



Fachhochschule Köln  
Cologne University of Applied Sciences

# Aachen and Cologne Universities of Applied Sciences

## Departments of Civil Engineering

California, October 17-28, 2013



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**Valerie Capezzuto and Lars Leitner (Turner Construction Company, New York)**

**Gina Warne and Gaurav Joshi (Turner/Devcon, New Santa Clara Stadium Project)**

**Jens Birkhölzer and Peter Nico (Lawrence Berkeley National Laboratory, Berkeley)**

**Billy Janhunnen and Tim Strickland (Tipping Mar, Berkeley)**

**Dave Lambert and Patrick Noll (Arup, Los Angeles)**

**Dennis Bush, Shalva Marjanishvili and Takayuki Yokoyama  
(Hinman Consulting Engineers, San Francisco)**

**Kelly Luttrell and Chris D. King (CONXTECH, Hayward)**

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Cologne and Aachen, December 2013

Ansgar Neuenhofer

Ulrich Vismann

Hannelore Damm



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## Friday, October 18



### Scenes from the warm wine country

Early in the morning of 18th of October, a group of students were all set to travel from the very city of San Francisco to Mayacamas Mountain, which is located North of San Francisco. These groups of students are made out of two Universities, one from Cologne Universities of Applied Sciences and the other group from the University of Aachen. On this specific mountain lies their very first destination: The Geysers, which has the largest complex of geothermal power plant in the world!

As mentioned before our first destination is located north of San Francisco, which means that we have to cross the Golden Gate Bridge to get there. So we were all very enthusiastic to finally see the grand Golden Gate Bridge. But we were all disappointed. We didn't expect the fog at all! Fog is a common and typical weather phenomenon in the San Francisco Bay Area. You can imagine how disappointed we are but anyway it was our first day and we still have chances to see the bridge, fog free.





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### 30 °C, High noon

After a long journey through beautiful landscape the group arrived at the meeting point next to some wine yards. After they checked in the group get on the bus, the journey continues. During the nearly one hour trip, we get some interesting facts about “The Geysers” from our two tour guides.



And then, we arrive at one of the 15 Geothermal power plants. These power plants at The Geysers have a net generating capacity of about 725 megawatts of electricity - enough to power 725,000 homes, or a city the size of San Francisco.





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A million years ago, a plume of molten magma intruded close to the Earth's surface. The heat from this 1400°F intrusion recrystallized the overlying rocks, making them hard and brittle, then caused fracturing to create permeability. Subsequent magmatic activity over the next half-million years maintained high temperatures as water seeped down through fractures to form a hot water geothermal reservoir. At about a quarter million years ago, the caprock overlying the ancestral Geysers reservoir fractured, allowing steam eruptions as the high temperature water boiled down to form the current steam reservoir. Geothermal power is energy derived from the heat of the earth's core. "Geo" means "from the earth" and "thermal" means "heat." This type of energy is clean and predictable, offering a reliable and renewable energy source.

