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Forensic Investigation of Abandoned GSIS Building in Manila

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Abstract

This descriptive study aimed to conduct a forensic investigation of the abandoned Government Service Insurance System (GSIS) building in Manila. The fire incident caused the five-storey GSIS building to lose its strength due to heat in addition to the exposure of reinforcement due to weathering and deterioration of the structure as years pass by. The research has shown that the abandoned GSIS building has to change its use and to lessen its occupant capacity for the structure to serve its purpose and put into use again. Some interesting insights of the study are: a) Deterioration damage of concrete of the abandoned GSIS building is increasing as the years pass by; b) The abandoned GSIS building is still in serviceable condition in terms of its structural members; c) Steel corrosion and concrete deterioration are the major factors that affected the stability and integrity of structural members of the abandoned GSIS building in Manila; d) There is a difference between the design loads used in the GSIS building in Manila from the present design codes of National Structural Code of the Philippines (NSCP) and American Concrete Institute (ACI) codes.

Keywords: *Abandoned buildings, building codes, forensic investigation*

1. Introduction

The fast modernization of living city life has paved way to the increased demand of construction industry. In the Philippines, more and more buildings are constructed especially in key cities in order to provide space for the growing industry of business, trade, and other services. Buildings are not just structures. These structures serve as landmark and also show the progress of the place. Nowadays, there are already numerous abandoned buildings within Metro Manila. Within the municipality of Manila alone, several abandoned buildings can be sighted

Abandonment of property is the most striking indication of neighborhood decline. Large scale abandonment threatens the stability and undermines the value of investments made by property owners. Fire is intertwined with abandonment as both a cause and an undesired side effect. Abandonment usually signals the end of a buildings' productive life. Real estate market conditions, difficulty in obtaining financing for renovation or repair, withdrawal of fire insurance, and declining economic fortunes of tenants, all contribute to abandonment.

Structural failures are not just accidents. They are result of human error originating from oversight, carelessness ignorance or greed. The design of a structure must contain a support system with a clear line of load path and resist the applied loads to a stable resistive foundation.

Most of the concrete-based infrastructure has now been in place for several decades. There is some feedback on technical performance at least in qualitative terms, but also at the level of

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deterioration in individual cases is dictated by a combination of factors in which design and construction issues are significant. The net effect can be a costly loss of function, or substantial unforeseen maintenance cost or both [1, 26]. However, the spectrum of obsolescence also enters the arena.

Many buildings and bridges have had to be upgraded or replaced, because their functional needs have changed quite apart from any decrease in technical performance [2]. In addition, the different components in individual artefacts (*e.g.*, cladding in buildings; expansion joints on bridges) have been shown to have useful lives much less than those for the basic structure. These factors have led to a more conscious effort to manage and maintain the existing infrastructure and to introduce life-cycle cost techniques to evaluate alternative designs for new structures [3].

On year 1954, the city of Manila was the center of development and primarily the capital of the Philippines. During this year, the Government Service Insurance System also known as GSIS, proposed to construct a five-storey concrete structure along Arroceros corner Concepcion Streets in Ermita, Manila [4].

At present, the old GSIS building in Manila is owned by the Supreme Court of the Philippines. An agreement between the GSIS and the Supreme Court had been made year 2012 [4, 5]. The agreement was about GSIS giving the ownership of the GSIS building in Manila to the Supreme Court in exchange for a property in Pasay in which the new GSIS building was built. The exchanging of property was finalized and approved by the Supreme Court at that same year [5]. The Supreme Court did not use or renovate the building because they wanted GSIS to pull out first their belongings, debris, etc. The GSIS then hired service of a hauling company to do the job.

On January 14, 2006, at around 5 pm, fire was spotted at the rear right portion of the 5th floor of the GSIS building [5, 6]. The fire was raised from 2nd alarm to 5th alarm in a span of 3 hours [6]. At the 4th hour, the fire was under control. The incident caused the five-storey building to lose its strength due to heat in addition to the exposure of reinforcement due to weathering and deterioration of the structure as years pass by [6].

