ARCHITECT AND CIVIL ENGINEER'S PIONEERING RECESSION AT CONSTRUCTION FIELD IN EGYPT.

"With increase of electromechanical installation cost ratio in buildings"

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ABSTRACT

The research monitors the recession of architect and civil engineer historical role in construction field in Egypt significantly during the past few years, after that they were the maestros in this area for a long past time ago. Both "Architecture and Irrigation" are the first engineering disciplines at "Al-Mohandes Khana" School, the first modern engineering educational institution in Egypt. With the steady increase of electromechanical installations in the buildings, that reach **40→50%** of initial cost and most of the maintenance cost in many building types now. The research monitors some indicators for this recession and their impact on architecture and construction field in Egypt. It explains the main reasons of this problem. Such as: ignorance of architect role, absence of aesthetic sense in the community, engineering curriculum, educational systems, misses coordination between other disciplines, and desire for more luxuries in buildings. It aims to present solutions for this phenomenon following a descriptive inductive methodology. It concludes a series of findings and recommendations to regain this leading with world trend towards reduction of technical installations in buildings, especially energy-intensive electromechanical systems.

KEYWORDS: Architect pioneering recession, Architect role decline, Regain of civil Engineer and Architect role, Retreat of architect role, Architecture future trend.

1. INTRODUCTION

Architect and civil engineer acquired importance of their role between other engineering disciplines by:

a) Both were only the first departments "Architecture & Irrigation" at "Al-Mohandes Khanah" School, which is the first modern engineering educational institute in Egypt at **1858**, until the appearance of other engineering disciplines in **1916**. (fig. 1)

Fig.1: Architect and civil engineer were the "Maestros" of construction field

b) Home "the human shelter" is one of the basic human needs. Humans can dispense with many other engineering inventions "TV, Telephone, Mobile, Car...etc." except shelter, Maslow's hierarchy (fig. 2)

The research focuses on the building's construction field far from the other branches of civil engineering such as: roads, bridges, ports and irrigation ... etc. So, it will refer mainly to the architect, concentrated on its role, which is a major part of the problem. The same is true for civil engineer in building and construction field.

Architect role declined clearly and significantly in construction field in general, and particularly in Egypt. He has now many competitors and perhaps replacements from other disciplines, through design and construction process. Unfortunately, architect now may be played a small role in the project at many construction companies and Engineering consulting firms. Some contractors wish to remove the architect from their operation, viewing unnecessary expense. However, Architect still has several critical roles to play.

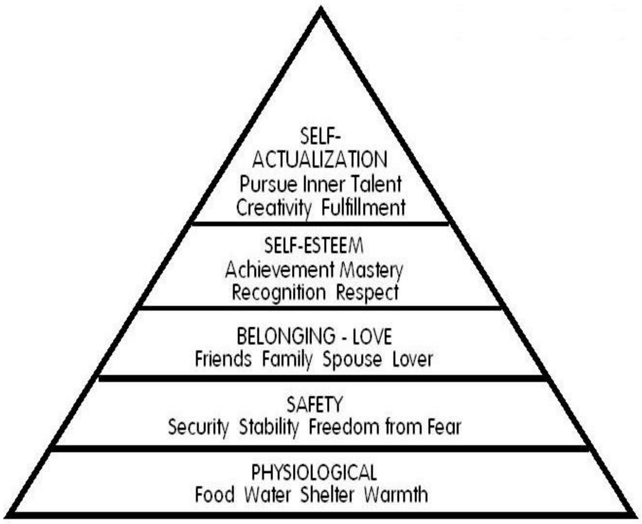


Fig.2: Abraham Maslow Hierarchy of Needs, Web Network.

The research **aims to** identify the main reasons of this decline. And proposes practical solutions to regain the leading role of architect "and civil engineer" in construction field in Egypt again.

The research following an inductive **methodology**, monitoring retreat indicators, extrapolates the reasons behind it, and then subtracts solutions to address these causes.

Many research have described architect role and its scope of work in engineering projects, but didn't treat its recession (fig. 3). Architectural education has some negatives caused this retreat so; many research have provided solutions for these negatives, mostly relied on education background to develop the architectural education system. But it didn't focus to improve professional practice of wide segment of architects who was already graduated and practiced. So, the research seeks to cover these missing points.

