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Spatial and Structural Design of Anganwadi Center using ETABS and Sketch Up

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ABSTRACT

Anganwadi is a type of rural mother and child care centre in India. It was started by the Indian government in 1985 as part of the integrated child development services program to combat child hunger and malnutrition. Anganwadi means "courtyard shelter" in Indian Languages. A typical Anganwadi centre provides basic health care. It is a part of the Indian public health care system. Basic health care activities include contraceptive counseling and supply, nutrition education and supplementation, as well as pre-school activities. Primary school is a school in which children receive primary or elementary education from the age of about five to twelve, coming after pre-school and before secondary school.Six services like Supplementary Nutrition, Immunization, Health check-up, Referral Services, Nutrition and Health Education and Pre-school Education are provided to children in age group of 06 Months to 06 years, pregnant women and lactating mothers.Despite decades of impressive growth, India has an acute shortage of doctors. The doctor population ratio in 2013 was 1:1800; the recommended level is 1:1000. Through the Anganwadi system, the country is trying to meet its goal of providing affordable and accessible healthcare to local populations. Anganwadi workers have the advantage over the physicians living in the same rural area, which gives them insight into the state of health in the locality and assists in identifying the cause of problems and in countering them. They also have better social skills and can therefore more easily interact with the local people. As locals, they know and are comfortable with the local language and ways, are acquainted with the people, and are trusted.

Keywords: ETABS, SKETCH UP

INTRODUCTION

SketchUp is a 3D modeling computer program for drawing applications such as architectural, interior design, landscape architecture, civil and mechanical engineering design. It is available as a web-based application.It is having simple user interface and you can the drawing to other civil software. Sketch Up is an intuitive 3D models with a patented “Push and Pull” method. The Push and Pull tool allow designers to extrude any flat surface into 3D shapes. All you have to do is click an object and then start pulling it until you like what you see.SketchUp is a program used for a wide range of 3D modelling projects like architectural, interior design, landscape architecture, and video game design, to name a few of its uses. The program includes drawing layout functionality, surface rendering, and supports third-party plugins from the extension warehouse. The app has a wide range of applications, including in the worlds of architecture, interior design, landscaping, and video game design. Sketchup has also found success with people who want to create, share, or download 3D models for use with 3D printers. ETABS stands for Extended Three-Dimensional Analysis of Building System. It is a sophisticated and suitable special purpose analysis & design program particularly developed for building systems. Large and most complex building models are easily configured with its best-integrated systems and its abilities, it guarantees: Powerful tools with graphical and object-based interfaces help to create a CAD-like drawing. Improves structural engineer's productivity in the building industries. Saves major time and has more efficiency over general purpose programs. analysis, and Response History Analysis. In ETABS special purpose software, the data output options are more favorable to lateral design. ETABS can be used for handling huge scale seismic projects including those that involve Non-LinearModeling.

Sketchup

SketchUp was developed by start-up company @Last Software of Boulder, Colorado, co-founded in 1999 by Brad Schell and Joe Esch. SketchUp was created in August 2000 as a 3D content creation tool and was envisioned as a software program for design professionals. The program won a Community Choice Award at its first tradeshow in 2000. The first macOS release of SketchUp won a "Best of Show" at Macworld in 2002.

Etabs

A well-known and established across the world structural and earthquake engineering software company, computers and structures, Inc. (CSI) established in 1975 and located in walnut creek, California with a further office position in New York. The structural analysis and design software CSI is a developer of lot of software including CSI Bridge, SAFE, and CSICOL, ETABS, and SAP2000. The most useful structural analysis and design software developed by computers and structures Inc, is ETABS was first utilized to develop the mathematical complete model of the Burj Khalifa, right now the highest building of the world.