As for the serviceability of the building as its main concern, serviceability is its priority characteristic. For civil engineers, serviceability refers to the conditions under which a building is still considered useful [7, 14, 15]. Should these limit states be exceeded, a structure that may still be structurally sound would nevertheless be considered unfit. It refers to condition others than the building strength that renders the buildings unusable [16]. Serviceability limit state design of structures includes factors such as durability, overall stability, fire resistance, deflection, cracking and excessive vibration [17].

For example, a skyscraper could sway severely and cause the occupants to be sick (much like sea-sickness), yet be perfectly sound structurally and in no danger of collapsing. This building is obviously no longer fit for human occupation, yet since it is in no danger of collapsing, the structure would be considered as having exceeded its serviceability limit state [18]

A serviceability limit defines the performance criterion and corresponds to conditions beyond which specified service requirements resulting from the planned use are no longer met. In limit state design, a structure fails its serviceability if the criteria of the serviceability limit state are not met during the specified service life and with the required reliability [19]. Hence, the serviceability limit state identifies a civil engineering structure which fails to meet technical requirements for use even though it may be strong enough to remain standing.

Abandoned should always be vacant, but vacant buildings are necessarily abandoned. Vacant and abandoned is recognized as a contributor of hindrance to the revitalization of the central cities like Manila.

The study is very timely because of some plan of reuse or rehabilitation of other abandoned buildings in Manila, Manila Metropolitan Theatre and Licaros building beside MAPUA Institute of Technology.

The external part of the GSIS building shows damage, one of the causes is deterioration due to time, broken window glasses, collapsed small strip of concrete on the 5th floor, yet aside from the seemly deteriorated facade the structure still stands firm [7]. With the help of this study, the possible causes of its abandonment and the remedial measures may be discovered for a potential reuse of this structure.

The inquiry to be conducted is the forensic investigation of abandoned GSIS building in Manila, some weaknesses in the design, human error due to oversight or carelessness and the comparison of design codes used in the design of the structure and the present design codes will be revealed. This will benefit the city of Manila, the owner of the property, the civil designers for them to incorporate good designs that may cope with serviceability requirements for a long period of time and the students taking up civil engineering program because they can make the findings of this study as a basis of good design.

This study was conducted to investigate the present condition of structural members of the abandoned GSIS building in Manila and determine the status of its serviceability with respect to its present condition. The aspects looked into were the structural members of the GSIS building, the comparison of old design codes and present design codes.

The purpose of the study is to propose a forensic investigation on the abandoned GSIS Building in Manila and determine if the structure is in serviceable condition.

The study was based on the intended utilization of the structure as determined from architectural and structural plans but not lower than the building code regulations. Occupancy, load of the structure is determined for load determination such as vertical and lateral load analysis and must check the allowable capacities (bending, shear, and deflection) as prescribed by the code.

This study will determine the capability of the structure to cope with the serviceability requirements in its present condition, the structural members, fire resistance, the mechanical systems and electrical wiring systems and installation, sanitation facilities, and location.

2. Related Literature

On the first year of the Commonwealth period, a significant piece of legislation that would later on become the touchstone of other retirement laws was passed into law. Commonwealth Act 186, creating the Government Service Insurance System was approved on November 14, 1936 on a Special Session of the First National Assembly. The GSIS was established to promote the efficiency and the welfare of the government employees and to replace the different pension plan existing then [8]. It was consolidation of all laws on social security.

With a starting capital of two hundred thousand pesos and 88 employees, the GSIS began its operation on May 31, 1937 in a building on Tanduay Street in San Miguel, Manila.

The main function of the GSIS was to provide compulsory life insurance coverage to all regular and permanent employees of the Commonwealth government, the National

Assembly, the Metropolitan Water District, members of the judiciary, and officers and enlisted men of the Regular Force of the Philippine Army. The GSIS is a government agency that provides financial assistance to its members through its different loan windows to help them obtain funds for specific purposes like building a house, augmenting funds for their family daily needs or even for investment purposes [9]. On the part of GSIS, such extension of service also serves as an investment opportunity as funds entrusted to the system are earning interest income.

