Introduction :-

The residence, "The Home, the 'Sweet Home'" uttering these words gives a pleasure to one and all, it may be a small one or a big bungalow, but the pleasure and the fillings are same. Even the thought of getting back to home, after a hectic activity day, is unmatchable. The safety, relaxation, filling to be amongst your family, having together meal, making fun with them, which is in offing at home, is termed as 'The Life.' All other things are secondary to that.

Such 'Sweet Home’ must be structurally safe, which then and then will safeguard family, and the fill that it gives. The structural safety therefore is of utmost importance, and the residence wherein one is staying or is proposing to shift must comply this basic condition. The Answer to question what is safety of structure? Need be addressed in respect of the ability of structure, to withstand the calamities, like EARTHQUAKE, Tsunami, excessive wind pressure, weathering effects, degradation effects etc.

What if the level of safety is not up to the required mark? The answer to this enquiry needs to bring it to the required level of safety by retrofitting the existing structure or by judiciously following BIS Code's recommendations and conditions. For a layman having this technical information is out of scope, and there is no reckoner spelling out this information in simple words, for him.

Evaluation is a process of assessment or revision of estimate as on date, with consideration to future maintenance cost and current requirement of retrofitting cost. Maintenance cost is the sum cost that includes, repairs to the structure, renovation of the structure current or future to suit the then requirements, and Eco-friendly retrofitting cost. The process of retrofitting enhances the life, of the structure, which in turn elevates the valuation, on the date; the process is of cyclic nature that defines the, "The Life cycle evaluation" process.

The Evaluation of the strength, quality and life of the structure is also equally important and essential, to assertion the proper method of retrofitting visa vis reconstruction of the structure. Here the issue is more of economics that will rule decision.

The safety of home from calamities became the necessity, which was first to be assessed in two stages i.e. Visual Inspection followed by NDT's. The results obtained indicated the level of weaknesses. It was further, processed for selection of strengthening method. The strengthening is, defined as retrofitting.

The need to rehabilitate the structure arises, in principal for safety of occupants and other following cases:-To enact change of uses, or to opt change of seismic zone, structures having strength but has deformed during the calamity. Climatic changes develop different types of effects of deterioration on construction materials. Thereby strength of the material goes on reducing. This result is developing damages in the building, if not attended aptly intime, the rate of deterioration is aggravated, shortening the useful life of the structure.
The RCC multi-storied engineered Structures, are built without specific consideration for seismic resistivity, the probable reason may be structural designer is untrained, unaware or ignorant towards the same, or may be conceding to property developer's demand for economic construction cost. The structure was safe till earthquake struck.

The horizontal force is predominant in seismicity. Both stone and brick masonry structures are weak in resisting horizontal forces. For reasons that there potential strength in resisting shear force has limitations depending on the material's inherent strength, method of building, the wall and floor or roof connection, the weight of the roof, the type of foundation, and bearing capacity of substrate.


What is Retrofitting?

Retrofitting of civil engineering structures, is an art, of enhancing the longevity of the life of the structure, beyond the period of life of the existing structure, if it would have not retrofitted.

Why is Retrofitting needed?

To induce new functional aspect to the existing structure, as and wherever it was possible. Converting a existing residential structure, into a commercial one, will call for, strengthening of many of the structural members, beyond its original designed strength. This will amount to asses the strength of existing member/s, analysis and design the member/s to suit the requirements as per new functionality.

Further, to analysis the force causing defects, in the structural member/s like cracks, deformities, scaling of plaster, the periodic/persistent dampness, rusting of steel member as well as monitoring any re-occurrence of these, if any, in the structural member, and to strengthen the structure.

Natural materials, are mixed and molded in to necessary forms, to build the structure, to suite requirements. The structures are build as per designs, based on the strength of materials, with appropriate factor of safety. The life of the structure depends on the fact that, the designed factors of safety remain within the designed limits of parameters, throughout the life of the structure.

