

Challenges of a Construction Defect Claim Involving a Highway Concessions Project: A Private Sector Forensic Perspective

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ABSTRACT

Privatization of transportation infrastructure is often accomplished through concessions contracts whereby the public agency transfers the costs of construction and/or operation and maintenance of the asset to the private entity for a period of time and in return, authorizes the private entity to then charge a user fee. Although this type of arrangement is not typical in the U.S, it is more common in Latin America and some European countries for large transportation infrastructure development and management. In the private sector, forensic engineers are commonly retained by stakeholders (owners, constructors, insurers) to investigate facilities that fail or do not perform as intended. Forensic engineers are often asked to determine the cause of a failure, identify the factors leading to a loss, assess risk, and assist in mitigation. Facilities constructed and operated under concessions create unique and challenging circumstances for forensic engineering investigations, as the contractual and risk allocation is different from traditional construction arrangements. This paper presents the unique challenges encountered by the authors for a forensic investigation of a construction defect claim made by a private consortium administering a tolled highway in Santiago, Chile that involved investors and insurance stakeholders from the U.S. and Europe. The construction and operation arrangements discussed in this paper will be of benefit to parties involved in management of public-private transportation facilities.

INTRODUCTION

Privatization of transportation infrastructure is often accomplished through public-private partnerships (PPP) involving concession contracts (1) (2). With this emerging, non-traditional arrangement, the public agency enters into a contractual agreement that provides for the transfer of the construction and/or operation and maintenance of the asset to the private entity for a specified period of time (3) (4). Typically, the concessions contract allows the private entity (the concessionaire) the right to charge a user fee and collect revenue. This type of arrangement for transportation infrastructure is not historically typical in the United States, but is more common in Latin America and some European countries, particularly for large-scale transportation infrastructure development and management.

Concessions provide states or public entities an alternative option for financing infrastructure development. They allow the public entity to collaborate and leverage financing with private, for-profit entities. Compared to traditional construction contract models, the concessions model can be more complex, as the investment resources, investment risk, and investment rewards are shared with or transferred to an assemblage of diverse stakeholders under specific terms of the contracts. In particular, PPP and concessions assume that the private entity is the best partner to assume the risks of: construction costs, construction schedule, maintenance costs, latent defects, and construction quality (5).

Investigation of claims for damages, or deficiencies of facilities constructed, administered, and/or operated under concessions create unique and complex circumstances for forensic engineers, as the aforementioned contractual structure and risk allocation is different from traditional construction arrangements. Forensic investigations include determination of the cause(s) of a failure, identification of contributing factors, the assessment of risk, and assistance in mitigation efforts (6). Forensic engineers are not only expected to understand the technical

factors of a failure, but also to understand the legal, contractual, and business practices that played a role in the failure (6).

This paper examines the unique circumstances roadway concessions present to forensic investigations in the private sector. The main purpose of this paper is not to present the empirical field data and cause/origin opinions from the case study, but rather to analyze the contractual and situational complexities the concessions model provides for construction defect claim analysis. The pavement construction and management arrangements discussed in this paper will be of interest to parties involved in privately owned and/or operated transportation facilities. First, an overview of forensic engineering and a literature review of concessions is presented for context. Then a brief summary of construction defects and design defects is discussed for additional background information. Lastly, a case study is provided which illustrates the circumstances the authors encountered when investigating a construction defect claim for a large American insurance company involving a highway concessions in Chile.

PRIVATE SECTOR FORENSIC ENGINEERING

Failure of constructed facilities can be defined as “an unacceptable difference between expected and observed performance” (7). The term “failure” need not coincide with a complete collapse of a structure, but simply involve an “unacceptable difference” between actual conditions and the reasonably anticipated conditions.

