The Present of ISSMGE and Geotechnical Challenges in South America

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ABSTRACT
This is a brief account of the present of our society in the South American region and the current most important aspects of the geotechnical activity, both in industry and in academia. All of it, within the framework of the celebration of the 75th anniversary from the creation of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

RESUMEN
Esta es una breve reseña del presente de nuestra sociedad en la región y de los aspectos más relevantes de la actividad geotécnica actual, tanto en la industria como en la Academia. Todo ello en el marco de la celebración del 75 Aniversario de la creación de la Sociedad Internacional de Mecánica de Suelos e Ingeniería Geotécnica.

1 INTRODUCTION

The ISSMGE South American Region is one of the geographically larger regions with a significant number of member societies. For this reason there are many soil types involved in regional geotechnical activities, as well as numerous universities involved in the geotechnical engineering education.

Currently, there are thirteen member societies, predominantly speaking Spanish and Portuguese, but soon this number may increase with the incorporation of, for example, French and English Caribbean islands.

Geographical and geotechnical conditions are different from one point to another in the region. Figure 1 shows the geographical division in South America, from coral islands with karst problems in the north, passing through mountainous areas with high prevalence of rock engineering aspects and fly ash soils, large semi-arid regions and tropical materials with unsaturated soil problems, to seashores and glaciers in activity in the south.

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Figure 1. Geographical zones in South America

Therefore, the natural disasters involved are also very diverse. There are areas of intense volcanic and seismic activity, regions with large landslides, salty deserts, collapsible and expansive soils territories, areas with large heavy jungle rains causing flooding, broken glaciers to generating large-scale mudflows.

Finally, South America has some of the most populated cities in the world with the attendant urban geotechnical problems, as well as huge areas with low population density which may need the supply of appropriate infraestructure for development.

The GINI number represents the income distribution in each country. A GINI value near to “1” shows a maximum inequality in distribution and near to “0” an excellent income distribution. Figure 2 shows the distribution of GINI number throghouth the world. In South America that number varies between 0,44 to 0,55 which is similar to all other countries on the America continent.

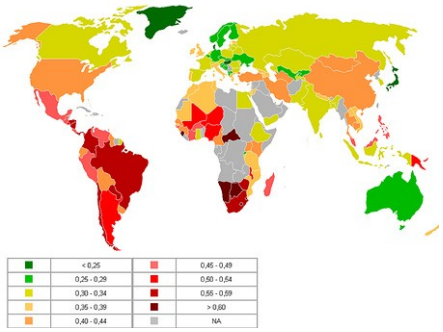

Figure 2. Distribution of GINI number in the world

2 THE SOUTH AMERICA REGION AS PART OF ISSMGE

The ISSMGE South American Region is located from the Central to the Southern part of the American continent. The region includes countries from Central America, the Caribbean and South America, speaking both Spanish and Portuguese. The distance to the other regions ranges between 8500 and 18000 kms, and the maximum

distance from one end to the other of the region is 8000 km (Figure 3). This is a problem that threatens easy communications and exchanges among the member Societies. Our continent is the only one that is subdivided in two regions.

Figure 3. Location of the South America Region

The region has more than 1300 members in the ISSMGE, and they contributed approximately 6% of the ISSMGE`s Subscriptions in 2009. Members of the region, from Argentina, Brazil, Chile and Peru, are involved in more than ten TCs, such as “Unsatured soils”, “Laboratory testing”, “Underground construction”, etc., with a significant involvement in each one.

The chair of the TC on “Megacities”, is located in the region (Prof. A. Negro of Brazil). Prof. Victor De Melo, President of the Brazilian Society and formerly VP for South America, was one of the more representative presidents of the ISSMGE.

As is shown in Figure 4, the region is composed of 13 member Societies representing as many countries. Some of them are very old such as the Argentinian Society which is 63 years old, and some very recent such as Dominicana Society created just 4 years ago.

There are now three Countries that have expressed interest in joining the ISSMGE. Guatemala has already completed the paperwork and from next year hopes to become a new member.