PROBLEM IDENTIFICATION

According to the latest research on Bangalore Anganwadis, infrastructure of the building is not safe for children surroundings are very unhygienic. Though there are enrollments many do not attend due to many reasons. 88% are moderately malnutrition and 12% are significantly malnutritional. Hence according to the 2018-2019 ICDS scheme 5371 crores to be allocated for new and renovation of old Anganwadis to help the poor in an efficient way in just past 2 years government schools' student strength has plummeted by 2.14 lakh. Hence according to sarvasikshanaabhiyana scheme all government schools to get a facelift through interiors to attract students to utilize the free education provided by government.There are anganwadis which are in the condition where they may collapse anytime. The small failure of structure may cause the damage to children which is dangerous. The nutritional supplies that are provided by the government for the sake of children and women are not distributed properly due to the lack of storage space. Generally, the strength of students in the village is high but due to the small space children aren't able to access proper seating arrangement. Anganwadi centers consist of only single room due to small space but if planned effectively the space may be used in a better way. And space can be allocated for women empowerments activities and also nursing facility.From various audit test done to adhere to the norms prescribed by the ministry regarding availability of spaces and furniture at 2716 sample anganwadis the following drawbacks were notes

1. Separate space for cooking (kitchen) wasn't available in 1752(64.51%) test-checked AWCs
2. Space for storage of food items was not available in 1505(55.41%) test-checked AWCs
3. Separate space for indoor activities of children was not present in 1082(39.84%) test-checked AWCs
4. Space for outdoor activities was not available in 1202(44.26%) test-checked AWCs
5. Basic furniture like table and chair was not available at 1,405(51.73%) test-checked AWCs

OBJECTIVES

- To provide a facelift to Anganwadi such that it to match the levels foreign play schools
- Provide a 3D model of structure using SKETCH UP
- Analysis of the structure using ETABS
- To provide extra/larger classrooms/equipment's if needed.
- To provide a minimum play area
- To maintain cleanliness and a safe environment

REASON FOR SELECTION

Education is the key for the success, when the students are facing the problem in getting proper elementary education how can they get quality education and make themselves a better fit for the society. By providing a proper and effective infrastructure we can uplift the education hence Our main focus is to plan up the space in such a way that Anganwadi is actually into real use and flexible and it should be useful for women empowerment and child play home. By providing a 3d plan we can give a clear idea about how the structure looks and what is the end product that we obtain. By analysing it structurally we can ensure the stability and safety of the structure hence it is easy to execute. The challenge is the space for design is minimum. And there are design limitations, also the economy of project must be kept in mind.

METHODOLOGY

- Research and conduction of literature survey
- Setting the objectives of project
- Location and analysis of site (bare shell)
- Determining the problems in bare shell
- Conduction of survey for data collection
- Understanding the requirements by studying what are the needs and how the Anganwadi is working

- ❖ Analysis of site, framing the criteria for the selection of the site such that maximum natural energy can be used
- ❖ Research about the site availability and guidelines given by government for construction of the Anganwadi
- ❖ Spatial design of the structure using sketch Up
- ❖ Analysis of structure using ETABS
- ❖ Specification of material grades,
- ❖ Preparation of rough estimate and detailed estimate of the project
- ❖ Conclusion and result of the project

Location and analysis of site (bare shell)

Location of bare shell: Government English and Tamil primary school Beli Mata road, cotton pet Bengaluru south division-7, Bengaluru 560053 Climatology , The climate here is tropical. The summer are much rainier than the winters in Bengaluru. The temperature here averages 23.6˚C. In a year, the average rainfall is 831mm

Determining the problems in bare shell

Bare shell analysis:

1.Non hygienic
2.Undulated flooring
3.Variation of materials
4.No accommodation space
5.No interactive session
6.Non plinth area
7.Old building in a bad condition
8.Toilets in bad condition

Spatial design of the structure using sketch Up

Creating a plan and elevation of the structure using Sketch Up Push and Pull" method. The Push and Pull tool allow designers to extrude any flat surface into 3D shapes. All you have to do is click an object and then start pulling it until you like what you see.

