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TREVIICOS

TECHNICAL REFERENCE

SELA 22 & 26

Southeast Louisiana Project

New Orleans, LA
USA

Elliptical JG

Owner:	CITY OF NEW ORLEANS / U.S. ARMY CORPS OF ENGINEERS
Main Contractor:	**Cajun Const.** *(SELA 22)* **Renda/JBros. JV** *(SELA 26)*
Duration of works:	**2014 - 2019**

Introduction

Public safety has always been the **United States Army Corps of Engineers'** top priority. One of these priorities is, without any doubts, the **Southeast Louisiana (SELA) Urban Flood Damage Reduction Project**, aimed at reducing the risk of flood damages due to rainfall flooding in Orleans, Jefferson and St. Tammany parishes.

The improvements generally support the parishes' master drainage plans and provide flood risk reduction up to a level associated with a 10-year rainfall event. A 10-year event is basically a rain storm that has a 10% annual probability of occurrence and equates to approximately 9 inches of rain over a 24-hour period for our area.

Overall, the scheduled design and construction efforts in Orleans Parish was completed by the end of 2020, whereas all major construction in Jefferson Parish was completed by the end of 2017.

EASTBANK: Project Status

SELA 20 - Florida Ave. Phases 2 & 3
Completed 2021

SELA 21 - Jefferson Ave. Phase 1
Completed spring 2019

SELA 22 - Jefferson Ave. Phase 2 (Dryades to Constance):
completed end of 2016 (JG completion July 2015)

SELA 23 - Napoleon Ave. Phase 2 (Claiborne to Carondelet)
completed summer 2016

SELA 23 a - Napoleon Ave. Phase 3 (Carondelet to Constance)
completed summer 2018

SELA 24 a - Claiborne Ave. Phase 1 (Monticello to Leonidas)
completed summer 2017

SELA 24 b - Claiborne Ave. Phase 2 (Leonidas to Lowerline)
completed summer 2016

SELA 26 - Florida Ave. Phase 4
estimated completion date end of 2023 (JG completion May 2019)*

SELA 27 - Louisiana Ave. (Claiborne to Constance):
completed spring 2019.

Some of the projects comprising the SELA program require ground improvement work to replace the existing soils between parallel lines of sheet piles with a soil-cement mass, with the ultimate goals of eliminating potential under-seepage, providing structural support for the underground concrete box culverts, as well as lateral support for the sheeting systems, and creating a stable and dry work platform for the subsequent operations of excavation, forming, casting, etc.

The **U.S. Army Corps of Engineers (USACE),** New Orleans District, selected the jet grouting technology for the construction of the, so-called, bottom plugs.

For the two contracts it was awarded (SELA-22 and SELA-26), Treviicos South, the US-based branch of the Trevi Group for the southern states, proposed to construct the ground improvement utilizing their proprietary and innovative elliptical jet grout technology, never employed before on a production work in the United States.

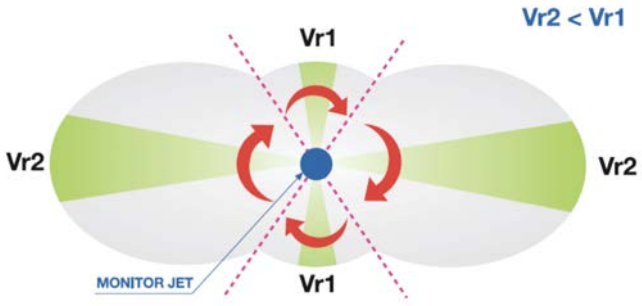
The SELA-22 began in March of 2014 and was successfully completed in July of 2015; its results provided the supporting evidences about the performance of the elliptical system for the SELA-26 project, to be awarded soon after. The ground improvement for this project was, in fact, effectively accomplished between November 2016 and May of 2019.

Elliptical Jet Grouting

Similar to the traditional jet grout technology, where the dimensions of a cylindrical column are achieved by selecting the appropriate combination injection parameters, this innovative elliptical version relies on a very simple concept: alternation of slow and fast rotational speeds.