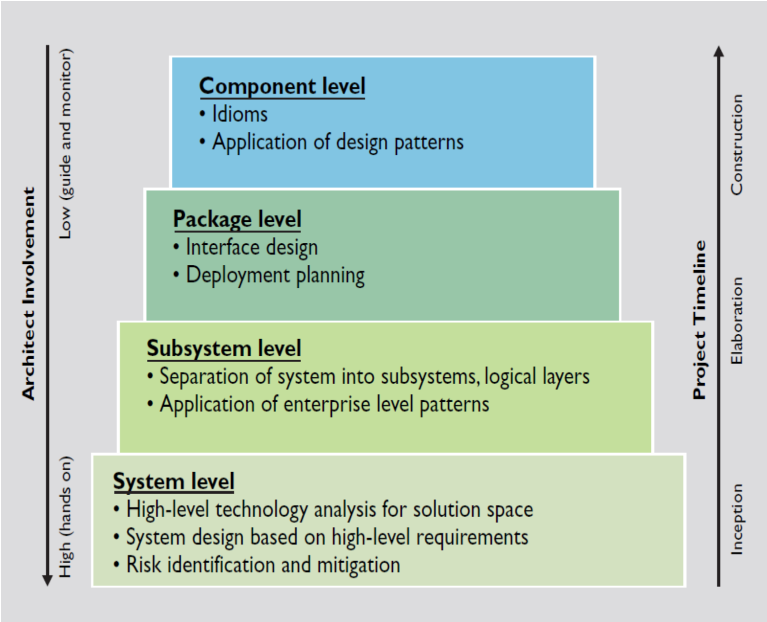


Fig.3: Architect Involvement according to Project Timeline, McBride, M. (2007).

2. RECESSION INDICATORS

This part monitors recession indicators of architect role in construction field in Egypt. Such as:

2.1. Use of Architect

Many clients go directly to the contractor ignoring architect & civil engineer "Especially for small residential buildings", evidenced by:

a) Architectural ugliness of building exteriors often hasn't finishing materials, which mostly refers to: "it is not designed by an architect" (fig. 4).

b) Eclecticism of many confused architectural elements, shapes, colors…etc.

c) Repetition of design "plans and elevations of the buildings" with some slight changes. Design may be stolen and used more than once. So, there is no need to go to the architect and to pay for him for a new design.

Fig.4: Ugly elevations indicating the absence of engineering role at Giza, Author.

d) Design and Construction mistakes; there are many design and construction mistakes, without standards, laws or codes, indicating clearly the absence of engineering role, (fig 5→7).

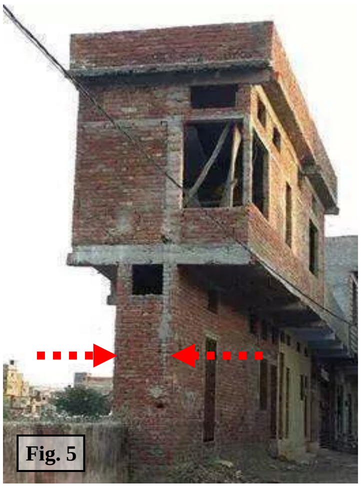
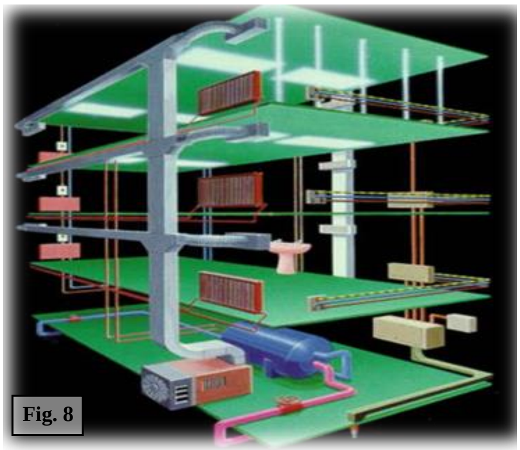


Fig.5→7: Design & Construction mistakes indicating the absence of engineering role, Author.

2.2. Increase of electromechanical works

Dominate and increase of cost percentage of supplementary & and electromechanical installations at many types of buildings because of magnitude, complexity of it, and trend to more comfort and luxury in building (its cost usually ≥ 40% of total initial building cost); this means more power & value for these specialists discounted from traditional architect and civil Eng. role (fig. 8,9).



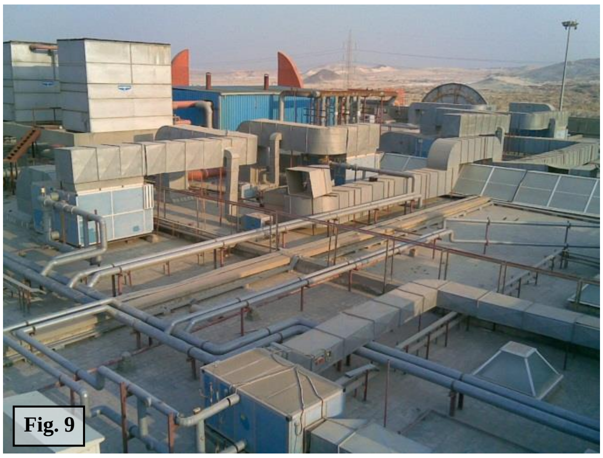


Fig.8, 9: Increase of electromechanical system installation importance at building deducted from architect role and fee, Author.