Analysis of structure using ETABS, Dynamic analysis is one of the effective procedures for evaluating the seismic performance of the building.7 dynamic analysis checks to consider in Etabs:

1.Base shear check:Base Shear, V is the total design lateral force or shear force at the base of the structure. Static Force or the Equivalent Lateral Force Procedure of calculating base shear should perform under the **UBC 97**, clause 1630.2.1 and or as per Equation 12.8-1 of **ASCE 7-10** codes. The static base shear will be used to calculate scale factors for the model to be balanced with dynamic base shear as specified by the code.The base shear forces to use in the design will be calculated using the Auto Load Function of ETABS Program using the "Equivalent Lateral Force Procedure" and the "Dynamic Analysis Procedures" as set out in UBC 97 Response Spectrum Analyses or ASCE 7 whichever code is required in your design.

2. Check for Overturning Moments : The overturning effects caused by earthquake forces that act on levels above and below of every structure shall be resisted and design according to the code specified in **UBC 97**, Section 1630.5 or at Section 12.8.5 of **ASCE 7-10**. These overturning effects on every element shall be carried down into the foundation.For further information, the summary of seismic provisions considering base shear and overturning effect as per UBC 97 and ASCE 7-10 has been discussed in previous articles, **Seismic Analysis: UBC 97-Provisions** and **Seismic Analysis: ASCE 7 and IBC 12 Provisions** respectively.

3. Scale Factors or Balancing of Response Spectrum : To properly distribute the forces, the base shear obtains or calculated from the dynamic analysis should be reduced to a certain percentage of the base shear results that is determined from the static force procedure. You may read the detailed principle of scaling or balancing on our previous article, **Scaling of Base Shear Results from Static and Dynamic Analysis.** Stay tuned for another article on how scaling is accomplished in ETABS to be posted soon.

4. Drift Check (Sway Check): Deflection Control is specified in terms of Story Drift which is defined as the lateral displacement of one level relative to the level above or below or simply the difference of the deflections at the center of mass at the top and bottom of the story under considerations. The difference between the roof and floor displacement is called inter-story drift.For example, for a 10-meter high story, an inter-story drift of 0.10 indicates that the roof is displaced 100 millimeters in relation to the floor below. This means that the greater the drift, the greater the damage in the structure. The values larger than 0.06 indicates severe damage while the values larger than 0.025 indicates that the damage is serious enough and already a serious threat to human safety. Values in excess of 0.1 indicate the probability of building collapse and failure in design.

4.1Seismic Drift Check

Calculated story drift using the Maximum Inelastic Response Displacement, Δm shall be in accordance with **UBC 97**, Section 1630.10.2 and or to Table 12.12-1 of **ASCE 7-10.** The allowable story drift should be greater than or equal to the design story drifts for each floor level. For detailed seismic drift limitations, kindly visit the sections in the code that are mentioned above.

4.2 Wind Drift Check

Wind Drift should be check according to the limitations 1/400 to 1/600 of the story height (ASCE 7-10, CC.1.2) considering the service load combination, 1.0Dead Load + 0.50 Live Load +0.70 Wind Load as specified in ASCE 7-10 commentary CC-3.

5. Building Irregularity Check : The designer should review the structural arrangement of the structural elements to ensure that the code requirements against building irregularity will be satisfied. **Building Irregularity** checks are depending on the code that we are using, although there are similarities. For example, when using **UBC-97,** clause 1629.9.3 and tables' 16-L or 16-M should be satisfied. When using **ASCE 7-10**, horizontal and vertical irregularity in sections 12.3.2.1 and 12.3.2.2 should be met respectively. The most common checks under a building irregularity are the **torsional irregularity check** which will be tackled on the succeeding articles. Stay tuned!

6. Designed and Checked Functions : Aside from the analysis, ETABS has also the ability to design structural elements such as column, shear walls/walls as well as beams through its "designed and checked" functions. We can use either of the two functions in member design. "Checked" when we input the appropriate reinforcements and to ensure that all the elements are passing, a run checked is done and "Designed", when we require the software to do the design. To see the design results of either function, each should be run accordingly. Further details of the "ETABS Designed and Checked" will be published soon.