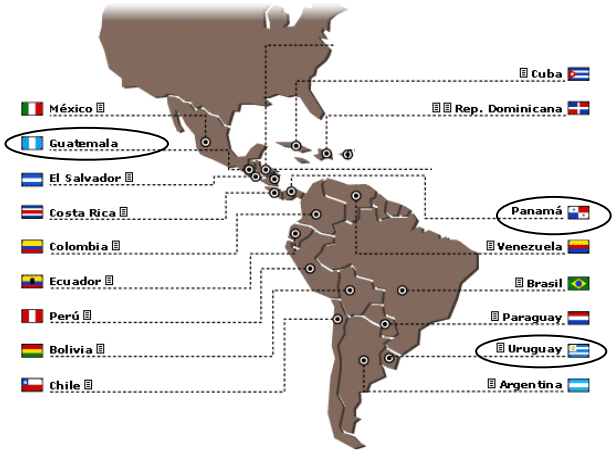

Figure 4. Geographical distribution of Member Societies

The number of members on their own it is not a reliable indicator. In this order, Table 1 shows the members of each society per million of inhabitants by country.

Country	Member per million of habitants	Average for South America
Cuba	1,8	3,5
Rep. Dominicana	3,4	
El Salvador	5,3	
Costa Rica	6,7	
Venezuela	0,9	
Colombia	0,5	
Ecuador	3,4	
Peru	0,9	
Brazil	3,7	
Bolivia	2,6	
Paraguay	9,5	
Chile	4,3	
Argentina	2,0	

Table 1. Member per million of habitants

The average for South America is 3,5 while for the whole ISSMGE is approx. 11. In one sense this index measures the degree of geotechnical engineering development of a particular region. Table 2 is a summary of the Situations, Issues and Challenges in South American Region.

Situation	Issues	What To do
2011 Pan Am Conference (Only Regional Conf. for 2 regions)	Low participants from the non host region. Economic asymmetries	Work together. PanAm Commitee Meeting in August 2010
Poor interaction between Societies of the region	Overlay of Conferences. Not optimized itinerant seminars and courses	Build up a calendar of events. Improve personal contact. Regional events.
Lack of communication between authorities	Misunderstanding and wariness among societies	Metings of Presidents of South American Societies
No official web page	Poor interaction between VP and member societies	Web page, with information, calendar of events, reports of TC members, etc.
Unbalanced participation in TC´s Commitees	Some Societies are not aware of these activities	Promote societies. Publish reports of TC´s members
Countries not members ISSMGE	Many Geotechnical Engineers not integrated	Promote the creation of local societies (SGG-SUG-CPG)

Table 2. Regional challenges

The following is a list of the activities in the region during 2010 and the first months of 2011:

- 4 National Conferences (Argentina, Brazil, Colombia, Venezuela)
- 2 International Conferences (Brazil, Chile)
- 8 International Seminars and Courses (Argentina, Brazil, Chile, Colombia, Ecuador, Perú, Dominican Rep.)
- >20 National Seminars and Courses (Argentina, Brazil, Chile,Colombia, Ecuador, Dominican Rep.)
- 2 Reports on Chile`s Earthquake (SoChiGeo-GREE / CICCba-SAIG Argentina)
- 1 International Publication (Soils & Rocks in English and Portuguese) + 8 Local Publications (hard copy and e-versions in Spanish) (Argentina, Brazil, Colombia, Costa Rica, Ecuador, Perú, Venezuela)
- Annual Meeting of the Panamerican Committee (Brazil)
- First Meeting of Societies from South America (Brazil)
- First Web Page of the Vicepresidence.

A special mention is made of the meetings of the region´s societies in August of 2010. All the representatives of the Member Societies could discuss their issues, and found the solutions together.

3 THE PRESENT IN THE GEOTECHNCIAL ENGINEERING ACTIVITIES

3.1 Professional Aspects

The South American region in recent years generally shows a sharp increase in government involvement in the development of local infrastructure, all of which is due to the increase of the prices of commodities.

The economic activities with most development currently are those related to mining, in Chile, Peru, Colombia, Dominican Republic, Brazil, and more recently Argentina. Figure 5 shows the distribution of mining production in the world, and relative incidence of South America.

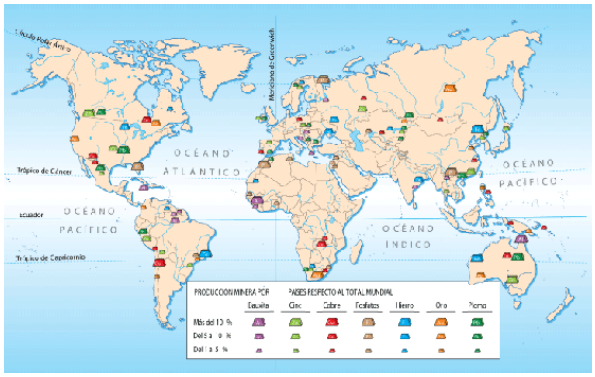

Figure 5. World distribution of mining production

The use of energy resources like hydroelectric projects or oil and gas exploitation in different zones such as forested areas in Ecuador and Venezuela, mountain in Bolivia, the patagonian desert in Argentina or the continental shelf in the case of Brazil and the export of industrial products and agri-food in all countries of the region. In Figure 6 the distribution of oil and gas deposits is presented, and the use of hydroelectric energy in the region.