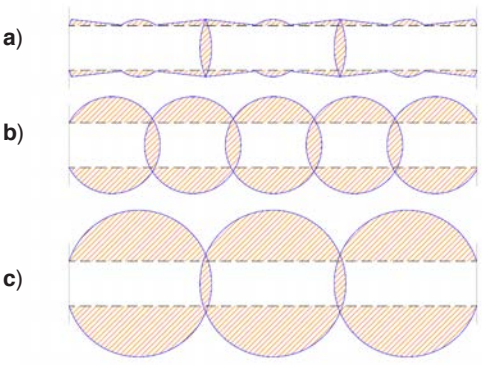
Specifically, when the injection nozzles are oriented towards the designed longer axis of the ellipse *(or column),* the rotational speed of the jet grout rods is reduced in order for the pressurized fluids to act for a longer time onto the soils *(slow sector)*. The exact opposite is accomplished along the designed shorter axis of the ellipse *(fast sector)*.

Like the traditional jet grouting system, the elliptical technology can be performed in single, double and triple fluid configurations.



Benefits of this unique application include:

- **reduced column overlaps;**
- **greater productivity and efficiency;**
- **lower consumption of m aterial;**
- **consequent less CO2 emissions.**

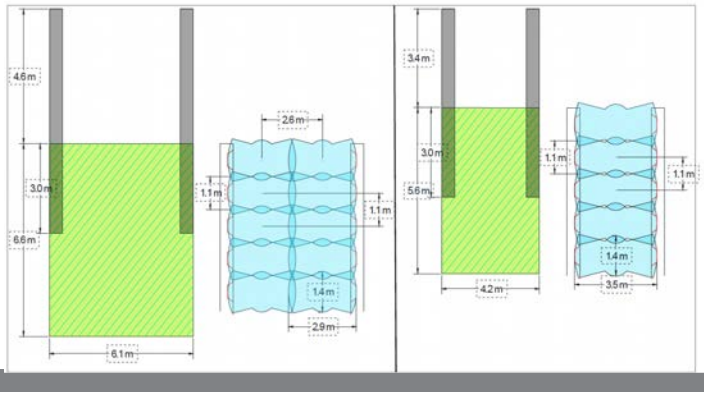


SELA 22

The SELA-22 - Jefferson Ave. Canal II project is located in one of the most urbanized areas of those involved with the program. It stretches for approximately 1,125 m along Jefferson Avenue in Uptown New Orleans, between Dryades St. *(northern boundary)* and Constance St. *(southern boundary*), and additional approximately 645 m along Prytania St. between Nashville Ave. on the west and Jefferson Ave. itself on the east.

The ground improvement was deemed necessary due to the local geology being characterized by the presence of soft to very soft sensitive clays, and silty sands, in combination with the proximity of the Project location with the Mississippi River and a consequent shallow water table *(Mississippi* River stages

Typical column layouts & profile:
Left Jefferson Av.; Right Prytania St.



typically vary between 0 and 4.3 m above sea level with peaks during the spring and summer seasons, while the ground elevation at project location is between 1.2 and 2.4 m above sea level).

The jet grout treatment was designed to cover 100% of the volume comprised between the two parallel lines of sheet piles, with the ultimate purposes to reduce engineering challenges and constructability issues. In fact, it allowed the General Contractor *(Cajun Constructors of Baton Rouge, Louisiana)* to work in a dry and stable environment for the entirety of their subsequent operations *(excavation, cast-in-place, etc.)*, and only required the installation of one level of bracing, as opposed to the traditional retaining systems commonly used in the past in the New Orleans area, where at least two levels of bracing had been required for similar excavation depths

About 2,400 elliptical jet grout columns, for a total horizontal

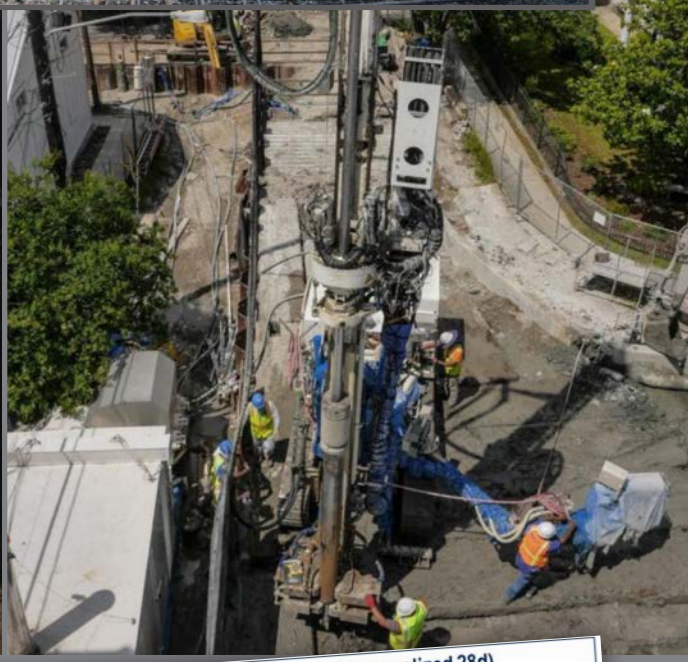
length of the treatment of almost one mile and an overall gross improvement volume of approximately 75,000 cy *(approx. 58,000 mc),* were installed to a maximum depth of approx. 4 0ft *(approx.sem 12 m)* in a very challenging environment, especially under a logistical point of view *(highly urbanized location)*, and in unusual soil conditions *(sensitive and soft clays, plastic clays).*