In the private sector, forensic investigations may be commissioned by stakeholders, such as owners, public entities, insurance companies, and other involved parties, to help determine the reasons constructed facilities fail or are not performing as intended. Although the terms “forensic investigation” and “forensic engineering” are often utilized anytime scientific or engineering expertise is applied to a causal investigation, the American Society of Civil Engineers (ASCE) suggests that the term “forensic engineering” be defined as applying engineering principles, education, and knowledge to problems where legal liability may be decided in a legal forum (6). Furthermore, ASCE provides that the “possibility that a forensic engineer will be retained as a consultant or expert in a legal proceeding distinguishes forensic engineering from other engineering disciplines...” (6). As a result, forensic engineers tend to be retained most often by the private sector, such as insurance companies, as opposed to public agencies.

These private sector entities hire forensic engineers for independent, third party investigations in which the forensic engineer has no stake in the outcome. As independent work, the forensic investigation may have implications in quasi- or formal legal proceedings such as settlements, arbitrations, and formal litigation. Insurance companies may utilize forensic engineering reports to help determine specific claim settlements, as well as for data to assess overall exposure and strategies for their product lines. Furthermore, the realm in which forensic engineers practice can sometimes be adversarial, as the assignments typically request, at the least, cause/origin determination and the identification of culpable circumstances and factors. At times, the investigation may even determine that the contributing factors of the failure were the result of the own party which commissioned the forensic investigation in the first place. In almost all cases, the forensic investigation must work against the constraints of time, as the schedule is predetermined by the client based on strict insurance or legal deadlines. As much field data as possible must be collected in a short period of time, as forensic engineering investigations typically are not granted the convenience of abundant time for field observations,

numerous site visits, or access to the involved parties. It also should be stressed that forensic engineers must be adept at understanding claims processing, legal proceedings, contractual relationships, and regional industry practices, including various business arrangements. It is with this context that affects how forensic investigations are practiced relative to other aspects of engineering, such as design, research, and consulting.

LITERATURE REVIEW

Initially, concessions were devised to construct and maintain infrastructure outside the public budget with private capital (4). However, more recent experience has shown that many PPP models have not always produced the expected financial benefit to the public, because the actual cost of concessions was greater than initially projected (3). Additionally, the concessions transfer risk from the public entity to the private entity, thus tapping into private sector efficiency. Because of the large scale of the projects and longevity of the contract terms, proper allocation of risk is a primary factor for success of concessions contracts (4), and has been the topic of published research papers in recent years.

The main risks that have traditionally been identified and examined in published literature are construction costs and operation costs, which are typically allocated to the private sector under the concessions model. User demand, or traffic risk, is also examined in recent published literature. User demand factors into operation cost and revenue, as does maintenance costs. Traffic risk is difficult to allocate because it cannot be controlled by a single entity or factor. Economic fluctuations, such as growth of gross domestic product (GDP) and competing transportation alternatives, are factors that influence traffic volumes and cannot be readily controlled (or predicted) by the concessionaire. As a result, some concessions have implemented a minimum income guarantee (MIG) mechanism for toll roads. MIG is structured such that the concessionaire shares surplus revenues with the government if the collected revenues surpass a threshold established in the bidding documents. However, if revenues fall below the established threshold, then the government will subsidize the concessionaire. Generally, this type of risk sharing has resulted in increased competitiveness in the bidding by potential concessionaires (4). Proper estimates for future operation and maintenance costs are key parameters of the MIG mechanism. It is important to note that with MIG, the government guarantees revenue flow but not cash flow, as costs are not shared or subsidized. With this arrangement, it is assumed that investors and concessionaires still have an incentive to monitor design and construction, as the type and quality of original design and construction will affect future maintenance and operation costs. Lastly, with concessions contracts, the concessionaire may have an incentive to attract more traffic, since the higher the traffic, the larger the revenues. However, increased traffic results in increased damage to the roadway, which in turn increases maintenance costs. For a detailed mathematical explanation of MIG and traffic demand risk mitigation, the reader is referred to the 2006 work by Vassallo, et al. (4).

