

**Cologne University of Applied Sciences**  
**Department of Civil Engineering and**  
**Environmental Technology**  
**Chile, September 1-9, 2018**



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All participants wish to express their sincere gratitude to the following individuals for hosting us at their company and sharing their time, professional expertise and enthusiasm with us. Thanks to all of you.



Johanna Sternberg, Cámara Chileno-Alemana de Comercio y Industria, Santiago  
Pablo Guindos, Raúl Álvarez Medel, José Luis Salvatierra, Universidad Católica de Santiago  
Laure-Helene Filhol, Dieter Albertz, Claudio Mancilla, Metro Santiago  
Mariana Ávalos, Hector Díaz, Marti Headquarters LatAm, Santiago  
Rene Lagos, Claudio Gahona, Rene Lagos Engineers, Santiago  
Arturo Castillo, VMB Ingeniería Estructural, Santiago  
Sebastian Fingerhuth, Pablo Eduardo Alcaino Reyes, Universidad Católica de Valparaíso  
Alberto San Martín S., Tecnofast, Santiago  
Marcela Vidal Vega, Maureen Trebilcock, Ricardo Hempel, Universidad de BíoBío, Concepción  
André Côté, Ignacio Vial, SIRVE S.A., Santiago

The group is also thankful for generous travel stipends awarded to the students by the International Office and the Department of Civil Engineering and Environmental Technology of Cologne University of Applied Sciences.

Cologne, December 2018

Ansgar Neuenhofer

Hannelore Damm

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# Saturday, September 1

## Bicycle Tour On The Easter Island

After a five-hour flight we finally arrived on the Easter Island early in the morning. As the sun was already up and the sky was only partly cloudy, we were able to view the beautiful landscape from our plane seats. After we checked in at our hostel, our discovery tour led us to Hanga Roa – the only town on this Island. On a side street we stumbled upon a small market with a variety of food including a lot of fruits unknown to us. At a bicycle rental we were able to get bikes for our tours on the following days.

The *Easter Island* or *Rapa Nui* – how it is called in the language of the natives – is a South Pacific Island with volcano origin. *Maunga Puakatiki* is the



Mataverí Airport

oldest of the three volcanos and forms the eastern part of the island. Thereafter the *Rano Kau* arose in the Southwest. Both volcanos were eventually connected through a third one – the *Maunga Terevaka*. Today the island has a 160 km<sup>2</sup> large surface and harbours around 6.000 inhabitants which mainly earn their money through fishing and tourism. They mostly live in *Hanga Roa*.



Rano Kau



Maunga Terevaka

The Island is known for its statues – the *Moai* and attracts many tourists every year. Scientists are still divided over the *Moai*'s age. The year dates mainly vary from 400 to 1200 AD depending on the localization of the first settlement phase. Radiocarbon samples originating from the statues that can be found today date their origination between 1400 and 1600 AD.

Their purpose is also an object of discussion. Today it is assumed that they represent worshipped leaders and ancestors acting as connection to the afterlife. Depending on the size and costs they may have also acted as symbols of power and authority.



inhabited caves

Now only the eye sockets can be seen, but originally the natives placed eyes in there - made out of white corals and either black obsidian or red scoria pupils. Broken fragments have been found on various sites. The *Moai* presumably have been painted but lost their colour over time.



Ahu Tongariki, ceremonial site near the eastern shore



# Sunday, September 2

## Discovering Santiago

As there was no official program this Sunday, we had some free time to discover the neighborhood of our hostel.

The hostel is located in the "Barrio Providencia" which is almost the center of Santiago. And close to the "Plaza de Armas".

Crossing the "Rio Mapocho" the "Barrio Bellavista" shows off its creativity. There is not even one wall which is not covered with colorful Street Art.

Going through Bellavista, "la cascona" right beneath the "Parque Metropolitano", was one of the houses of the famous poet Pablo Neruda. Neruda was a great lover of the sea, so the dining room is modeled on a ship's cabin and the living room on a lighthouse. Neruda receives 1971 the nobel prize in Literature.