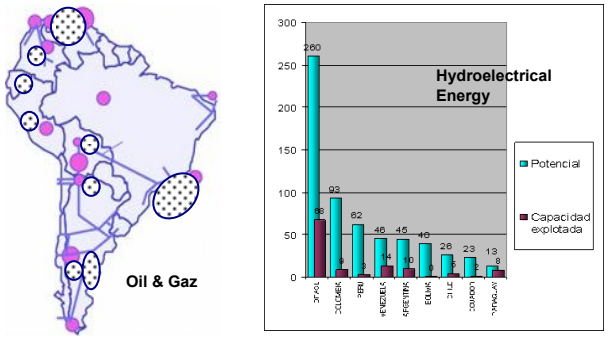

Figure 6. Oil and Gas depositis & use of hydroenergy

For these activities it is necessary to build extensive infrastructure including railways, roads, ports, factories, tunnels and large excavations.

Currently there are projects in development for two tunnels over 40 km long to cross the Andes, linking Argentina and Chile, the enlargement of the Panama Canal (figure 7), new ports and steel plants in Brazil, Argentina and Venezuela, large hydroelectric plants in Ecuador and Colombia. Figure 8 shows one of this.

New sections of international roads are under construction in El Salvador, Nicaragua and Panama.

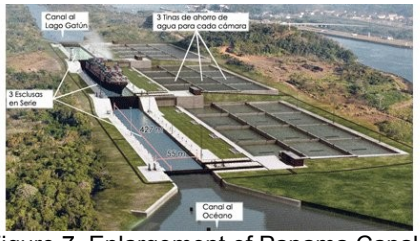

Figure 7. Enlargement of Panama Canal.

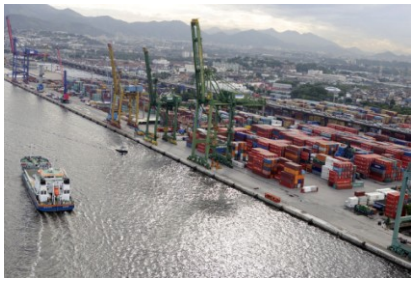

Figure 8. New Port in Rio de Janeiro, Brazil.

The region has more than 70 cities with populations of over one million inhabitants, which need to be provided for. Figure 9 shows the distribution of largest cities.

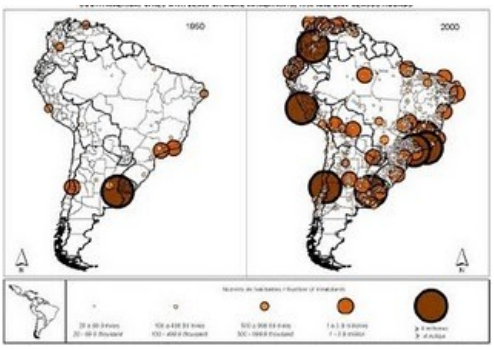

Figure 9. Distribution of main urban areas

There are a number of mega urban development projects involving the construction of large buildings with several levels of basements that occupy the area equivalent to a small town. Figure 10 shows an excavation for basements in an office building.

Figure 10. Seven level basement excavation in Lima, Perú.

The new urban developments need mass transportation, subways and urban trains in Venezuela (figure 11), Argentina, Brazil, Panama, and Peru.

Figure 11. Subway construction in Valencia, Venezuela

New power plants in Argentina, Brazil and Venezuela. Figure 12 shows a new thermoelectric power plant.

Figure 12. Timbues Power Plant in Santa Fe, Argentina.

New water supply networks and sewage in Panama, Peru and Venezuela, and oil & gas pipelines between Bolivia, Argentina, Brazil and Chile. Figure 13 shows the excavation of a shaft for a sewer tunnel.

Figure 13. Shaft excavation for sewer pipeline in Panama

Finally, the natural disasters in the region are very diverse, ranging from volcanic and very strong seismic zones (Chile, Peru, Haiti and Nicaragua), to hurricanes affecting the Caribbean islands and Central American countries, as shown in Figure 14.

