aquatic lifestyle	4
c.	Residence provides shelter to other species like birds	3
d.	Wet in existing natural ground consideration upon soil living animals	3
e.	Inclusive to Panchatato	4
f.	Biophilic design in residence	5
g.	Water gives cool	4

Figure 8: Environmental Efficiency based on water

5.7 Energy Efficiency based on air, rate out of 1-5

Ventilation rate & ventilation from window are highest scored indicators of energy efficiency based on year, there should be fulfill on minimum requirement upon sufficient ventilation.

S.No.	Indicators	Points
a.	Minimum indoor air quality performance	4
b.	Fresh air Oxygen & CO2	4
c.	Ventilation rate	5
d.	Ventilation from window	5

Figure 9: Energy efficiency based on air

5.8 Environmental Efficiency based on air, rate out of 1-5

According to survey, environmental efficiency based on environmental parameters had been prioritize upon quality on indoor air, used air should give back to nature, consideration of type & size of opening according to air moment, maintenance of types of opening & inclusive to Panchatato.

S.no	Indicators	Points
a.	Quality on indoor air	5
b.	Quality of outdoor air	4
c.	Air that gives livable to other animals	2
d.	Air back to nature	5
e.	Consideration of types & size of opening according to air moment	5
f.	Maintenance of types of opening	5
g.	Inclusive to Panchatato	5

Figure 10: Environmental efficiency based on air

While looking on overall table, total sum of sub points based on air & water are as follows:-

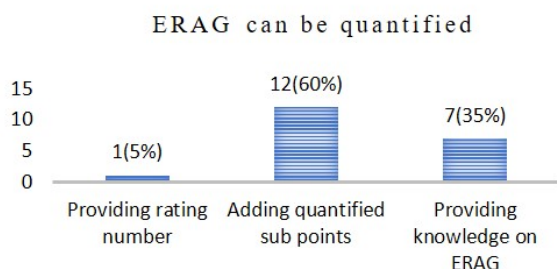


Figure 11: ERAG can be quantify

## 6. Conclusion and recommendations

### 6.1 Conclusion

The objective of study was to Quantitative explore upon Ecologically Responsive Architecture Guideline (ERAG). Quantitative analysis was done with 20 sustainable practicing architects to find out perspective of architect upon ERAG. While looking upon energy efficiency based on water, most of Architects gives water demand reduction, wastewater treatment, ground water recharge, these are most prioritize points. According to survey, environmental efficiency based on environmental parameters had been prioritize upon biophilic design in residence design, that is natural things have to prioritized in have to considered highest point in ERAG guideline. Ventilation rate & ventilation from window are highest scored indicators of energy efficiency based on year, there should be fulfill on minimum requirement upon sufficient ventilation. According to survey, environmental efficiency based on environmental parameters had been prioritize upon

quality on indoor air, used air should give back to nature, consideration of type and size of opening according to air moment, maintenance of types of opening & inclusive to Panchatato. From which it is found that, quantifying ERAG is best option to continue ERAG, from which water & air based parameters are being decided for; as shown in table four indicators has respective points for quantify; point giving aspect which can be used to quantify residence of Kathmandu.

### 6.2 Recommendations

Based on the findings of the research, following recommendations are suggested. As findings are obtained through case study method & quantitative analysis, questionnaire surveys done in with 20 sustainable practicing architect. The recommendation are drawn from views of the researcher.

1. There are five elements of Panchatato, for ERAG guideline where I had looked water & air; selection of other three elements could be better for ERAG rating analysis.
2. Continue of ERAG; SONA have to make some quantify points & have to strictly apply.
3. From my research it is found that, in Nepal there is required of quantifying tool to check sustainability in building for that either form SONA or from government of Nepal have to take initiated.

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