The ten year preparatory period for the Philippine independence was interrupted when the Japanese started the war in the Pacific. The GSIS was barely four and a half years old when the World War II hit the Philippines. On December 31, 1941, it was abolished and placed under liquidation.

After three years of Japanese occupation, the temporary seat of the government was re-established in 1944. Shortly after, GSIS re-opened on March 27, 1945. On December 10, 1945, the system resumed operation. On May 1954, GSIS building in Arroceros corner Concepcion Streets in Ermita, now known as Villegas corner Lopez Streets, Manila was constructed. This five storey structure covers 10,818.10 square meters. The GSIS vacated this building in the late 1980.s and moved to a modern building in the Manila Bay Reclamation Area in Pasay City [9, 10].

After 51 years, former President of the Philippines Gloria Macapagal Arroyo has issued a proclamation giving the City of Manila its own Hall of Justice. By virtue of the Proclamation No. 835 signed last April 27, 2005 [7, 8]. President Arroyo transferred the former building site of the Government Service Insurance System (GSIS) in Ermita, Manila to the Supreme Court to improve the administration of justice in the city and provides better public service to its courts. On that lot will build the Hall of Justice for the City of Manila, a 10,818.10-square meter property [9, 21]. The President directed the city's Register of Deeds to issue a new title over the property in the name of the court. President Arroyo also issued Proclamation No. 833, transferring a 6,470.30-square meter parcel of land registered in the name of the Philippine Jai-Alai and Amusement Corporation to the GSIS after the Supreme Court had agreed to yield the Jai-Alai property to the GSIS in exchange for the former site of the GSIS Manila office [9, 10]. The Jai-Alai was originally intended for the construction of the justice hall, but such proved to be impractical. Halls of Justices are buildings constructed under the Justice System Infrastructure Program, an offshoot of Administrative Order No. 99 issued in 1988 by then former President Corazon C. Aquino. Under the program, courthouses or Halls of Justice buildings shall be rehabilitated or constructed for the use or occupancy of the lower courts, the National Prosecution Services, the Parole and Probation Administration, the Public Attorney's Office, and the Register of Deeds [7, 8]. The order directed the Secretaries of Justice, of Public Works and Highways, and Interior and Local Government, in consultation with the Supreme Court, to undertake the program to improve the infrastructure of the justice system.

There was nothing wrong with the GSIS building when the employees left the building structure back in the late 1980’s. The main reason why the GSIS building was vacated because the system is moved to a new building situated in the Manila Bay Reclamation Area in Pasay City.

In January 2006 the building was on fire. The origin of the fire was on the 5th floor, the laborers of the hauling agency tried to control the fire by using extinguishers but the fire is spreading past that is the time they called the fire station [6, 10]. The fire lasted for 4 hours and went from 2nd to 5th fire alarm. As of this time the property is used as a parking area for the Supreme Court employees.

3. Research Methodology

Descriptive method of research was used by the researcher to gather information about the present existing condition of the abandoned GSIS building in Manila. The principal aim of the researcher in employing this method are to describe the nature of the situation of the building as it exists at the time of the study and to compare the different editions of design codes of ACI.

Descriptive method describes the data and characteristics about the population or phenomenon being studied. The researcher utilized the descriptive method of research in three major areas a) condition of the abandoned GSIS building in terms of structural members; b) present serviceability status of the building that can does it cope with the present serviceability requirements of buildings; and c) comparison of ACI design codes and utilizing it in STAAD to generate the difference in the design from the edition of ACI codes used.

3.1. Project design

As shown in Figure 1, project design comprises of data gathering, surveys and ocular inspection, structural plans, software application, incorporating design codes, and establishes a conclusion. The data and information gathered are the structural members which comprises of slab, beams, columns, footing, and shear- walls.

