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# PATTERN OF DEFECT ON POST TENSIONED SYSTEM IN BUILDING APPLICATION

This academic project is submitted in partial fulfillment of the requirement for the Bachelor Of Building Surveying (Hons.)

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# CHAPTER 1

## 1.0 INTRODUCTION

The A.C.I. Committee on Prestressed Concrete gives one of the descriptions of post tensioned concrete.

***'Prestressed Concrete is concrete in which there have been introduced internal forces of such magnitude and distribution that the forces resulting from given external loadings are counteracted to a desirable degree'.***

Post-tensioning is a method of reinforcing (strengthening) concrete or other materials with high-strength steel strands or bars, typically referred to as tendons. Post-tensioning applications include office and apartment buildings, parking structures, slabs-on-ground, bridges, sports stadiums, rock and soil anchors, and water-tanks. In many cases, post-tensioning allows construction that would otherwise be impossible due to either site constraints or architectural requirements.

Buildings have to serve defined functions. Accordingly, they have to be equipped with various electrical, mechanical and sanitary installations and certain climatic and other environmental variables have to be maintained within given tolerances. Similar to a vertebrate's skeleton the structural frame of a building is just one essential component of a complex system and working on the design or construction of a building has a highly interdisciplinary character in any position.

The post-tensioning of buildings can only be successful if this is recognized and a close cooperation with all relevant parties is established. Building frames have to resist gravity and lateral loads. Horizontal members (floor slabs, beams) account for the major part of the total costs. With increasing height the relative costs of vertical members (walls, columns) increase and extra costs are incurred for resisting the increased lateral loads (wind, seismic action).

Post-tensioning is particularly suited to reinforce floor slabs and there is no doubt that this will remain the primary area of application of post-tensioning in building structures.

Restraint to concrete volume change (shortening) was the first big pervasive problem faced by the industry. The mechanics of volume change, and the restraint to that volume change, is different in post-tensioned concrete members than in non-prestressed members. In non-prestressed concrete beams and slabs restraint to shortening provided by connected elements (walls and columns) results in many closely and uniformly spaced cracks throughout the length of the member.

The ends of a non-prestressed member tend to stay in their original positions, and the total shortening is simply the sum of the crack widths along its length. Because of this, shears and moments induced into restraining connected elements are relatively small.

In post-tensioned concrete members, the effect of the axial prestress force tends to close most of the restraint to- shortening cracks which would otherwise form between the ends of the member. Unlike non-prestressed members, the total volume change along the length of the post-tensioned concrete member is reflected in significant movement inwards at the ends. This induces large shears and moments into the connected walls and columns. These shears and moments can result in large and unsightly cracks in the post-tensioned member, and in the walls and columns themselves.

Engineers had to learn how to design post-tensioned concrete floor systems with levels of cracking normally accepted in non-prestressed floor systems. This was accomplished over the years largely with the use of joinery details (slip joints and pour strips) and the use of properly located and sized non-prestressed reinforcement. Mitigation of restraint to- shortening effects in the design of post-tensioned buildings has become as large a part of the design process as the selection of the forces and profiles themselves.

But without doubt the biggest problem ever faced by the industry was tendon corrosion. The early unbonded tendon sheathings and coatings (grease) were inadequate for aggressive environments, such as those where de-icing salts are applied to exposed concrete surfaces. Serious corrosion problems began to be apparent in such buildings within about 10 years of service. Most were repairable, and several companies thrived by specializing in corrosion-related repairs.

Possibly causes of defect in Post Tensioning Systems are from:-

a) Design Failure
b) Construction Failure
c) Aging
d) Quality of Material Use

Pattern of defect on Post tensioning can be divided in 3 categories:-

i) Cracks
ii) Corrosion on Prestressing Steel
iii) Poor Workmanship

Perhaps the largest potential future growth for post tensioned concrete is in the area of tall buildings, buildings taller than about 20 stories. Decision makers in building construction are beginning to realize the advantages of post-tensioned concrete framing in tall buildings. The use of post-tensioned concrete in the floor systems of these buildings reduces their weight by up to 30%, and the use of high-strength concrete in the columns of tall concrete buildings makes their sizes reasonable.

Therefore, post-tensioning, particularly in buildings, is not regarded as a familiar and/or desirable construction option by many developers, architects, engineers and contractors.

## 1.1 REASONS TO CONSIDER POST TENSIONED

- Increased span to depth ratio resulting in a reduction in construction materials and a subsequent reduction in overall cost.
- Positive deflection control.
- Designers are offered design flexibility with post-tensioning.
- Joints in structures are minimized or even eliminated.
- Post-tensioning can improve the long-term durability of concrete structures exposed to aggressive environments.

## 1.2 OBJECTIVE

The objective of this dissertation is to study the pattern of defect on post tensioning systems for buildings application.

## 1.3 PROBLEMS ISSUE

One of the major problems that agencies face today is the difficulty of providing good monitoring and inspection techniques for bonded post-tensioned structures. Condition surveys are often limited to visual inspections for signs of cracking, spalling and rust staining. This limited technique can often overlook the deterioration of prestressing steel and fail to detect the potential for very severe and sudden collapses

A variety of factors can influence behavior, including design, materials, construction, maintenance, service loads and environmental conditions. These several techniques to improve service or exposure conditions, enhance physical properties, provide barriers, modify electrochemical behavior or halt water intrusion.

Proper repair and treatment of the concrete in combination with an external post-tensioning system provide a viable strengthening approach when