Street art in Santiago



The best sweeping views over Santiago that we got so far, were from the peaks and viewpoints of the "Parque Metropolitano" also known as "Cero San Cristobal". At 722 hectares, the park is Santiago's largest green space, but it's still decidedly urban: a funicular carried us between different landscaped sections.



Santiago de Chile

Another group of us took advantage of the free day and drove with a rental car to the nearby Andes to the 2,500 m high "Embalse el Yeso" in the nearby Andes Mountains.

In wonderful weather, we enjoyed the landscape on the three-hour drive and also a typical Empanada could not be missing. Arrived at the reservoir, we were surprised only by the sheer mass of visitors, but later found a nice place to stop, further up the valley. From there we walked a bit up the slopes and had the perfect view of the lake and the surrounding Andes.



Embalse el Yeso" near the Andes



# Monday, September 3

## German Chilean Chamber and Universidad Católica Santiago

To get an overview of the day a table with the planned program points is shown at the right side.

The day started at 7:30 at our Hostel. After a short trip with the metro we arrived at the German Chilean Chamber of Commerce (CAMCHAL), where we heard a presentation. We got information about the services the Chamber provides. They can help you to participate in the Chilean market activities, support you on legal and tax issues, or other services you need to expand your business to Chile. We also learned some more general information about the Chilean history, their economic situation and their biggest trading partners.

The Chilean economy depends nearly completely on the export of raw materials like copper, fruit, wine, fish and wood. A big problem of the Chilean society is, that universities are very expensive and that they don't have a dual education system in practical jobs like in Germany.

We also learned that Germany is well regarded amongst the Chilean. Germans workers are very welcome because of their working attitude and the good training they got in Germany.

After the presentation we took the metro to the Universidad Católica Santiago one of Chile's oldest and one of the most recognized educational institutions in Latin America. The timber construction professor picked us up and we followed him to his lecture hall. The theme of the class on that day was earthquakes and dynamic loads and their impacts on buildings and also possible protection measures.



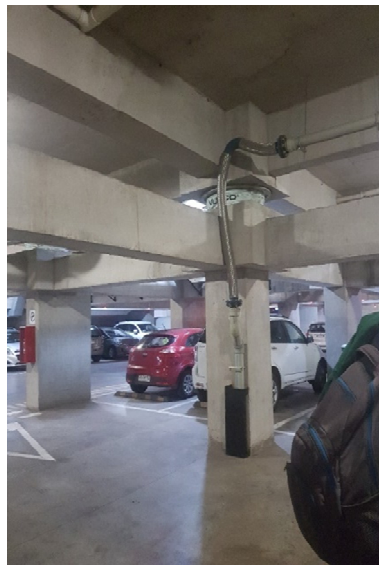
Lecture at Universidad Católica de Santiago

At lunch hour we got a large selection of menu at the university.



Lunch at the university

Afterwards we went to the underground car park of the university building. This part of the building is structurally separated from the upper floors. In case of an earthquake the building starts moving, however the separation reduces the movement in the upper floors. The two following pictures show the construction.

