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A dig into the past: the first tieback wall

Alberto Ortigao[1#], Paulo Henrique Dias[2], Hélio Brito[3], Marnio Camacho[4]

Case Study

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Abstract

This is an investigative work by the authors, all of them former students and employees at Tecnosolo Ltd, the company founded by our late Professor Costa Nunes, to find and photograph the first tieback wall designed and built in 1957 by Tecnoloso under Prof Costa Nunes' guidance.

1. Introduction

This is a story of digging into the past, which the Authors embarked on and eventually had a successful outcome on 26 June 2023.

In the late 60's the first three Authors were undergraduate students at the Federal University of Rio de Janeiro, while the fourth Author, 10 years senior, was a practising geotechnical engineer working at Tecnosolo SA. This company was founded in the early 50s by the late Engineer and Professor Costa-Nunes (1917-1990) – researcher and pioneer in ground anchors.

In his classes, Costa Nunes (Figure 1) talked about the first tieback wall built in 1957. He mentioned it was built at the site of an old 19th-century hospital named "Beneficiência Portuguesa" in the city centre of Rio de Janeiro, and 1958 in Germany.

Weatherby (1982) and Hunt & Costa Nunes (1978) reported that permanently tied-back walls have been the most common method of slope retention in Brazil since 1957. After 1958 tiebacks found their way into Europe in Germany (Jelinek & Ostermayer, 1966; Jelinek & Ostermayer, 1967) and later in Switzerland, England, and France (Ranke & Ostermayer, 1968; Dupeuble & Brulois, 1969; Descoeudres, 1969; Littlejohn, 1980).

The first permanent soil tiebacks in the United States took place in 1961 (Jones & Kerkhoff, 1961).

The Authors were engineers and colleagues at Tecnosolo since the early 70s and recently realized that no photographs of this early wall survived. This is the story of a quest to find this wall.

Figure 1. Professor Costa Nunes.

2. A quest to find a wall

The first Author contacted several old colleagues from Tecnosolo, but only the second Author, aka PH, knew exactly the wall location, as he had visited the site long ago. The other Authors shared information about this first wall.

Today it is located between an old and the recent hospital building (Figure 2 and Figure 3) and it is difficult to access, hidden between two buildings (Figure 4).

Corresponding author. E-mail address: ortigao@terratekinc.com
[1] Terratek, Rio de Janeiro, RJ, Brasil.
[2] Seel, Rio de Janeiro, RJ, Brasil.
[3] Consultor independente, Rio de Janeiro, RJ, Brasil.
[4] Pesquisador independente, Belo Horizonte, MG, Brasil.

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Figure 2. Site view, foreground: the old Beneficiência Portuguesa Hospital, at the back of the Gloria D'Or Hospital in Rio de Janeiro city centre.

Figure 3. 19th Hospital (foreground) and the new hospital building (background).

3. Eureka

On 26 June 2023, the first (AO) and the second (PH) Authors visited the site. It did not take long for PH to find it hidden between two buildings (Figure 4). Eureka!

After conversations with the hospital management, permission was granted for this visit (Figure 5).

4. Description

Figure 6 presents the 6 m high and some 50 m long wall sketches. Hunt & Costa Nunes (1978) described this innovative construction method taken from the top (Figure 7), replacing gravity walls which demanded a lot more excavation volume to be built.

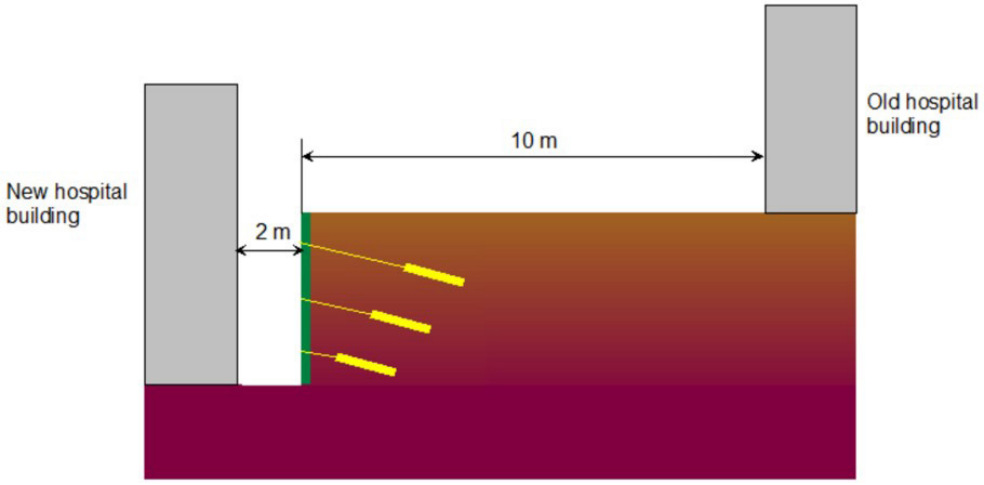

Figure 4. Sketch of the tieback wall location, squeezed into the new hospital building.