2.3. Technical, coordination and construction mistakes

Such as:

a) Common plumbing mistakes at our buildings indicate the weakness of architect's technicality at these works (fig. 10, 11).

b) Distortion of building exteriors by electromechanical installations (fig. 12→14).

c) Poor coordination between these works because of misunderstanding of their basics. So, most of project's leader now are not Architects. Architect now couldn't be the maestro because he just still plays one device "The Architecture" and don't know anything about the others (fig. 1).

d) There are many other common finishing mistakes at buildings "suitability, quality, durability ...etc.

Fig. 10: A luxury housing project reflects that the architect focus of interest is aesthetics, ignoring the technical aspects, Author.

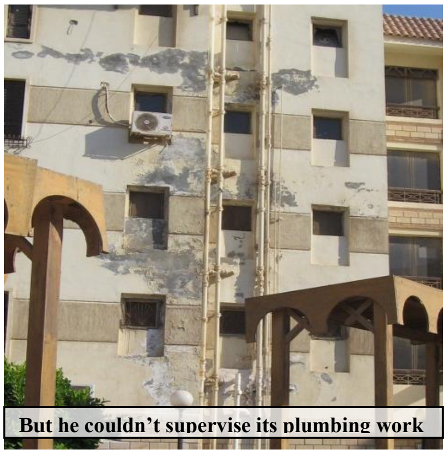


Fig. 11: Plumbing mistakes supervised by the same consultant, at this project, Author.

Fig. 12→14: Architect unawareness of electromechanical special needs caused these ugly malls exteriors, Author

3. MAIN REASONS OF THIS RECESSION

This part discusses some of the most important reasons of this retreat, such as:

3.1. Unawareness of architect role

Society unawareness of architect role at successive building design and construction phases, and at wide range of other engineering disciplines too, caused this retreat.

3.2. Absence of moral and aesthetic sense

The absence of aesthetic sense for a wide segment of society is not important to get a distinct or beautiful design. So, there is no need to go to the architect.
There is no moral or legal reason to use a design "belonging to the others" more than once, with minor adjustments on layout or interiors during implementation and maybe not. So, there is no need to go to the architect and to pay for him.

3.3. Unawareness of electromechanical systems basic principles.

Awareness of electromechanical system basic principles and technical work installations, help architect to:

3.3.1. Design & supervise its implementation properly

Plumbing works are mostly, not installed properly (fig. 11). Bad choose and design unsuitable spaces for electromechanical equipment at plans and elevations, such as use bad locations for external air conditioning and refrigeration units. So, choosing appropriate locations and suitable external treatments prevent ugliness at building exteriors, (fig.12→14), (fig.15→17).

Fig. 15→17: Use recessed open space for external A/C & refrigeration units then hide it with aluminum lovers at elevations of commercial buildings, Author

3.3.2. Improve operation condition, optimize efficiency and thus save energy

Proper choosing of equipment's and machine locations and directions, increases its efficiency and thus decreases energy consumption.

For example: To the following building layout (fig. 18), architect needs to choose the best location of electromechanical rooms to optimize efficiency and minimize energy consumption of these systems, and he has many alternatives for that.

a) Two rooms for DX "direct expansion" central air conditioning package units (**1**, **2**, **3,** or **5**)

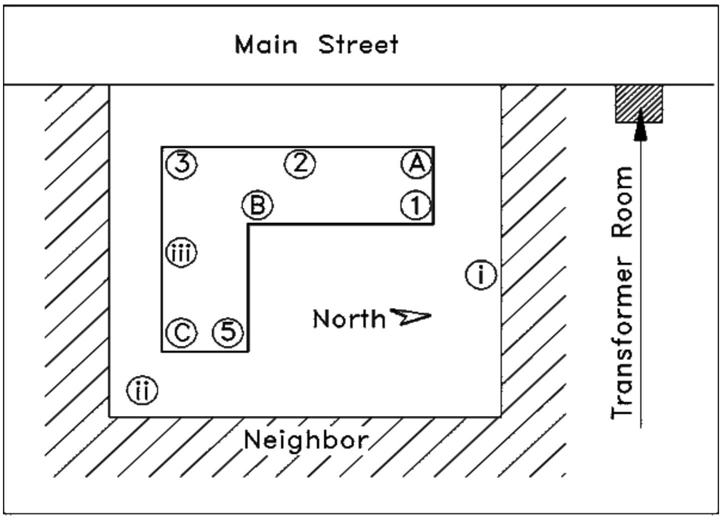


Fig. 18: Zoning of electromechanical spaces is an important design step, Author.