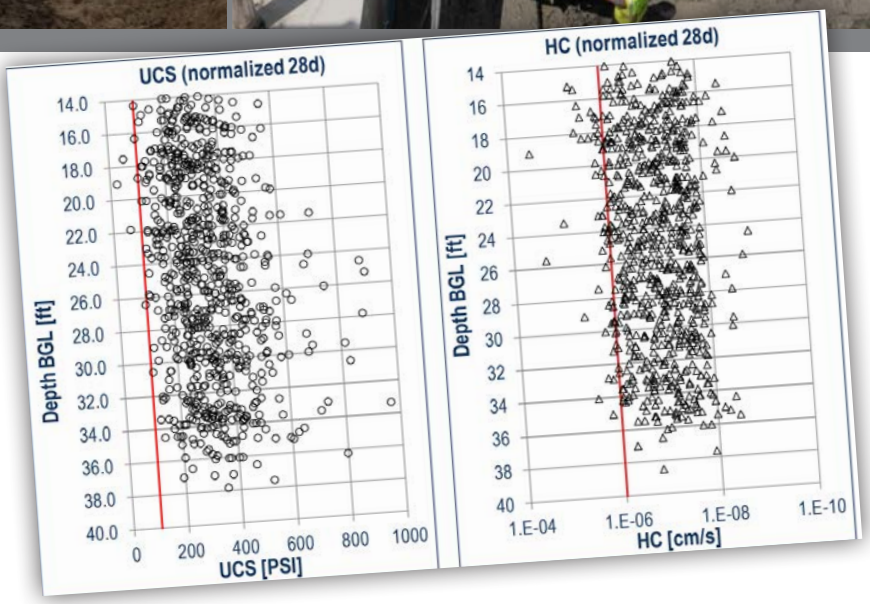
Bi-fluid jet grouting configuration was chosen for the construction of this bottom plug. In particular, based on the different logistical conformation of the Project and the different design criteria, two distinct geometries of the improvement were required :

1) Along **Jefferson Avenue** *(north-south alignment)* the block of improved soils was designed to be 21.5 ft. thick, and 18.0 ft. wide;
2) Along **Prytania Street** (east-west alignment) the block of improved soil was designed to be 18.5 ft. thick, and 11.5 ft. wide.

Quality of the end product was checked by means of continuous coring to be executed on 5% of the installed columns. At intervals of 3.0 ft. of vertical treatment, soil-cement mixture was tested for unconfined compressive strength *(UCS)* and hydraulic conductivity *(HC)* and the 28-days results needed to comply with the minimum design criteria of 100 PSI and $1x10^{-6}$ cm/s respectively.

The elliptical jet grouting solution proposed for the SELA-22 in Uptown New Orleans proved to be efficient and effective in resolving the constructability and engineering challenges it had been designed for. Notwithstanding this was the first time this technology was used in the U.S., and in particular in mostly cohesive soils, it showed high reliability and outstanding quality of the final product.





Q.ty of works: Elliptical jet grouting

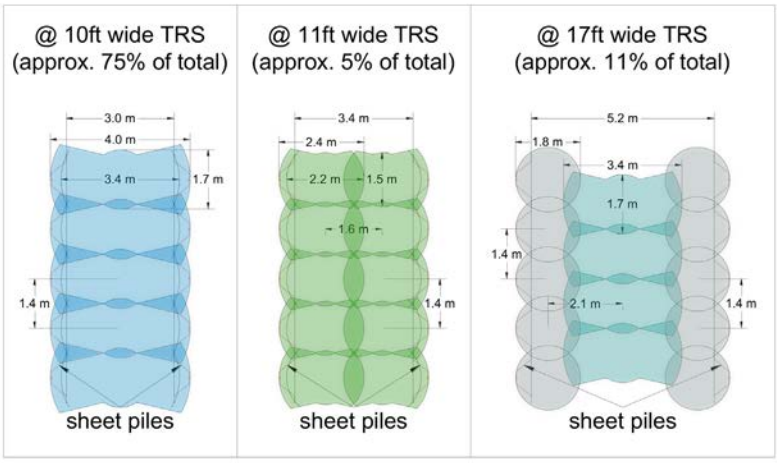
Gross treated volume:	**57,570 m³**
JG elements:	**no. 2400**
Max depth:	**12,2 m**
Binder used:	**21,500 ton**