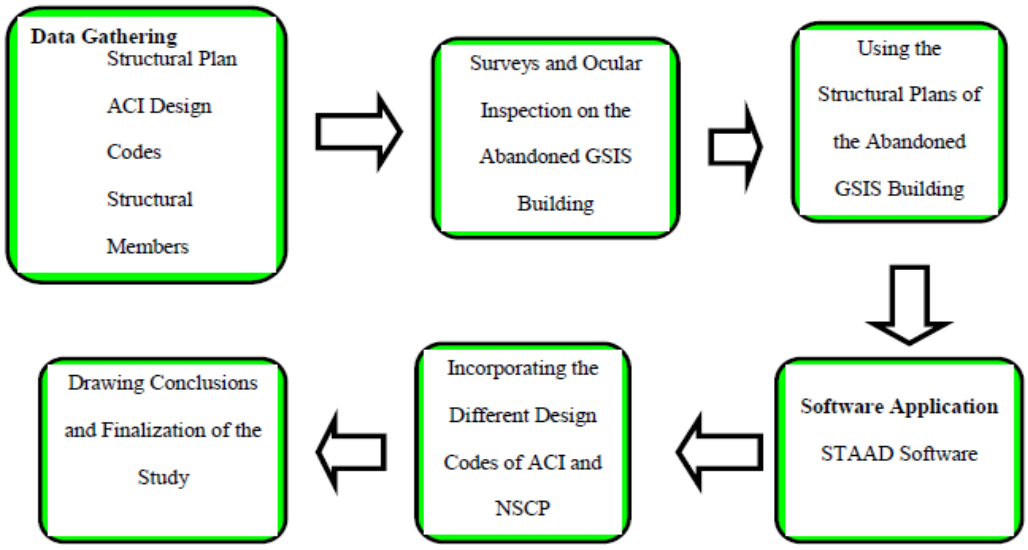

Figure 1. Project design

Surveys from the engineers who inspected the GSIS building in Manila is used and also ocular inspection and personal site investigation and visits were done to personally verify the condition of the structural members of the abandoned GSIS building in Manila.

Structural plans of the abandoned GSIS building are used to know the actual dimension of structural members. With the use of STAAD software program, the loadings and capacities of the building were generated [11, 12]. The design codes of ACI and NSCP were used to compare the capacities and loading from which the design of the structure was based.

3.2. Project development

This describes the connectivity and interdependency of each component for the development of the study. The researcher formulated different ways of how project develops. The researcher exchanged views about the development of the study and then finally came up with a suitable process of project development. The data and information that will be used in the study shown in Figure 2 are the architectural plan, (includes the site development and elevations), structural plans, (includes all the member detailing and scheduling).

As the fundamental approach towards the meeting of two separate requirements of safety and serviceability of a design analysis problem. These include the basis that came from the source of gathered information, organization of data covers the interpretation of data and how to apply these data, drawings and specifications and other design documents in the study of the abandoned GSIS building in Manila through a) layout analysis, b) structural modeling, c) plans, and d) structural plan detailing.

In the preliminary design phase, most of the specific structural design parameters (such as floor heights, columns, spacing, and beam cross sections) are selected. The total structural design process is consisting of 3 general phases a) conceptual design, preliminary design, and final design. These phases will be analysed and investigated.