b) Electrical control panels room (**A**, **B**, or **C**)

c) Boilers room (**i**, **ii**, or **iii**)

The optimum solution & chosen criteria:

a) For DX units, location (**1**) and (**5**) are the best for the following reasons:

1. Two rooms in the north direction "the prevailing wind direction". Which optimize the efficiency of condensing and compressor units' ==▶ minimize actual working time hour's ratio ==▶ save **energy** ==▶ save **money** for running cost.

2. These locations minimize the distribution of ducts "for supply and

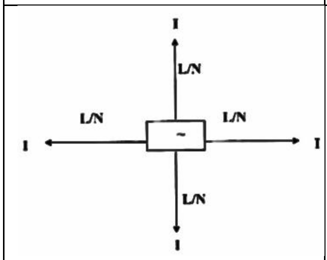
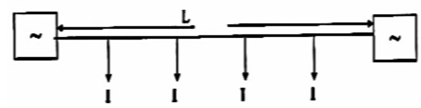
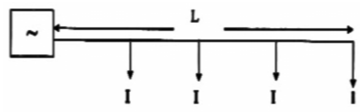
Fig.19: Electrical control panels room in a commercial building, Author.

return air" to cover floor area ==▶ <u>more efficiency</u> for A.H.U. "air handling units" ==▶ <u>save **power**</u> ==▶ <u>save **money**</u>

b) For electrical control panels room (fig. 19), there are three major constrains:

1. The need for good <u>ventilation</u> and prefer direct contact with the external environment
2. Nearest to building transformer room. So, location (**A**) and (**B**) are better than (**C**).
3. Located in the center of the building to minimize lengths of distributed cables, which is known as: "Polar Distribution system" (Table 1) ==▶ reduce its <u>cost</u> ==▶ reduce <u>cable resistance</u> ==▶ <u>save **power**</u> ==▶ <u>save **money**</u>. So, location (**B**) is the best

Table 1: Power supply loss ratio for elec. Distribution systems at buildings

Number of Elec. Loads (N)	Power supply loss ratio %		
	Polar distribution	Dual distribution	Single distribution
			
2	1	0.666	2.5
4	1	2	7.5
8	1	6.67	25.5

I: Load Current (Ampere), **L**: Feeder Length (meter), **N**: Number of Loads "Outlets", Egyptian Energy Code, 2009, p. 170,171.

c) For boilers room location (**ii**) is the best, it is out of building so; it has good <u>ventilation</u> and <u>safe</u> building on exploding danger.

3.3.3. Coordinate between systems to prevent conflict

Coordination weakness between civil work and electromechanical systems in the building, and early detection of the conflict between them, is one of the main reasons of architect leading role recession. The traditional way of coordination by laying the transparent sheets of drawings above each other and detect the conflict with the naked eye. But often these conflicts are detected at the site, and require experience, time and money to treat (fig. 20, 21).

Fig.20: Complexity of electromechanical systems required previous coordination, Author.

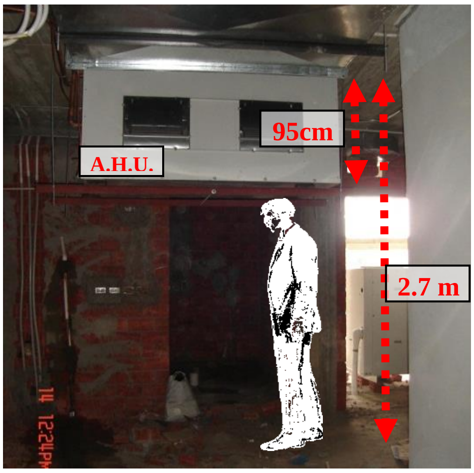


Fig.21: Bad heights coordination, detected at under construction site, Author.

3.3.4. Many of Architect's decisions are affected by other building electromechanical systems

Many of architectural decisions are affected by these systems requirement, for example: Travelling distance (fig. 22) "the maximum distance user could walk to reach the nearest safe exit in the building" in commercial uses

= 30 m. If building doesn't have firefighting system.