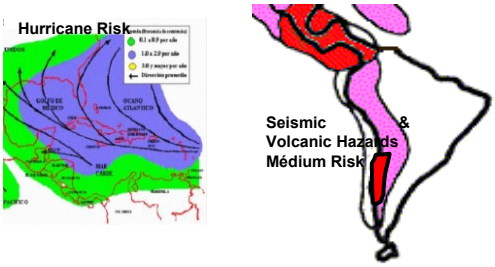

Figure 14. Volcanic, Seismic and Hurricane Zones

Several of the megacities such as Rio de Janeiro, Santos, Valparaiso, Lima, Buenos Aires, Panama, Guayaquil, Recife, Havana, etc., are located at sea level and subject to conditions related to global climate change.

All these activities must be accompanied by studies, design, consulting, engineering projects that test the capability of regional specialists and even requieres support from colleagues from other ISSMGE regions.

3.2 Academic and Research Aspects

There are among 100 universities in the region teaching civil engineering. Nine of them are among the best 400 in the world as ranked by the Academic Ranking of World Universities (ARWU), which takes into account the quality of education, quality of schools, published research and the size of the institution. Table 3 shows the best ranked universities.

RANKING	INSTITUCIÓN	PAÍS
1	Universidade de São Paulo	BRA
3	Universidade Estadual de Campinas	BRA
4	Universidad de Chile	CHI
5	Universidade Federal de Santa Catarina	BRA
6	Universidade Federal do Rio Grande do Sul	BRA
7	Universidade Federal do Rio de Janeiro	BRA
8	Universidad de Buenos Aires	ARG
9	Universidade Federal de Minas Gerais	BRA
10	Universidade Estadual Paulista	BRA

Table 3. Best Ranked Universities in the region

Several engineering schools in South and Central America have graduate studies granting doctorates and master's degrees in geotechnical engineering. There is an important exchange of graduate students from several of these universities, especially in South America. This is being extended by scholarships in countries like Brazil, Argentina and Chile, aimed at students from the rest of the South American region.

Geotechnical investigations are varied as they take into account local soils, structural requirements and natural hazards cited in the previous section, as well as actions related to them. In 2006 the International Journal of Natural Disasters and Civil Infrastructure (RIDNAIC), edited by the University of Puerto Rico, published a compilation of the most important research carried out in regional soils in South American research institutes. It is shown in Table 4.

Research	Authors	Institution
GEOTECHNICAL ASPECTS OF THE PARANA RIVER DELTA AND RIVER PLATE ESTUARY	Victor Rinaldi and Ernesto Abril	National University of Cordoba, Argentina
GEOTECHNICAL CHARACTERISTICS OF THE LOESS OF ARGENTINA	Ricardo Rocca, Emilio Redolfi and Roberto Terzariol	National University of Cordoba, Argentina
SOILS DERIVED FROM VOLCANIC ASH IN COLOMBIA	Arsenio Lizcano, Mario Herrera and Carlos Santamarina	University of Los Andes, Colombia
GEOMECHANIC CHARACTERIZATION OF COARSE GRAINED SOILS	Ramón Verdugo and Karem de la Hoz	University of Chile, Santiago de Chile
DYNAMIC ALLUVIAL DEPOSITS IN COLOMBIA	Adolfo Alarcón, Jesús Garcia and Fernando Díaz Parra	National University of Colombia

Table 4. Research on regional soils

The list should also include the studies in terms of landslides in Central America and Brazil, tropical and soft soils in Brazil and Colombia, seismic problems in Chile, Dominican Republic and Peru, and rock engineering in Costa Rica, Argentina and Peru.

A remarkable fact was pointed out during the GeoFlorida 2010 conference, when D. Laefer and D. Mc Hale, in their paper "America`s research active, geotechincal faculty members - a snapshot of the community" shows that 11% of geotechnical teachers in USA come from abroad, emphasizing the South American contribution.

Some of these professors currently teaching, are Carlos Santamarina, Jorge Zornberg, Dante Fratta and Pedro Arduino, all from Argentina, Rodrigo Salgado from Brazil, Giovanni Cascante, from Costa Rica, and Juan Pestana, from Venezuela, among others.

4 FINAL REMARKS

- This article shows the reality of the geotechnical community in the South American region of ISSMGE.
- It has attempted to highlight the strengths and show the great efforts being made to overcome the weaknesses.
- The region has countries that have reached a great maturity in the development of geotechncial engineering, and others that must be supported to encourage their growth.
- Professional work as well as the academic and research activities show a development in keeping with the global context of geotechncial engineering.
- The above discussion shows the strength and the maturity of the Geotechnical Engineering in the region and the efforts of each Member Society.

ACKNOWLEDGEMENTS

The writers would like to acknowledge the contribution of Ministry of Science and Technology of the Government of Cordoba, Argentina.

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