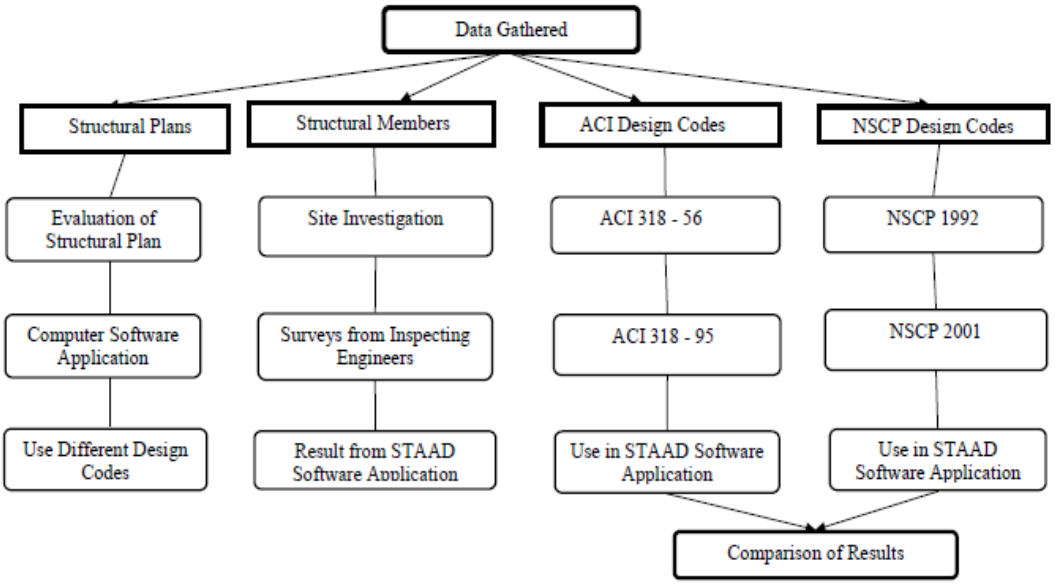

Figure 2. Project development

The structural analysis determines the response block of the preliminary design to the prescribed loads. This deals with so many uncertainties with regards to external loads and material properties, dimensional tolerances, etc. The occupancy requirements is relaxed and rather approximate analysis are acceptable in the preliminary design stage [13, 22].

The data and information gathering is crucial to this study. The information and data must be substantial and with relevance to the study undertaken. The structural plan of the building is examined as it compromises with the structural members constructed.

Design codes of ACI and NSCP from different editions or years were used in the STAAD software application. These design codes were used as a basis on the kind of design code is used [20, 23].

4. Analysis and Interpretation of Data

4.1. Deterioration in relation with service life of concrete

As shown in Table 1, the probability of deterioration damage in relation with service life of concrete obtained 0.99, 2.09, 3.3, 4.4, and 5.50 vector damage state for every 10 years in the span of 50 years. For the year 2012, the probability of deterioration damage is at 5.83. This implied that the probability of state of the abandoned GSIS building is also in poor condition

Table 1. Probability of deterioration damage

Span (years)	Year	Damage State
10	1964	0.99
20	1974	2.09
30	1984	3.30
40	1994	4.40
50	2004	5.50
58	2012	5.83

In 1964 and 1974, the state of structure is in good condition. State of structure is still acceptable in 1984, in fair condition in 1994 and finally in poor condition in 2004 and 2012.

Table 2 shows the damage levels on reinforced concrete due to steel corrosion.

Table 2. Damage levels on reinforced concrete

Visual Indications	1	2	3	4	5	6	7
Color Changes	None	Rust stains	Rust stains	Rust stains	Rust stains	Rust stains	Rust stains
Cracking	None	Some longitudinal	Severe longitudinal	Extensive	Extensive	Extensive	Extensive
Spalling	None	Rust stains	Some longitudinal	Extensive	In some areas steel is no more in contact with concrete	In some areas steel is no more in contact with concrete	In major areas steel is no more in contact with concrete
Loss in Steel Section	None	Some longitudinal	5%	10%	25%	Some stirrups broken. Main bar buckled	Most stirrups broken. Main bar buckled
Deflections	None	Rust stains	Rust stains	Rust stains	Rust stains	Apparent	Apparent

There are 7 states of structure which are state 1, state 2, state 3, state 4, state 5, state 6, and state 7 [24, 25].

The state indicate the damage levels of the reinforced concrete based from the probability mass function of the concrete structure wherein there is no damage in state 1 and states 6 and 7 indicates extensive damages on the concrete structure. The visual indications are cracking, spalling, colour changes, loss in steel section and deflection [26, 27].

4.2. Condition of the structural members

Cylinder debris taken from the abandoned GSIS building having a diameter of 76mm, height of 70mm, an area of 4536.46 mm² and weight of 1kg was tested shown in Table 3. A compressive stress of 4.36 MPa is obtained from the test under a compressive load of 19800 N.