7. Other Independent Checks : Other independent checks may be completed by the designer but this is primarily for local authority requirement and review. These checks may include thermal analysis checks and the like.Codes in practise

- Seismic analysis code book IS (1893) part-1 (2002).
- Dead load: code IS 857(part-1)1987
- Live load: code IS857(part-2)1987

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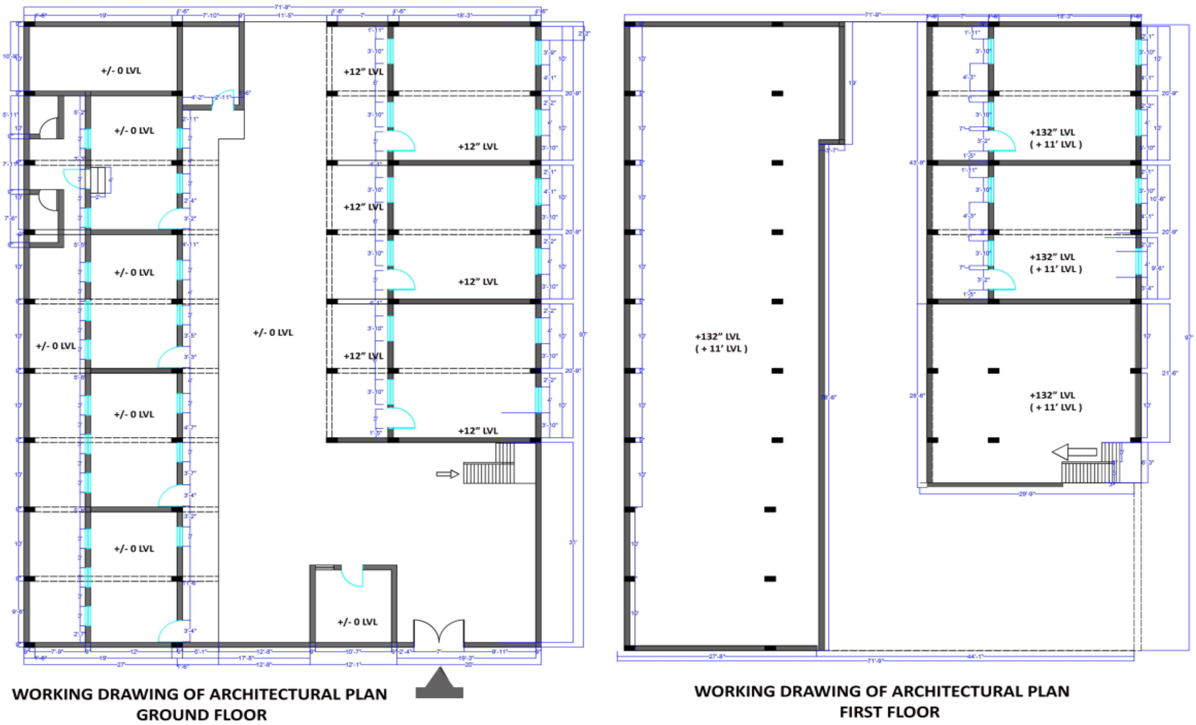
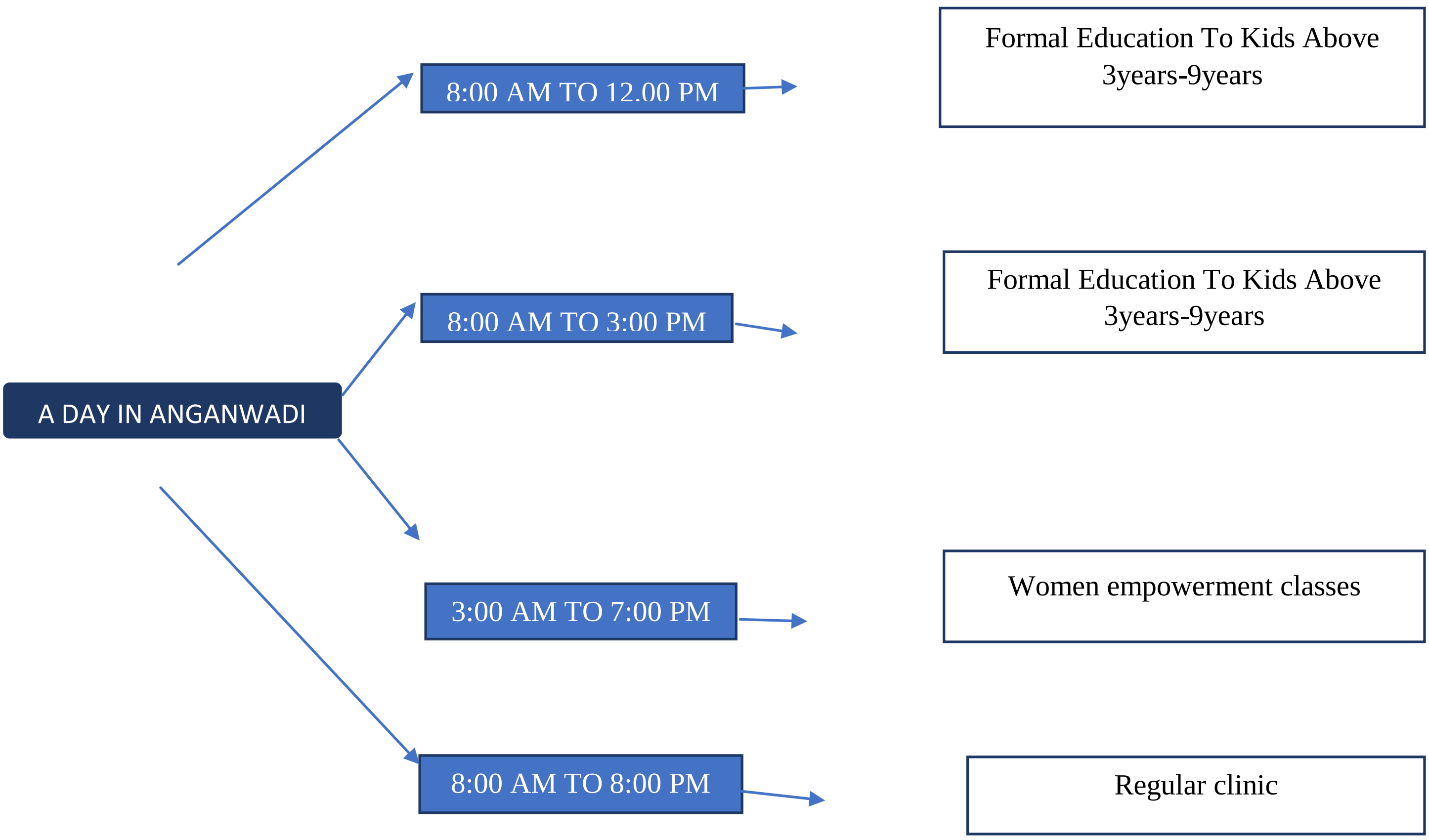
COLLECTION OF SITE DATA