= 60 m. If building equipped with an automatic fire alarm & firefighting system

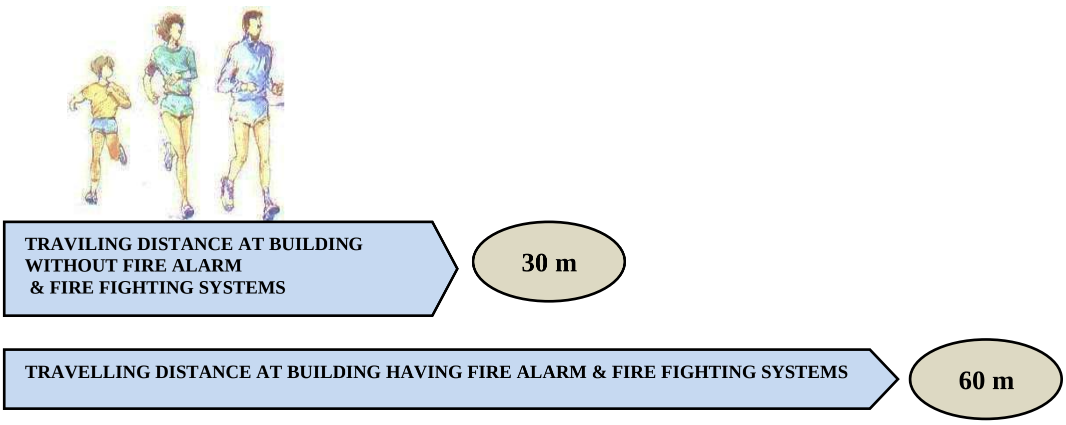


Fig.22: Maximum travelling distance, at mercantile occupancy, Egyptian Fire Code, Part. 1, 2009, P. 113.

3.4. Unawareness of local codes and many architectural design basic rules

Unawareness of many designs' basic rules, mentioned in the local or international engineering codes, especially with regard to security and safety considerations.

3.5. Architectural education problems

There are many reasons related to this important field, caused this retreated such as:

a) Low professional level of fresh graduates

b) Weakness of technical works curriculums and disjunction with working field, at many of architectural academic institutes.

c) Separation between curriculum, practical field and the real needs of the labor market in Egypt. And focusing on the theoretical aspects

d) Random summer training programs for students, and maybe unreal in many cases. That does not direct them to specific training courses.

e) The proliferation of private institutes, which may need laboratories, equipment and instructional tools.

f) Low educational level of many architectural students. Some of them go to architecture department to prevent physics, mechanics, chemistry and mathematics studies. Often, there is no capability test exam to apply architectural students

For example:
The following drawing is a common frequently part of architectural student's graduation projects. It is a conference hall ground floor plan at conference center (fig. 23). But it has many design errors. Which, clearly indicates the problems existence in the engineering educational system

There are many design errors at:
- Exits (numbers, direction, width dimension and distribution)
- Corridors (length, width and exits)

So, it will be revised according to Egyptian safety code "Ref. 15"