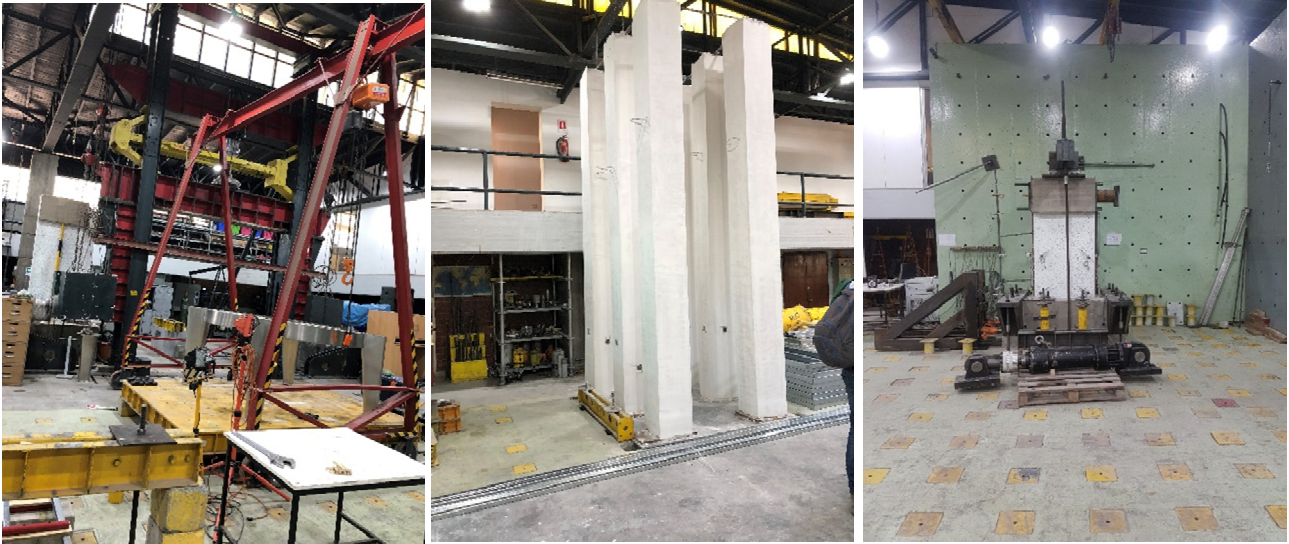


Construction elements of the carpark at Universidad Católica de Santiago



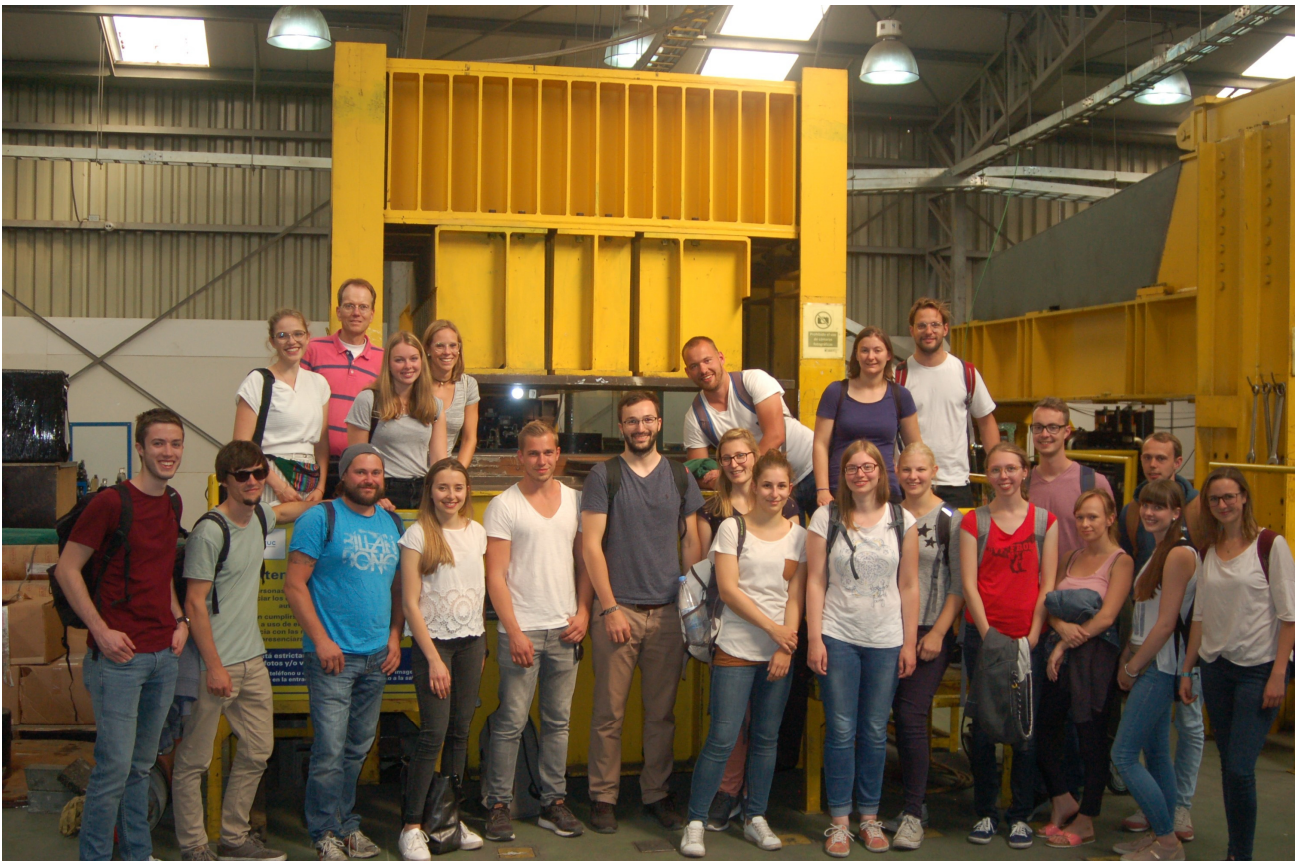
Furthermore, we visited the dynamic testing lab. Wall elements, columns and other parts of buildings are tested there. The pictures below show an impression of the equipment.