Understanding the requirements by studying what are the needs and how the Anganwadi is working



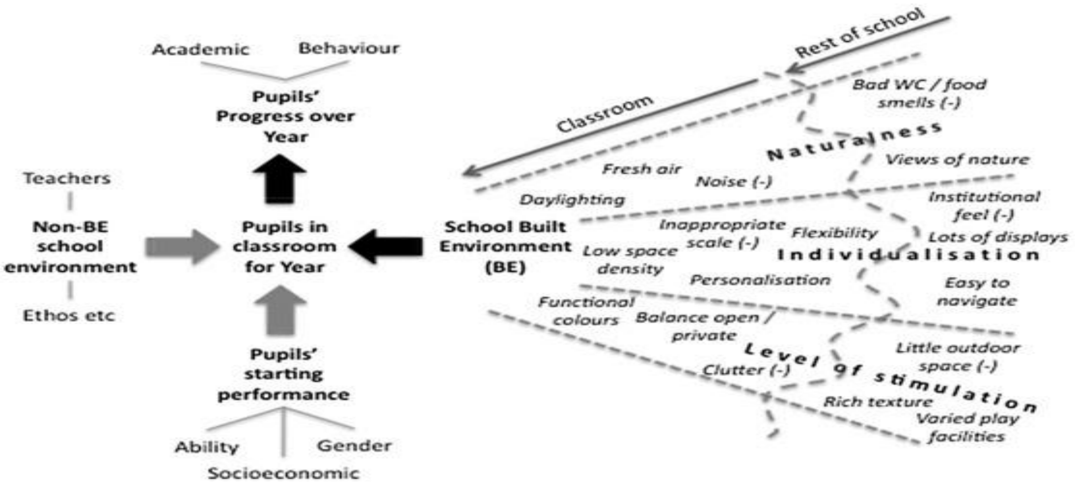
BASIC GUIDELINES TO BE FOLLOWED

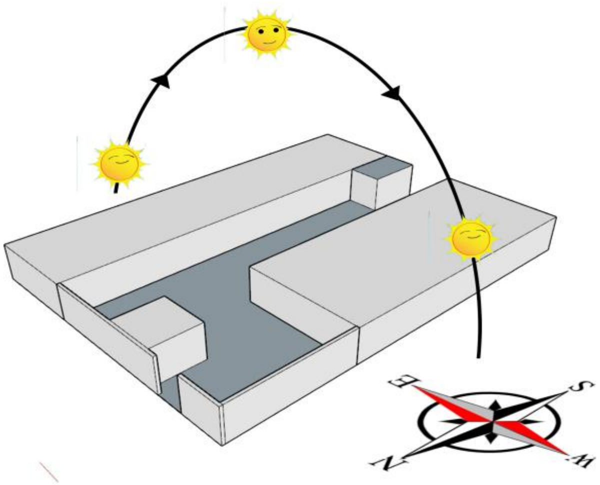
- The school should be located in a land that is non hazardous (low lying area, too close to highway, river or pond, underneath high tension electric lines etc.) and is easily accessible to all sections of children
- The design of the school building should be functional and attractive.
- The interior of the classroom should have adequate light and ventilation and space for storage, display and chalkboards.
- Eco-friendly building materials to be used.
- Barrier free features like ramp, handrails etc. are to be made mandatory in each school.
- Provisions for toilet and drinking water are essential in every school while electrification, boundary wall and playgrounds are desirable.
- The school campus should be clean, hygienic, safe and secure for the children. Greenery should be encouraged.

DESIGN PRINCIPLES

Three dimensions, or design principles, have been used to suggest and structure the factors to be considered, namely

1. Naturalness: light, sound, temperature, air quality and links to nature
2. Individualization: ownership, flexibility and connection
3. Stimulation(appropriate level of): complexity and color





REQUIREMENTS OF SCHOOL BUILDINGS

SL NO	CATEGORY	AGE- GROUP	LEVEL
1	Pre school	3-5yrs	Pre nursery, nursery
2	Primary school	5-10yrs	1st to 5th STD

CLASSROOMS

The size of a classroom shall depend on the following:

a)Anthropometric dimensions of children and their space requirements

b) Dimensions, arrangements of furniture and equipment and their incidence

c) Number of students to be accommodated

d) Types of activities to be carried out

e) Diverse seating arrangements essential for these activities.