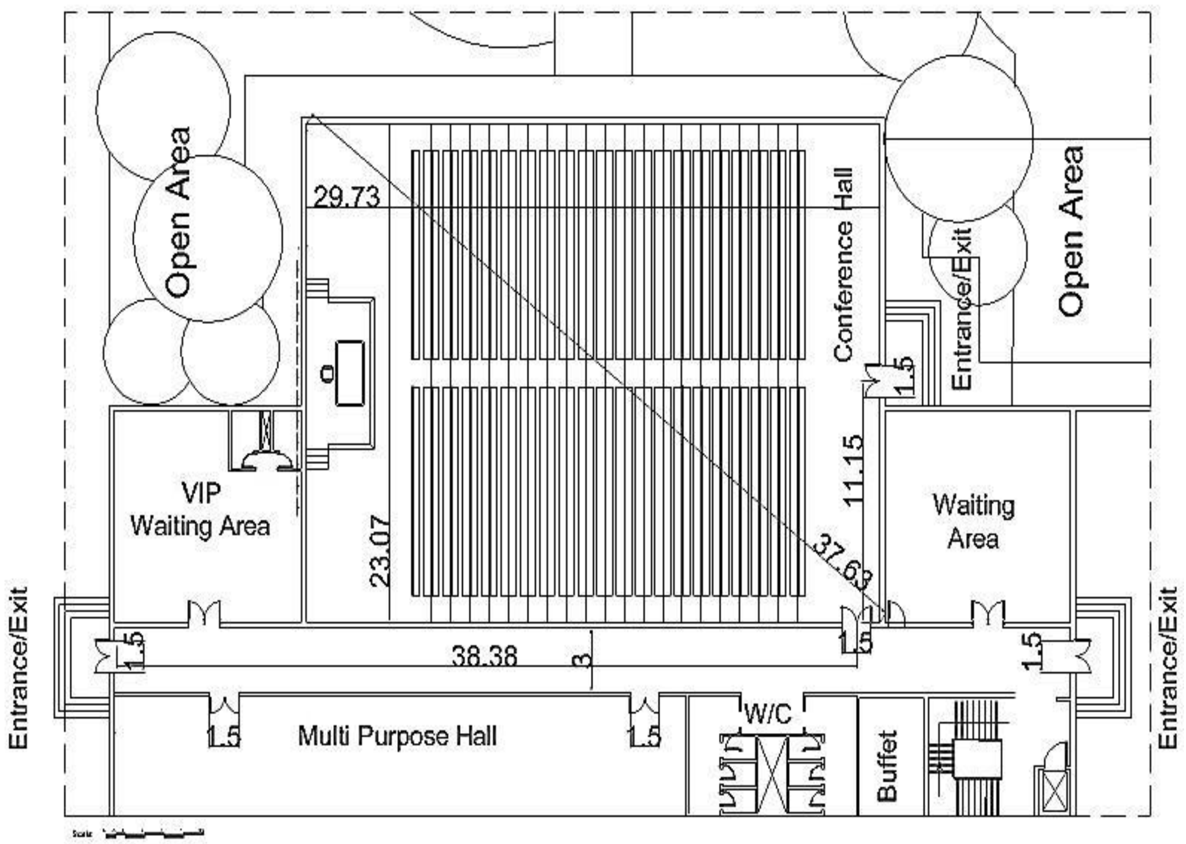


Fig.23: Conference hall ground floor plan "Part of architectural student's graduation project", 2014, Author.

Constants:
Occupancy group of this use = **A**
Specific occupant load = **0.6**m2/person
Exit unit = **55**cm
Exit unit capacity = **90** person
Maximum travelling distance for this use ≤ **50**m

Exit's Minimum Number:
Total occupant load = conference hall area / specific occupant load
= (30m x 23m) / 0.6 = **1150** persons
Exits no. for this occupancy must be ≥ **4** exits

Exit's minimum width:
Total exit units for hall = total occupant load / exit unit capacity
= 1150 / 90 = 12.78 exit units
Exit units for one exit = no. of exit units / exits no.
= 12.78 / 4 = 3.2 exit units
Exit width (for each door) = (exit units for one exit) x (exit unit width)
= 3.2 x 0.55m = 1.76m ≈ **1.80** m

Minimum allowed distance between exits:
Minimum allowed distance between exits ≥ maximum hall diameter / 2 (fig. 24)
≥ 38 m / 2 = **19**m

Corridor (length, width and exits)**:**
Corridor minimum width ≥ ∑ exits width on it
≥ (1.76 + 1.76 + 1.50 + 1.50) = **6.52**m
(Note: services occupancy included in main function occupancy number)
Total exits width from corridors ≥ ¾ corridor width
≥ 0.75 x 6.52 = 4.89m ≈ 4.90m
(We have two exits so; each of them should be ≥ 4.90m / 2 = **2.45**m)
Maximum Length of the corridor must achieve above maximum travelling distance requirement.

Design mistake's conclusion:

a) Doors must open to escaping direction, to outside not to inside
b) Minimum exits for this hall ≥ **4** exits not 2
c) Minimum width for each exit door ≈ **1.80** m not 1.50 m
d) Minimum allowed distance between exits should be ≥ **19**m not 11.2m
e) Corridor minimum width ≥ **6.52**m not 3m
f) Minimum width for each exit at the end of the corridor ≥ **2.45**m not 1.50m

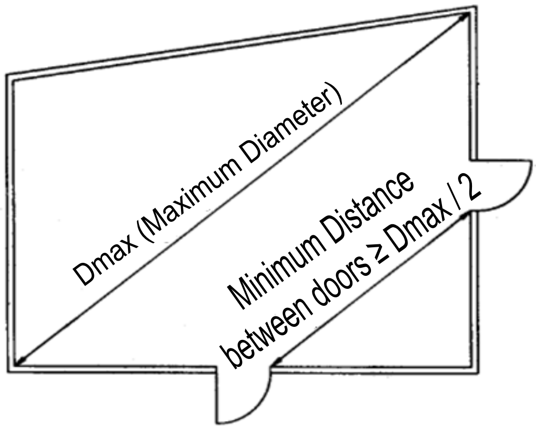


Fig.24: Minimum allowable distance between exits, Egyptian Fire Code, Part. 1, 2009, P. 151.

These mistakes refer to the poor educational level of some fresh graduated architects.