The materials used in construction of structures are earth, river sand, cement (first mixture of natural resources), mild steel (mild steel, made by processing iron ore). It is therefore subjected, to natural deterioration. The deterioration reduces the strength of the material, thereby lowering the factor of safety assumed in the designing.
Degradation is the rule of "Nature". No material can escape the rule, therefore as soon as the material is put into use, it starts deteriorating. This is not the matter of worry, as the material has potential to resists, this level of phase of degradation, still maintaining the assumed designed strength. When any material shows a sign of fatigue, it must be taken care immediately, in order to curtail its rate of degradation, which may be alarming at that point of time.

The defects must be, carefully observed, and treated immediately. When a defect/s occur repeatedly (Especially in structure's early stage of life), structural should be audited and as per advice, the structure must be strengthen so that, it will function in order, in the rest of its life. The structural audit should be carried out as per rules.

The complaints of occupants in case of residential/ commercial buildings, as well as, the maintenance engineer's observations, play important role in enhancing the life of the structure. Periodic maintenance helps to increase, the life of the structure, is termed as Structural Health Monitoring (SHM).

Strengthening of structure (repairs to structure in non technical terms) is a specialized field, hence the work must be carried as per advice and under the supervision of consultant, who is knowledgeable and authority, in the subject.

The strengthening of structure is achievable by many methods. The choice of method is made on the following grounds.

1) On technical grounds:- It is essential for the structural designer, to analysis the existing strength, and asses the structure for its weakness in the design parameters, then to consider all the options available, of methods of construction, like using only steel or composite or RCC or FRP, poly propline members in place off or supplementing to existing one, primarily on technical grounds, conforming to the latest cods of practice.

2) Skilled, specialized labour and material availability:- In remote areas, skilled and/or specialized labour will not be readily available and therefore cost for the same will be excessive. Similarly, material availability, will also pose the same problem.

3) Feasibility and limitations in execution under working conditions:- In thickly populated urban areas question of working space material stacking space, material transporting will have to be in restricted time as per traffic rules are poised, on the other hand in remote places it is availability of fuel and electrical power will be on the screen, along with extra cost of transportation my be required.

4) Future life and utility of the structure:- The 'Future life and utility of the structure', in retrofitting, will play a great role in deciding the method as it will cover the major decision about commercial aspect of the project.
5) On the architectural design grounds: The better architectural design will fetch more commercial value to the structure. Which can become a landmark as well as model. Extra cost will have to be incurred for the architectural features.

6) Execution time: The time requirement of the project plays a crucial role as the commercial commitments are based on this. The delay will create imbalance for the commercial commitments.

7) Eco compliance: The current rules, regulations, and codes are insisting on 'Eco compliance'. It is moral duty of every individual as well. This will increase capital, and maintenance cost.

8) Commercial grounds: It is the real 'HEART' of the project, and projects are majorly conceived on this ground. Not only the current scenario but the future economics, of the project depends on it too. Any derailment or deviation in the above discussed points will hamper this, causing escalation of the project cost. When the structure is new the maintenance cost is less and as the time progress the cost increase, this cost can be minimized when maintenance is done systematically and as per guidelines of the structural Engineer.

9) Aesthetic grounds: Better 'Aesthetic' will influence in fetching more commercial value to the structure.

10) Conformation tests: The strength achievement conformation tests are necessary as future of the structure depends on this.

The consulting structural engineer has to consider all the above factors, before deciding the method of retrofitting.

The different retrofitting methods for different types of constructions were found be fitting. The methods for masonry structures were as follows:

Traditional methods

a) Infill walls
b) Providing bands
c) Vertical reinforcement at extreme corners
d) Providing Buttress Walls
e) Strengthening of wall foundation
f) Confined masonry construction

The methods for RCC Multistory structures were as follows:

X01) Provision of infill walls to reduce open story effect
X02) Column Jacketing
X03) Foundation strengthening  
X04) Improving connection between infill walls and columns  
X05) Strengthening respective joints to reduce strong beam weak column phenomena  
X06) Improving strength in fever of demand for change of use  
X07) Making provision to cater floating column situation  
X08) Strengthening for excessive overhanging features  
X09) Providing steel bracing

Innovated Methods

Y01) FRP wrapping on Masonry face  
Y02) FRP wrapping on RCC beams, columns, frames.

In this paper it was intended to elaborate the needful information which can be physically be observed and conformed by oneself, and the enquiry he needs to make and conform from the concerned professionals so as his "Dream Sweet Home" can be a reality.