The previously described structural separation of the underground is tested in another private laboratory. It is also located at the university ground. There we took a group photo in front of the laboratory equipment.



Dynamic testing lab of the Universidad Católica de Santiago

At the end of the day we enjoyed another course. The topic was wood buildings in Chile, especially already realized buildings and planed buildings.





# Tuesday, September 4

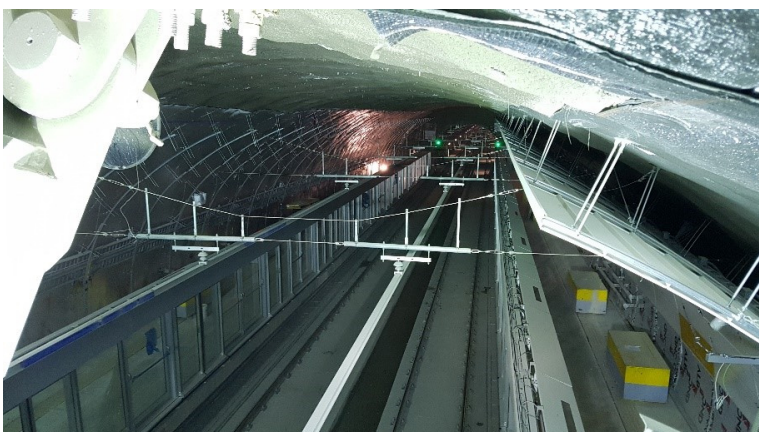
## Metro de Santiago, Marti Office and Chilean Chamber of Construction Building Visits

It was Tuesday at 8 am and rush hour at the metro station Baquedano, where we started. We've been up for a visit at the central of the Metro de Santiago. Mr. Albertz, who emigrated from Germany into Chile eight years ago, gave us an introduction to the company.



Monitoring center of the Metro de Santiago

The railway network of Metro Santiago is one of the most modern railway systems in Latin America. Some of the trains drive automatically without a human facility on board. In addition to this autonomous system, this particular network is also the third largest in Latin America. Momentarily it is composed of six lines with 118 stations and 118 kilometers of revenue route. Mr. Albertz gave us an interesting view about future plans. Some lines will be extended, which will lead to an increase of destinations and daily connections. Moreover Mr. Albertz invited us to have a look at the monitoring center where all trains and all stations are monitored. In addition to general supervisors a police man is available to increase the level of safety. It is also an important place when there is an earthquake because they decide what to do then, maybe to stop the trains. But Mr. Albertz told us, that down in the metro is one of the most safe places during an earthquake.



Construction site of a new Metro station in Santiago

After finishing this interesting presentation, we moved over to the construction side of a new Metro station. The special feature of this station is a wall manufactured of glasses between the stationary train and the boarding passengers. If a train is in the station, some doors open in the glass wall. If the train leaves the station, the doors close, so that no incursion of the track system by humans are likely to occur. An additional interesting system is providing people with tickets that are only available at a slot machine.