3.6. **Lack of ethics and practicing regulations**, such as.

a) Some other disciplines encroachment on architect role and prep the architectural drawings, in the absence of prohibitive laws

b) Some architects charge low fees, this detriment of their colleagues, and descend the service level.

4. FUTURE TRENDS

World architectural trend now towards to sustainability, save energy, minimize running cost and reducing technical installations in buildings, especially energy-intensive systems, such as cooling and heating mechanical systems, using environmental solutions such as passive and active solar energy tools for cooling, ventilation, heating, lighting and power generation. To build what is known as zero energy buildings, Plus buildings, Green or sustainable buildings.

ZEB "Zero Energy Building" of Singapore is one of the good samples for this trend. It was built in October 2009 by BCA "Singapore's Building and Construction Authority" to develop green technologies to meet the goal of making 80 percent of all Singapore's buildings green by 2030; with construction cost just (5 %) more than conventional ones. It includes offices and academic classrooms (fig. 25).

Fig.25: ZEB "Zero Energy Building" at Singapore

Stack Ventilation System

Floor air diffusers

Mirrors for natural lighting.

Greenery system and Photovoltaic technology

Fig.26→30: Passive & Positive solar systems at "ZEB" to reduce energy consumption & to produce power, www.greenbuildconsult.com, Sep. 2013.

It uses Passive & Positive solar systems to reduce energy consumption and to produce power (fig. 26→30)

The main target of the project was to demonstrate that the concept of a zero-energy building is possible, after almost one year of analytical energy monitoring it has been achieved (Table 2)

Table 2: Annual Energy consumption & production of "ZEB" building

	Total	Intensity
Electricity Consumption	183 mwh	41 kwh/sq.m.
Renewable Energy Production	203 mwh	45 kwh/sq.m

Source: www.greenbuildconsult.com, Dec. 2014.

5. RECOMMENDATIONS TO REGAIN ARCHITECT ROLE

1. Improve curriculums & educational architectural programs for more junctions to the actual field needs.
2. Acquirement necessity of basic knowledge of electromechanical works at building & explain its relationship with architecture
3. Use passive solar energy systems for heating and cooling to minimize electromechanical systems of buildings.
4. Increase the art sense of society, through educational programs and media.
5. Enact laws to push clients to prepare the architectural design by architects, with a genuine design not belonging to another-, by punishment enactment for violators.
6. Use computer programs such as "Revit" to detect conflict & coordinate between various system networks at building (fig. 31)