In general, risks associated with design, construction, and operation are borne by the private sector for concessions contracts. Depending on the particular concessions arrangement, risks associated with financing may be allocated to the public entity, private entity, or shared by both. While earlier studies identified and focused on only a few types of primary risks, such as construction costs and traffic demand risk, more recent studies have identified and begun to examine numerous other types of risks, such as environmental risks and the many risks associated with operations. In particular, Ke in 2010 (8) provided a list of 46 categories of risk

associated with concessions, and allocated each risk to either the private sector, public sector, or shared. Studies by Heravi in 2012 (9), Cruz in 2013 (3), and Brochado in 2014 (1) noted that risk allocation is constantly evolving in concessions contracts as socioeconomic situations change and as countries gain experience with concessions. For example, Cruz (3) noted both a shift of certain risks from the private sector to the public sector and an overall increase in governmental regulation as the most recent evolutions of concessions contracts in Portugal.

Defective construction is a risk that carries implications in construction costs and long-term maintenance costs, and thus operation and pavement management costs. Although the risk of defective construction is mentioned in a few of the recent technical studies of concessions, it has not been thoroughly discussed, nor has the topic been thoroughly examined from the perspective which carries this risk in concessions projects – that is the private sector. Therefore, the remainder of this paper will discuss the authors' experience with private sector forensic investigations involving defective construction.

DESIGN AND CONSTRUCTION DEFECTS

Defective construction (or construction defect) is a broad causal category (or risk) which is borne by the private sector and is typically insurable in private markets. For example, damages from construction defects may be covered by commercial general liability policies and project-specific warranty policies for contractors and by professional liability policies (errors and omissions) for design professionals. Indemnification and “duty to defend” contractual clauses may further intertwine the various parties in a construction project. Forensic engineers are often asked to investigate construction defects as potential causes of failure of all types of constructed facilities, including transportation infrastructure. In determining who is liable for defective construction, it is necessary to determine whether the defect, or failure, is caused by faulty construction practices or faulty plans and/or specifications. More specifically, faulty construction practices are often referred to as construction defects, while faulty plans and/or specifications are often referred to as design defects. In most construction projects, the designer and constructor are separate entities with separate insurance coverage, and as a result, a forensic investigation must differentiate between construction defects and design defects. In most situations, the contractor is responsible to the owner for defective construction caused by faulty construction practices, unless the defective construction is caused by faulty design (10).

Concessions are unique (and also complex) in that the owner, or public entity, does not assume responsibility for long-term maintenance and operation of the project, although the public entity most likely regulated the design and construction of the project. Therefore, the public entity that may have financed and/or regulated the construction, does not accept the risk of operating and maintaining the facility after construction is complete. In other words, the concessionaire, who does assume the long-term responsibility for maintenance and operation, may not have regulated the design, construction, and/or quality control of the construction project. Concessions provide complex risk sharing arrangements in which construction defects and design defects may factor significantly into future operation and maintenance costs.

CASE STUDY

Americo Vespucio is an urban highway loop serving the Santiago, Chile metropolitan region that is divided into south (sur) and north (norte) sections. Americo Vespucio Norte is the northern

section of the highway and is approximately 29 km in length. The subject case study focuses only on the northern section of the highway, hereinafter referred to as Vespucio Norte. Vespucio Norte is a tolled highway consisting of three lanes in each direction. The driving surface is constructed of hot mix asphalt (HMA). The major portions of the pavement cross sections consist of an HMA surface course over an HMA binder course over a granular base. The highway was constructed in segments between 2002 and 2005 as a concessions contract in the form of build, operate, transfer (BOT) between the government and a private consortium (concessionaire), and represented an approximately \$240M infrastructure investment at that time. In 2009, the authors were retained by an American insurance company to investigate a construction defect claim brought by the concessionaire against the contractor. For the claim, the insured was the concessionaire, who had control of the operation and maintenance of the highway.

Per the concessions contract, the concessionaire is required to maintain the condition of the highway within certain service thresholds based on several parameters. Amongst these parameters are linear cracking, fatigue cracking, rutting, international roughness index (IRI), and skid resistance. A 2009 condition survey report from the concessionaire's consulting engineer - who was not the original designer - indicated that sections of the highway were nearing the service thresholds for some of the parameters, particularly fatigue and IRI, after only four to five years of service. Furthermore, the concessionaire's data showed that traffic was below predicted levels. Thus, the concessionaire concluded that nearing these service thresholds in such a short period of time with less traffic than predicted defined the distresses as premature, and thus a facility failure. The concessionaire contended that the failure was attributable to deficient construction. The contractor, on the other hand, contended that the failure was attributable to deficient design. This resulted in a claim being filed amongst the private entities, and thus the involvement of various private stakeholders with the commissioning of independent forensic investigations.