FLOOR AREA OF CLASSROOMS

CATEGORY	NO.OF STUDENT PLACES PER CLASSROOM	GROSS AREA OF CLASSROOM IN m2 PER STUDENT PLACE
i) Pre-school	20/25	2.00
ii) Primary /Junior		
i) With furniture	40	1.11
ii) With squatting	40	0.74
iii) Secondary/Higher Secondary	40	1.26

OVERALL AREA OF SCHOOL

	For Primary, School	For Secondary Higher Secondary	For Secondary, Higher Secondary
a) Built-up area (on all floors) per student place:			
1) For a school having four sections per class	1.80 sq mts	3.40 sq mts	2.60 sq mts
2) For a school having two sections per class	I.80 sq mts	4.60 sq mts	3.20 sq mts
b) Plot area other	(The area per student place will decrease when number of sections per class increase and vice-versa) 2 to 3 times the built-up area (on all floors)		
c) Play fields	play fields ding upon the number of storeys According to provisions		

PROVIS1ON OF VARIOUS AREAS IN SCHOOLS OF VARIOUS CATEGORIES

	Category	Nursery	Primary	Secondary	Higher primary
1	Classroom	✓	✓	✓	✓
2	Art/draw room		✓	✓	✓
3	Science room		✓	✓	✓
4	Crafts room	✓	✓	✓	✓
5	Labs			✓	✓
6	Library		✓	✓	✓
7	Canteen		✓	✓	✓
8	Toilets	✓	✓	✓	✓
9	NCC room			✓	✓
10	Medical room	✓	✓	✓	✓
11	Principal room	✓	✓	✓	✓
12	Vice principal room				✓
13	Office room		✓	✓	✓
14	Staff room		✓	✓	✓
15	General store	✓	✓	✓	✓
16	Play ground	✓	✓	✓	✓

Fig (e) Ground floor-modified plan

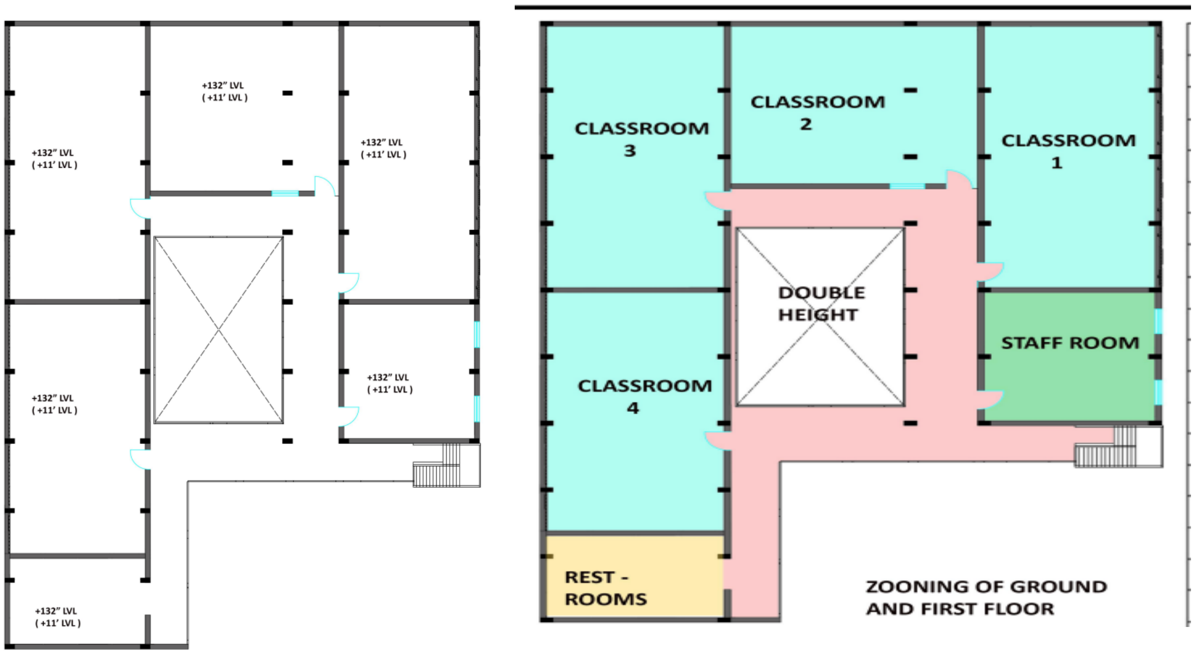
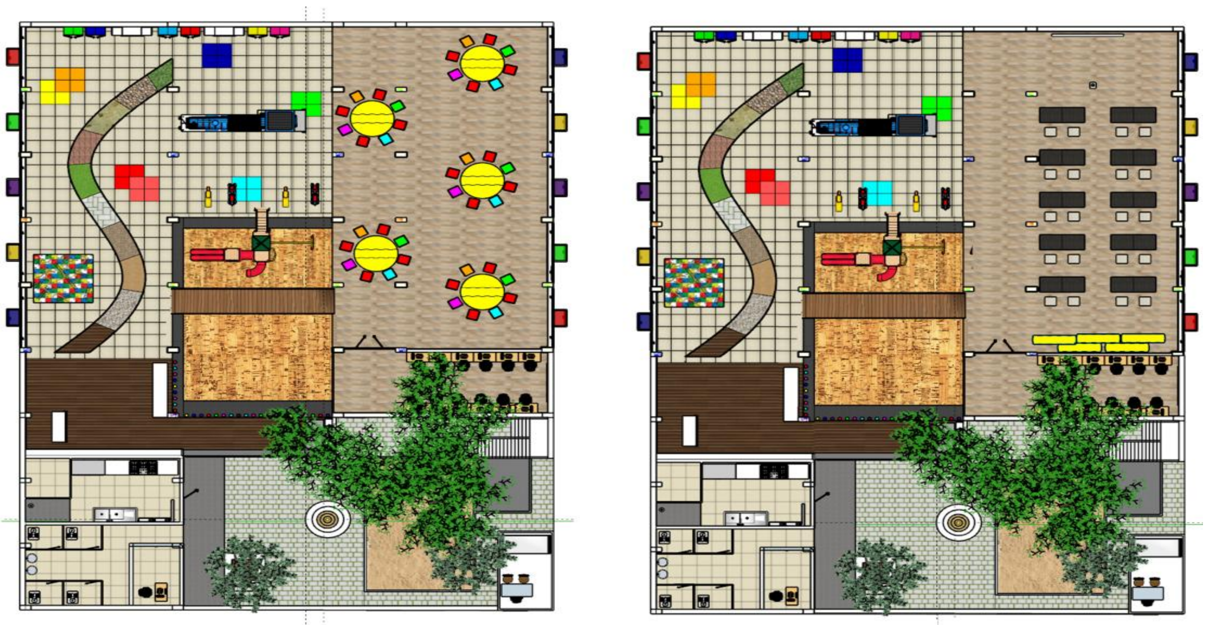