Figure 5. Evidence of this “archaeological” digging, left A Ortigao, right PH Dias.

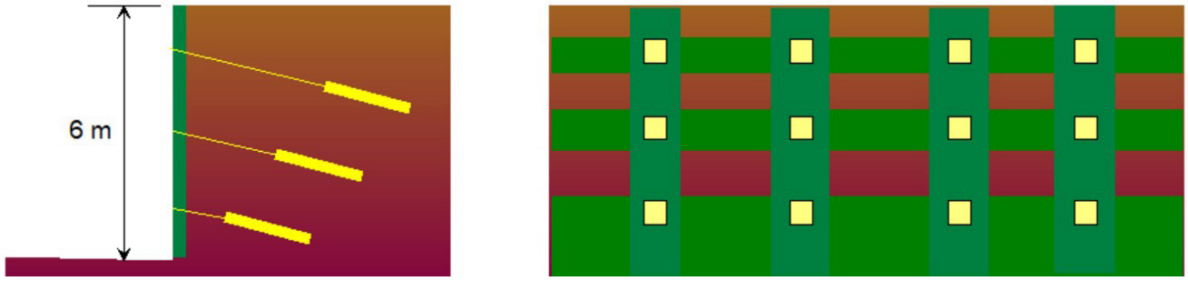

Figure 6. Tieback wall sketch.

Figure 7. Tieback wall pictures.

Professor Costa Nunes once told in his classes that he designed the upper part of the wall with a concrete grid, given the high cohesion of this residual soil. Nevertheless, he changed his design of later walls and used a concrete slab, replacing the grid. “Concrete grid only for rock slopes”, he said.

The Authors found that the ground anchors were 20 mm in diameter, certainly CA-50 steel-grade, which became available a few years before. All anchors were tested to 90% of the steel yield load (170 kN), then reduced to the working load of about 100 kN.

5. Design method

It took a few years for Prof Costa Nunes to publish a paper on the design method of anchored walls, which he did in 1963 (Costa Nunes & Velloso, 1963). They devised a wedge method (Figure 8) and equations which were used in Brazil for the design of thousands of anchored walls, until the advent of computers and limit equilibrium specialized software.

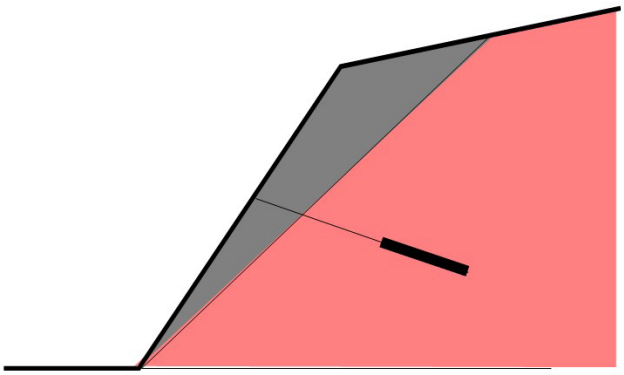

Figure 8. Wedge method (Costa Nunes & Velloso, 1963).

6. Corrosion

Corrosion protection was certainly not an issue in this first tieback wall. Nonetheless, the corrosion level seems quite small (Figure 9), given its 60 years of ageing.

Figure 9. Corrosion is underway.

It was the first of its kind, followed by a series of developments which included corrosion protection, and higher load reduction factors, among others, thanks to Prof Costa-Nunes' ingenuity.

The Authors are very pleased to re-discover this geotechnical engineering milestone and to remember our mentor, the late Prof Costa-Nunes.

Declaration of interest

The authors have no conflict of interest regarding the matter included in this paper. All co-authors have observed and affirmed the contents of the paper and there is no financial interest to report.

Authors' contributions

Alberto Ortigao: writing, reviewing and editing. Paulo Henrique Dias: methodology. Hélio Brito: validation. Marnio Camacho: validation.

Data availability

All data produced or examined in the course of the current study are included in this article.

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