The contractual hierarchy amongst the parties for construction is presented in Figure 1 and for maintenance in Figure 2. For this project, the concessionaire opted to utilize the MIG mechanism for the contract to help mitigate traffic demand risk. Essentially, with this arrangement, the government guaranteed the concessionaire's minimum revenue flow but not operational cash flow or profit. Thus, while minimum toll road revenues were guaranteed, expenses for maintenance and operations were not capped or shared. Furthermore, in the case of the MIG mechanism, the government predicted all costs associated with upfront investment, operation, and maintenance in calculating the present value of the guaranteed revenues. These predicted values were provided by the government, and the concessionaire chose to receive the guarantee at the time of the bid. Therefore, the concessionaire accepted the risk of the government's predicted values. Further complicating the contractual and claim arrangement was the international diversity of the stakeholders: the Chilean government, a contractor conglomerate consisting of Spanish, German, and Chilean companies, Chilean consultants, and American insurance companies, just to name a few.

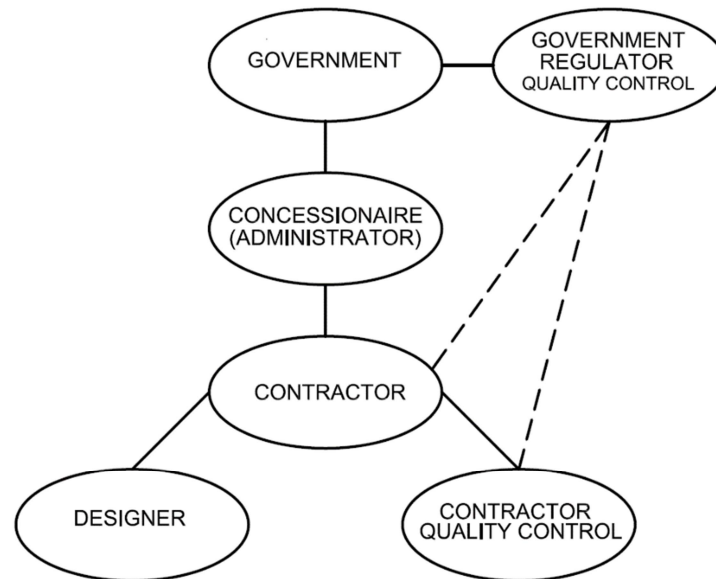


FIGURE 1 Construction hierarchy.

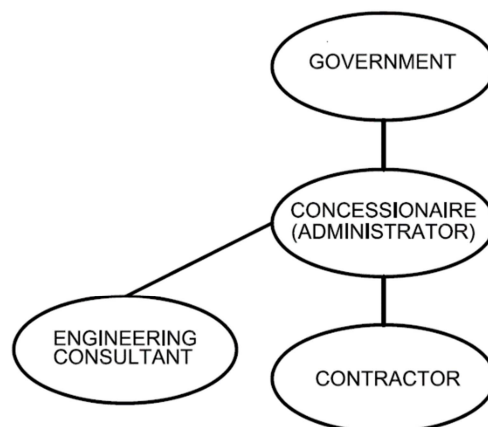


FIGURE 2 Maintenance hierarchy.

As would be expected, the various involved parties provided conflicting opinions as to the cause of the alleged failure. The reported premature distresses were documented and regularly monitored for several years by the concessionaire's consultant prior to the claim. The primary types of premature pavement distresses reported by the concessionaire were linear cracking, rutting, and fatigue cracking.