SELA 26

Similarly to its precursor, the SELA 26 project entailed the construction of a concrete covered canal along six individual stretches, leading into expanded canal systems at Florida Ave and Peoples Ave, and the temporary support of rail line relocation.

Specifically, SELA 26 was located in New Orleans Eighth Ward, St. Roch neighborhood of Orleans Parish developing over nearly 6,400 L-ft treatment on six roads and a railroad block.

Upon previous successful demonstration of elliptical JG technology for the SELA 22 project, in fact referred by the client in early correspondence as ***"the Cadillac of ground improvement"***, Treviicos South's proposal was accepted by the Owner as a valuable alternative to the more traditional



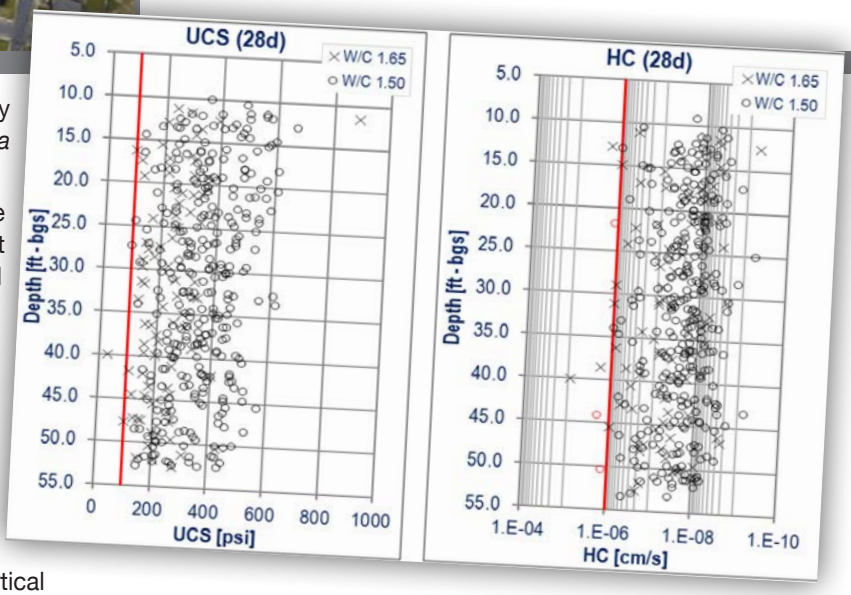
Q.ty of Works: Elliptical jet grouting

Distance treated:	**1940 m**
JG columns installed:	**No. 2178**
Gross volume treated:	**113,120 m³**
Cement used:	**36,500 tons**