At noon some of us had lunch at the Costanera Center. It was full of people, because they all wanted to eat lunch. But there is a huge variety of shops and also a big place, where the people can have lunch.



To learn something about the design and construction of the Costanera Center we went to the Latin American Headquarter of the Swiss construction giant Marti. At their office, René Lagos, the CEO of René Lagos Engineers together with Claudio Gahona, one of his colleagues, gave us a breathtaking presentation on the Costanera center. Mr. Lagos explained to us a lot about the design and construction of this landmark structure, one of the tallest buildings in the southern hemisphere. His presentation was particularly focused on aspects related to the seismic design (in Santiago people sometimes feel several earthquakes a week). At first he told us that the Costanera Center not only consist of the tower. There are also some smaller buildings around, which now include a shopping center. Because of this large area, the Costanera Center is subdivided in four sections. They had a strict plan at which time they build which part of this area.

Following Mr. Lagos, Mr. Castillo of VMB Ingeniería Estructural talked about the design of the tuned mass damper (TMD) in the Chilean Chamber of Construction (CChC) Building. The fundamental idea behind a TMD is to positively influence the vibration properties of the building such as amplitude and frequency. A simple mathematical model of the combined building-TMD system is that of a two-degree-of-freedom oscillator.

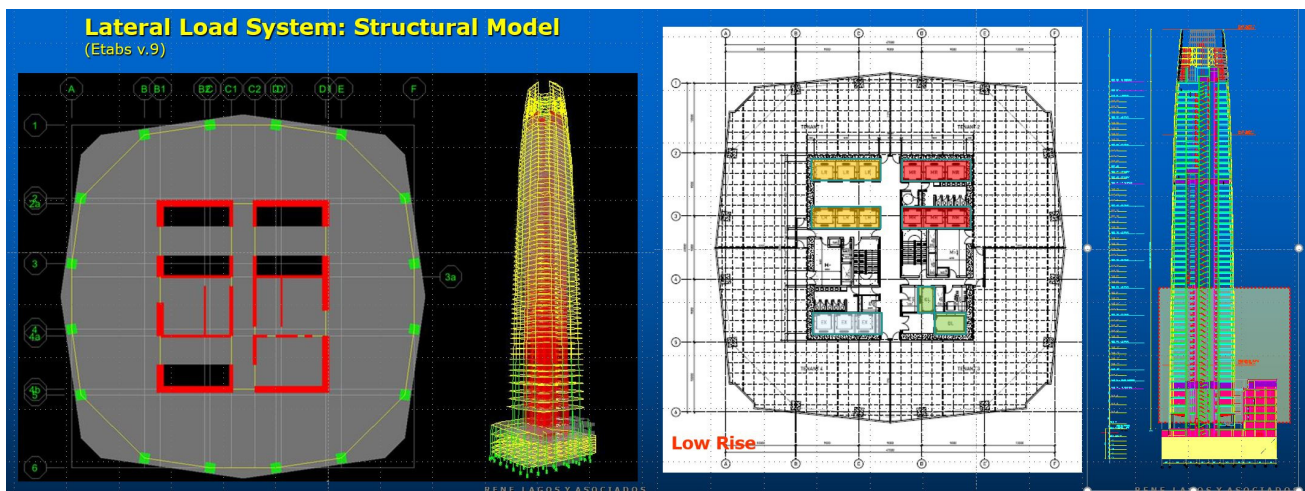


The Costanera Center

One of the challenges in the design of the TMD was that the steel chains, on which the one hundred-fifty-ton mass is fixed, swing in a similar way by an earthquake. He explained us how they measured the damper and which problems and discussion they had during the development.

After the presentation, we visited the Chilean Chamber of Construction to see the TMD. It was very impressive to see the giant damper on top of the building and we could better imagine how it works during an earthquake.

The videos shown on top showed as well some interesting details about the mass damper and the importance of such developments.