The concessionaire stated that debonding was occurring between the HMA layers of the pavement due to improper construction, and that the distresses were initiating within or near the bottom of the pavement due to the debonding. The concessionaire surmised that the distresses in the pavement were initiating at the interface of HMA layers due to insufficient pavement structural strength caused by the debonding between layers. The concessionaire's consultant provided supporting falling weight deflectometer (FWD) data, calculations, and coring results. The concessionaire and its consultant attributed the poor bond between HMA layers to the improper application of the tack coat during construction. Testing results were provided by the concessionaire indicating that the HMA thickness, density, and HMA aggregate gradation all met

the construction specifications. The concessionaire also provided that there was no evidence that the sub-base and subgrade layers beneath the asphalt pavement were deficient.

Conversely, the contractor stated that the distresses were due to improper design and material specifications, which resulted in the premature distresses initiating in the top of the pavement (top-down cracking). The contractor asserted that the cracks originated in the surface of the of the HMA pavement and propagated downward through the asphalt layers, which lead to damaging moisture intrusion that eventually broke the interface bond between the HMA surface course and binder course. They alleged the surface cracks occurred due to weakness in the HMA surface course layer, and the weakness was due to deficiencies in design and material specifications.

The empirical portion of the forensic engineering investigation by the authors involved site visits, visual assessments, interviews of the involved parties, reviews of pavement condition surveys, the extraction of 54 cores from representative pavement segments for visual examination and laboratory testing, and dynamic cone penetrometer (DCP) testing of the granular base, sub-base, and subgrade. Each field extracted specimen was visually examined, photo-documented, and measured. Laboratory testing of the field extracted specimens included testing for binder content, aggregate gradation, binder viscosity, binder ductility, binder penetration, moisture susceptibility, and interface shear testing. Furthermore, the original design calculations and materials specifications were reviewed and analyzed. Due to confidentiality and legal ramifications of the claim, the specific results and engineering opinions of the investigation are not included herein.

However, equally important to the empirical evidence was understanding the intricate circumstances of the claim and the concessions arrangement. The subject concessions contract helped mitigate traffic demand risk via revenue sharing between the concessionaire and government, but did not provide mitigation for unanticipated operation and maintenance costs. Furthermore, the government, not the bidding concessionaire, provided the projected costs for the upfront investment, maintenance, and operation. During construction, the quality control entity was via the contractor and regulated by the government. The concessionaire did not have a direct contractual relationship to the designer or the quality control entity. During interviews, the concessionaire stated that traffic volume, and thus revenues, were lower than anticipated, although the minimum revenue guarantee was in-place. Concurrently, the concessionaire stated it was bearing significantly higher operation and maintenance costs than anticipated. The concessionaire concluded that the higher maintenance costs were because the highway pavement was experiencing premature distresses, which were due to construction deficiencies. As a result, the concessionaire sought relief against the unanticipated portions of the maintenance costs by way of the construction defect claim.

CONCLUSIONS

This paper discussed the unique and complex circumstances forensic engineers may face when investigating insurance claims involving concessions contracts. In the case study presented involving a Chilean highway concessions, the MIG mechanism was utilized to mitigate traffic demand risk, in which the government guaranteed a minimum level of revenue for the concessionaire, but did not guarantee operational cash flow. The concessionaire experienced lower traffic volumes than anticipated concurrently with higher maintenance costs than anticipated. The concessionaire concluded that the higher maintenance costs were because the

highway pavement was experiencing premature distresses, which were due to construction deficiencies. As a result, the concessionaire sought relief against the maintenance costs by way of a construction defect claim. The authors were then hired by an American insurance company to investigate the cause and origin of the alleged premature distresses in the pavement per the subject claim.

Construction defects and design defect are risks that are typically borne by the private sector and are insurable in private markets. Concessions are unique in that the owner, or public entity, does not assume responsibility for long-term management of the project. Concessions provide complex risk sharing arrangements in which construction defects and design defects may factor significantly into operation and maintenance costs that are borne by the concessionaire.

In the private sector, forensic investigations may be commissioned by stakeholders, such as owners, public entities, insurance companies, and other involved parties, to help determine the reasons constructed facilities fail or are not performing as intended. Forensic engineers are not only expected to understand the technical factors of a failure, but also to understand the legal, contractual, and business factors that may have contributed to the failure. In cases involving concessions, equally important to the empirical data is understanding the intricate circumstances of the claim and arrangement of the concessions contract.

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