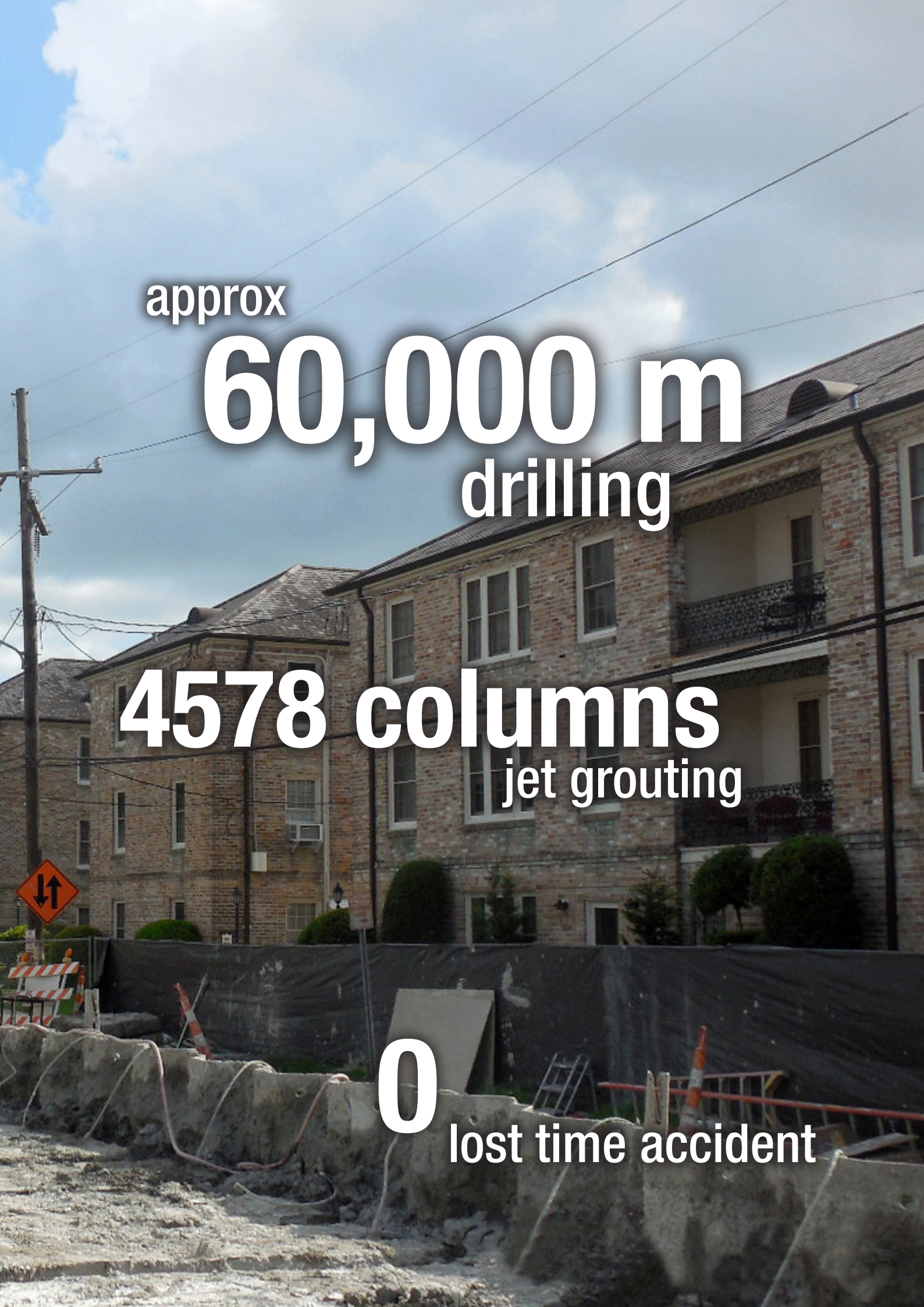
cylindrical geometries and the contract appointed by the General Contractor *(J. V. between Oscar Renda and Johnson Brother's).*

The ground improvement provided 100% volume coverage by means of approximately 2,170 Jet Grout columns, incorporating both varying diameter elliptical configuration *(between 2.2 m to 4 m thus targeting dimensions larger than for SELA 22)* as well as circular columns *(between 0,9 m to 2,45 m)*; total gross treatment resulted in approximately 113,000 m³ with an average depth of 15,85 m below ground surface and a maximum depth of 22,8 m.

Technical and quality requirements in terms of were the same as for SELA 22: coring on 5% of the installed columns, sampling at intervals of 0,9 m of vertical treatment, with samples to undergo unconfined compressive




99,500 m³
total treated area
40,000 tons
concrete used
TREVI
TREVI
soilmec
SM-21
VOLVO


approx
60,000 m
drilling
4578 columns
jet grouting
0
lost time accident

strength *(UCS)* and hydraulic conductivity *(HC)* tests and the 28-days results to comply with the minimum design criteria of 100 PSI and $1x10^{-6}$ cm/s respectively.
At its completion, which was achieved not without challenges under logistical, schedule and security points of view, the SELA 26 proved once again that knowledge, expertise and determination, together with the constant drive for innovative solutions, are the solid basis we shall rely upon for continuous future success in the specialty foundation industry.

Conclusions

The innovative elliptical jet grouting technology, invented and developed to overcome evident technical limitations of the more conventional solutions in specific applications, has the potential to resolve many geotechnical challenges with great benefits in terms of productivity and flexibility.
The successfully completed bottom plug at the SELA22 project in uptown New Orleans, and the ongoing work at the neighbor SELA26 project, proves the effectiveness and viability of the elliptical JG for a broad range of engineering challenges and geotechnical applications. Nonetheless, the experience, knowledge, skills, and resourcefulness of a well-coordinated team, from early design to conclusion, are critical for the success of such endeavors.

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