### Nuevo Edificio de la CChC

Arquitectura: A4

Diseño Estructural: VMB Ingeniería Estructural

Revisor Estructural: IEC

Constructora: Nahmias

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# Wednesday, September 5

## Bridge & Tunnel Project and City Tour of Valparaíso

On Wednesday we took a day-trip to Valparaíso, a city next to the Pacific Ocean. Our first stop was a huge Bridge and Tunnel Project of the region, which is already built and opened 2015. The infrastructure project is part of the route 60 of Chile and it connects the city Valparaíso with Argentina. A very informative presentation of the project was given to us at the entrance of the Tunnel T1 by an engineer. At first, he gave us a background of the history of the special part of the road and he explained us the meaning of the nickname; Camino la Pólvora. In the 19<sup>th</sup> century, the road was used to carry gunpowder and ammunition.



The building at the entrance to the Tunnel T1

After the short introduction about the history, we got an overview about the different steps, for examples the planning process and the building process. The challenging part of the project was the difference in elevation between the harbor and the route 68, and the steep valleys. Therefore, three tunnels and several bridges were built. After the presentation, we had a look at the smoke extraction and the tunnel T1 itself. It was interesting to see how many security cameras are needed to control the tunnel and how much effort they put in to keep the tunnel secure. E.g. from drivers, who are driving in the wrong direction.



Following we drove to the city of Valparaíso. We had a short visit of the labs of the Pontifical Catholic University of Valparaíso. We saw the testing machines of the faculty of civil engineering. After that, we were invited for a typical German lunch (schnitzel with mashed potatoes) at Club Alemán de Valparaíso.



Lunch at Club Alemán de Valparaíso.

In the afternoon we had a guided tour through the city. The City is nicknamed “the jewel of the Pacific” and declared as a UNESCO World Heritage Site. Due to its topological conditions the Porteños, name of the inhabitants, built funicular lifts. Of these formerly 28 “ascensores”, 12 are still in use. We had a ride with Ascensor Reina Victoria to have a walk through the beautiful streets of Cerro Alegre and Cerro Concepción. Many of the houses are painted colorful in many ways. Some of them just in one color, some others with cartoons on them.



Some impressions of Valparaíso.



We had a great overview of the city with its many hills. But there is a wonderful view of the harbor and the Pacific, too. The harbor was the biggest one in Chile once, today it's just a harbor with the home of the Chilean Navy. In the 19th century, many immigrants from Britain, Germany, France, Switzerland and Italy came to Valparaíso. Their influence can still be seen today, for example in the Club Alemán de Valparaíso.

After the tour, we had free time. Some of us went to a concert of a hill, some others just chilled with one or two beers in bars. Late in the evening we headed back to our hostel in Santiago.



Our group touring the city of Valparaíso

# Thursday, September 6

## Tecnofast, Fundación Cristo Vive and Titanium Building

In the Morning on the 6th of September we visited the company *Tecno Fast* in Santiago. This company is focused on delivering modular buildings to engineering, architectonic and construction projects. *Tecno Fast* is able to produce many different modular buildings from small offices to large mining camps that can host thousands of people. As we saw the system of the inline prefabrication, we recognized the many different steps to produce the modular buildings, for example to install the electrical systems.



Modular buildings for minina campos



During our visitation the company had to do a job for a mining company to build a large camp for the workers. That job included for example to build bedrooms, kitchen and bathrooms.



Bathroom for workers





The next station of our program was the visit of the club *Cristo Vive*. *Cristo Vive* is a non-profit association which was established by the German nun Karoline Mayer 40 years ago. This association is depending on their members and their donations. Without them they cannot do their social work. The function of this association is to improve the living conditions of the poor people in Chile. Improving the living conditions means to build hospitals, to arrange emergency medical services for them and especially to fight for their human rights in Chile.



Another aim of this association is to establish a good education system and alternative for the poor youth. While our visit at *Cristo Vive* we were shown by the workers the training workshop of painters and the fitters.

Training workshop for the fitters





In the afternoon we visited the firm *serve*. It is a company that provides integral solutions of engineering and seismic protection. At the office we given made a presentation by an engineer about the La Portada Titanium Tower with regard to the design of seismic protection.