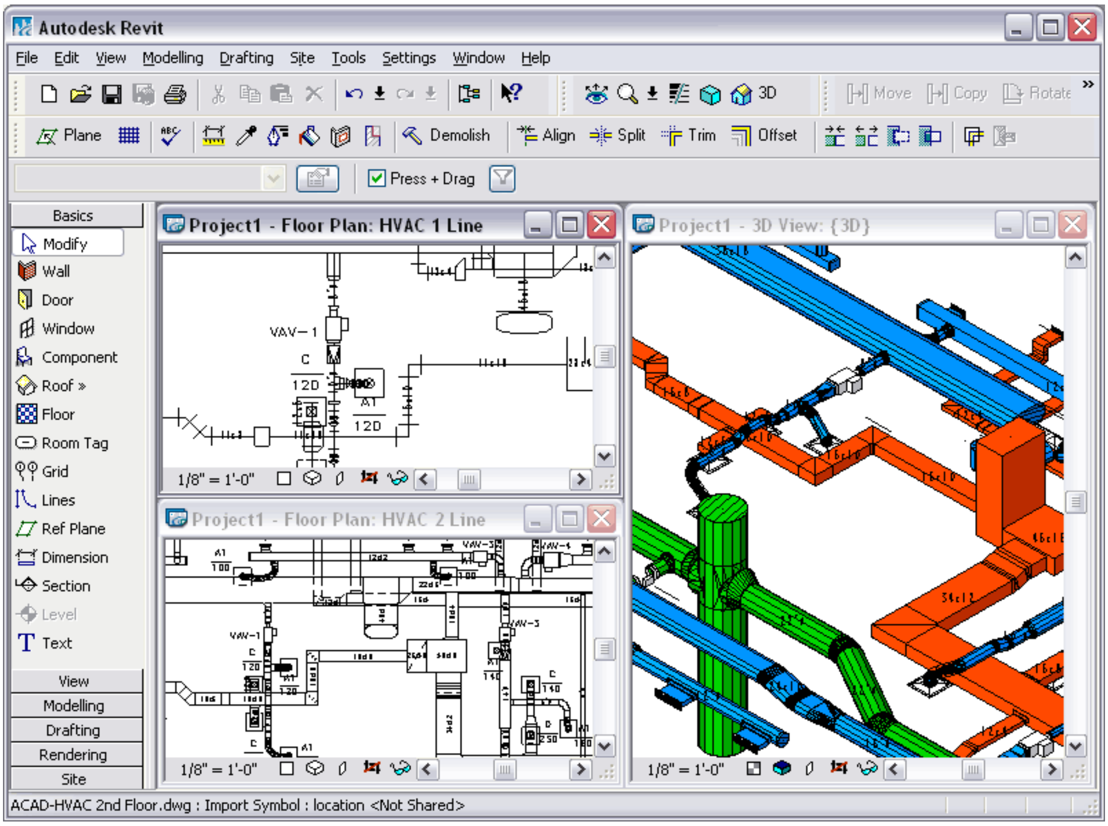


Fig.31: Revit is CAAD design program helping architect to detect conflict and coordinate between building systems, Autodesk Revit website, Dec. 2014.

7. Increase practice curriculums aids such as:
    a. Building and materials workshop
    b. Technical work and Plumbing laboratory
    c. Environmental laboratory
    d. CAAD "Computer Aided Architectural Design" laboratory
8. Activate capability test exam to apply architectural students
9. Necessity to adopt architectural institutes periodically.
10. Make programs to educate practicing "graduates" engineers to increase their efficiency

6. CONCLUSION

Architect role has been retreated in construction field in Egypt. There are many indicators and reasons caused this recession. The research presents many recommendations to regain this historical leading role in the construction Field as a maestro, and to reduce the technical installations in buildings as a sustainable requirement, especially energy-intensive systems. Using alternative architectural-environmental solutions, this bodes for the architect role importance rise again (fig. 32).

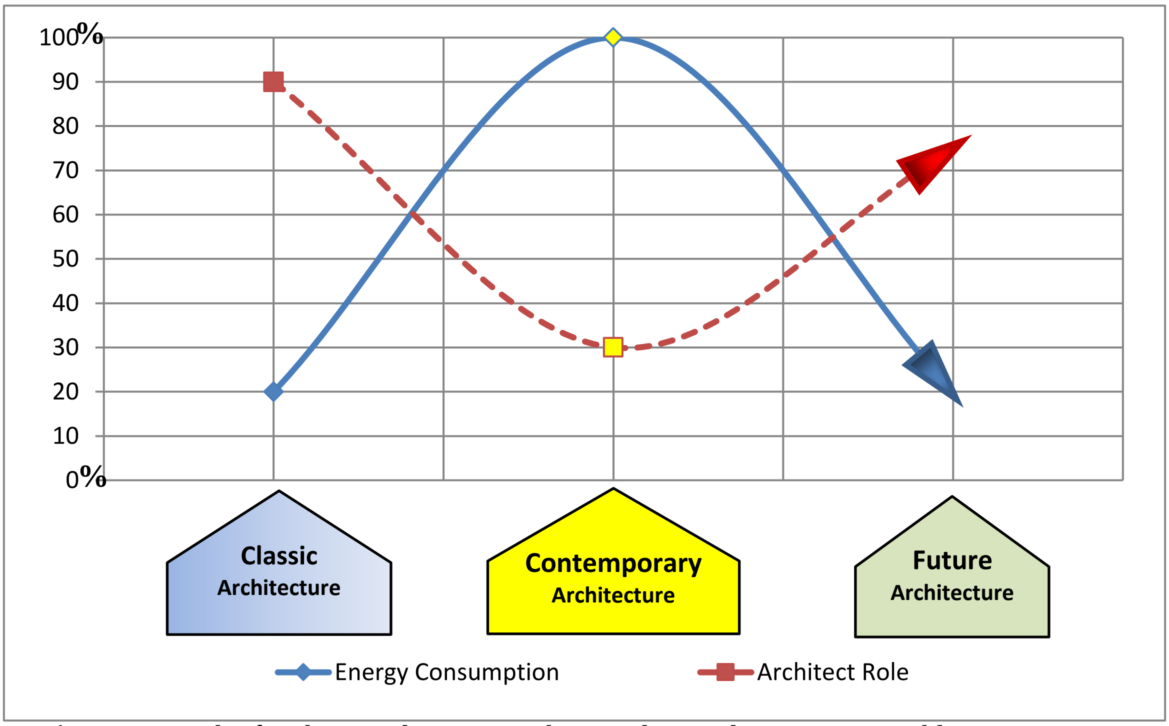


Fig. 32: Growth of architect role again, with a trend towards using sustainable energy-saving systems in buildings, Author.

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