Fig (f) modified first floor plan

PLAN USING SKETCH-UP



GROUND FLOOR PLAN A

GROUND FLOOR PLAN B

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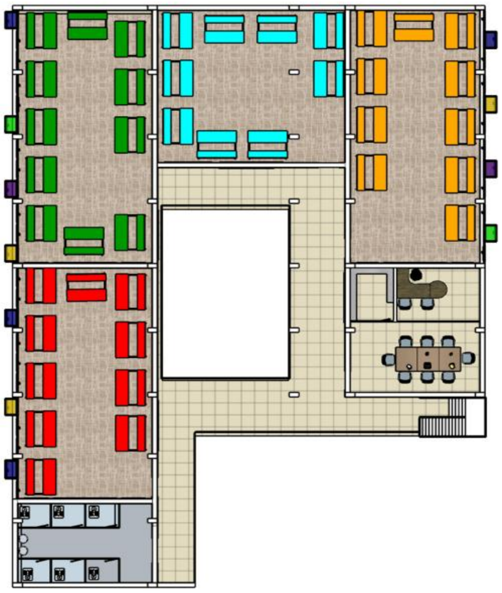
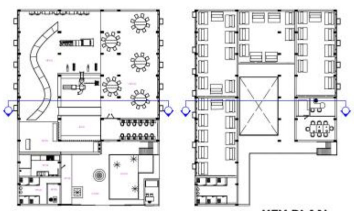
PLAN USING SKETCH-UP



1ST FLOOR PLAN A

1ST FLOOR PLAN B

SECTION 9



KEY PLAN

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