Seismic protection system

The Titanium La Portada is an office building which is located in the capital's high-end financial district of El Golf. Currently, this building is the second tallest building in Chile. Because Santiago is prone to earthquakes, this building needs a special seismic protection system. Sirve did not only construct the design of seismic protection but also planned its architecture. For their work on the Titanium Tower *serve* received an award.



Our group at the top of the Titanium Building



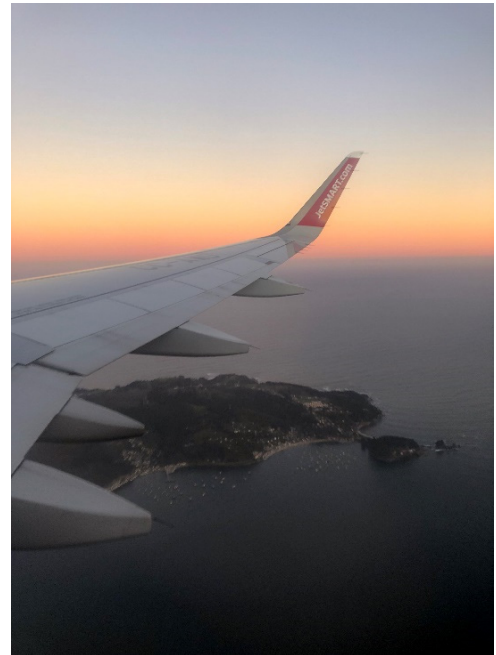
# Friday, September 7

## Concepción

### Departure

The day started with an early departure from our Hostel to the airport of Santiago de Chile. Today's schedule called for a trip to Concepción, Chile's third largest city, where we should learn much about timber and timber constructions in Chile.

Our flight was at 7:15 and the arrival in Concepción at 8:22.



On the flight from Santiago to Cocepción

### Universidad del Bío-Bío

The first stop was Universidad del Bío-Bío, which is named after the river of Concepción and was founded on 9th of April 1947.



Universidad del Bío-Bío

After a short tour around the campus was our welcome meeting with Mr. Ricardo Hempel, dean of the Faculty of Architecture, Construction and Design for 16 years. His research focused on timber construction. Because of his professional education as an architect, he has designed more than 1000 individual complexes such as multi-family houses, schools, sports halls, sports centers, etc.. Since 1972 he has been working as an academic at the School of Architecture and has been dedicated to wood design in construction for 30 years. He carries out numerous studies

around the subject. After introducing himself Mr. Hempel showed us some of the projects in which he and his students were involved throughout the years. Unfortunately, because Mrs. Damm could not be there, we called her to participate by remote in his presentation.

## Teatro del Bío-Bío



Teatro del Bío-Bío

The next appointment was at 11:30: the visit of Teatro del Bío-Bío, the largest regional theatre in Chile, placed on the edge of the Biobío River. This performing arts center is six-stories high and wrapped in a shell of semi-transparent PTFE, a Teflon-coated woven fiberglass. The covering let the theatre appear solid during the day and translucent at night.

Two theatres and a rehearsal room are located in the building at different heights. The materials that were used to give the inside of the theatre hall its certain look were concrete, wood and coconut fiber. At ground level the thin concrete grid was let open to create a large foyer.



Teatro del Bío-Bío



## Lunch

One timber construction, which Mr. Hempel pointed out earlier was the *club deportivo aleman*, where we ate lunch.



Lunch at Club Alemán de Valparaíso.

## Los Angeles

Furthermore, at 15:00 the bus drove us to Los Angeles in order to visit CMPC. The project we got to know was a large office building made of wood. We got to ask many questions and were shown around the building.







Construction site in Los Angeles

### Dinner

In the afternoon we had a typical chilean dinner with a heavy amount of food. Before getting back to the hostel we explored the city center and ended the evening, the week and the “official” portion of our wonderful trip to beautiful Chile with full stomachs and full minds.



Large chilean dinner