Table 3. Sample of concrete debris of abandoned GSIS building

Debris Sample	Diameter (mm)	Area (mm^2)	Height (mm)	Weight (kg)	Load (N)	Stress (N/mm^2)
Cylinder Debris	76	4536.46	70	1	19800	4.36

As shown in Table 4, serviceability requirements for structural members include deflection, cracks in tolerable limits and minimized vibrations. The structural members do not exceed the maximum deflection.

Cracks were kept in tolerable limits and only minor vibrations were felt inside the structure. The abandoned GSIS building is still in serviceable condition in terms of its structural members.

Table 4. Serviceability requirements of structural members

Serviceability Requirements	Status	Effects on Structure
Deflection is adequately small.	Does not exceed maximum deflection.	Still in serviceable condition.
Cracks in tolerable limits	Still in tolerance limits	Still in serviceable condition.
Vibration minimized	Minor vibrations were felt	Still in serviceable condition.

Deterioration of concrete greatly affects the strength of concrete of abandoned GSIS building. For instance, age weakened the concrete strength of the concrete through time. Corrosion occurred on exposed reinforcing bars or metal reinforcements doubled the volume of reinforcing bars and then applied pressure to the surrounding material that results in stress levels greater than the tensile strength of concrete.

As a result in Table 5, there are concrete fractures and separation of rebars occurred. Cracks exist in concrete at its early ages later expand and widen due to service conditions. Heat conduction and temperature changes decreased the strength of both the concrete and its steel reinforcements.

Moisture cause corrosion of steel reinforcements and resulted in decrease of tensile strength of steel reinforcement making it weak. These factors cause the deterioration of concrete thus making the concrete less serviceable.

Table 5. Causes of deterioration and its effect of concrete structural members

Causes of concrete deterioration	Effects on Concrete Structural Members
Age	Weakened the concrete strength through time. There is reduction on load carrying capacity.
Corrosion of Rebars	Doubled the volume of reinforcing bar and applied pressure to be surrounding material that resulted in stress levels greater than the tensile strength of concrete.
Cracks	Cracks which exist on concrete at early age expand and later widen during service conditions.
Heat Conduction	Heat and temperature changes affected the concrete and its steel reinforcements resulting in decrease of concrete strength.
Moisture Transfer	Moisture on steel reinforcements resulted in corrosion and weakening of steel strength.

5. Conclusions

Deterioration damage of concrete of the abandoned GSIS building is increasing as the years pass by. As the concrete becomes old, the concrete strength decreases that shortens the service life of concrete. The structural members do not exceed the maximum deflection. Cracks were kept in tolerable limits and only minor vibrations were felt inside the structure.

The abandoned GSIS building is still in serviceable condition in terms of its structural members. Corrosion occurred on exposed reinforcing bars or metal reinforcements doubled the volume of reinforcing bars and then applied pressure to the surrounding material that results in stress levels greater than the tensile strength of concrete. As a result, there are concrete fractures and separation of rebars occurred. Cracks exist in concrete at its early ages later expand and widen due to service conditions. Heat conduction and temperature changes decreased the strength of both the concrete and its steel reinforcements. Moisture transfer caused corrosion of steel reinforcements and resulted in decrease of tensile strength of steel reinforcement making it weak.

There is a difference between the design loads used in the GSIS building in Manila from the present design codes of NSCP and ACI codes. This implies that standard design loads do not satisfy the requirements of the present design codes of NSCP and ACI codes.

To be able to use the abandoned GSIS building, the following recommendations are made: a) Change the use of the abandoned GSIS building in which the structure will have less occupants and less machineries installed inside the structure; b) Refurnishing the part of the building which is mainly damage by fire to lessen the effect of deterioration and to restore the area affected by fire; and c) Retrofitting of the structural members which need added support in carrying loads acting on it.

Appendix

Figure 3. Abandoned GSIS building in Manila

Figure 4. Typical level tested by GHD and inside the GSIS building

Figure 5. Fifth level hallway and portion of building affected by fire

Figure 6. Portion of building affected by fire and inside the GSIS building

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