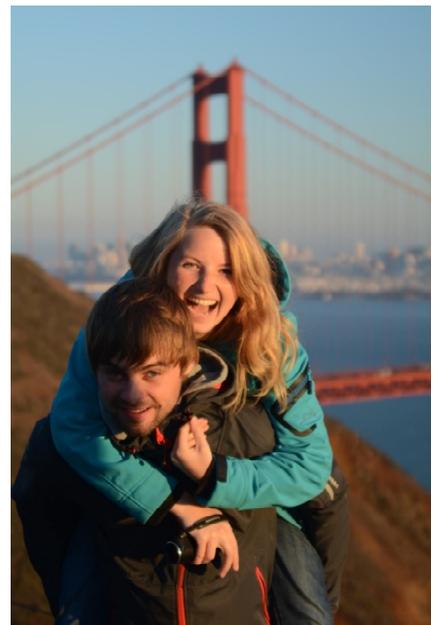
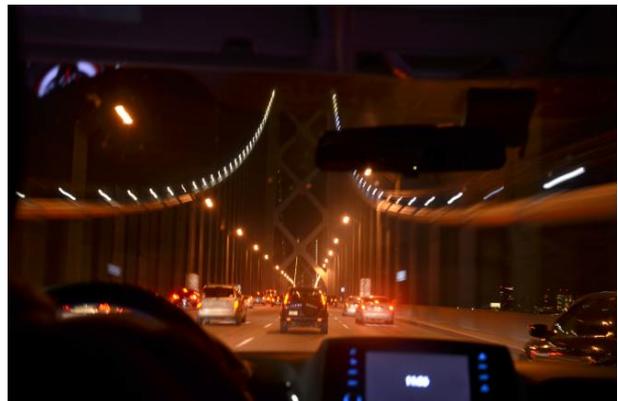
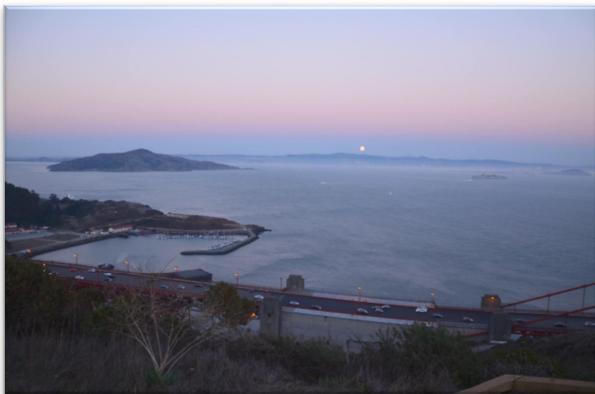




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### Late afternoon, 20°C

After the very informative and interesting trip in The Geysers the students with their Professors drove their way back to San Francisco and made a stop at Hawk Hill, where one can experience the best view of the Golden Gate Bridge. Hawk Hill is reached by a winding road and is located at the north side of the bridge. On the top of this Hill you can see over the Bay and San Francisco and yes we are indeed very lucky because the fog was gone! We can entirely see the whole Golden Gate Bridge as if we were in an airplane! The sunset was breathtaking! We were fascinated!!! After we took thousands of pictures it was time to make our way back to our hotel. We took the Bay Bridge though instead of the Golden Gate Bridge, but it was as fascinating as the Golden Gate Bridge itself.





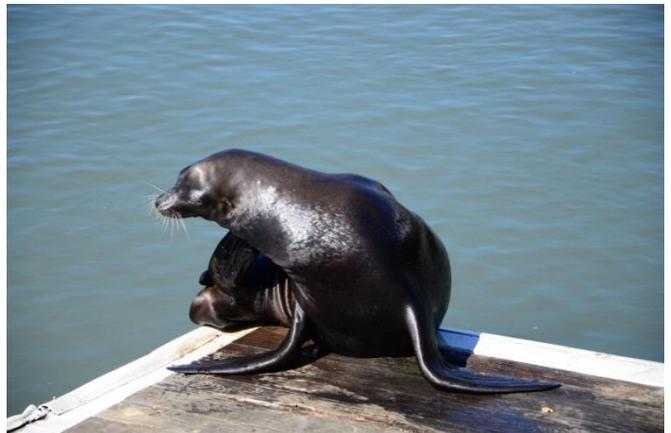
## Saturday, October 19

On Saturday the 19<sup>th</sup> October we have a free day to visit San Francisco or something else we want. We were a group of five people and we walked over 12 km through San Francisco and visit the best places of the city.



First we walked to China Town which was not so far away from our hotel. We take some picture from the entrance of China Town. You can see it on the photo. After that we walked through China Town, saw a lot of people sitting in front of their houses and doing something like music or produce things for selling.

From China Town we walked through Little Italy, which is an beautiful part of San Francisco, to the San Francisco Bay. On Pier seven we have a great look over the Bay of San Francisco to Berkeley it is on the other side of the Bay. On our Way to the famous Pier 39 we saw a lot of other Piers where you can enter ships to Alcatraz or a ferry to get on the other side of the San Francisco Bay. Totally we reached the famous Pier 39 and walked through lot of shops and restaurants.



In the harbor close to Pier 39 we saw some sea lions reclined in the sun. Lots of the sea lions migrate to the south during the winter. Since a few years a group of nearly 100 sea lions are staying in San Francisco.

After we had enough from the nice sea lions we walked to Fisherman's Wharf to eat some fresh fish and shrimps. It was very delicious. At Fisherman's Wharf we talked to some people who explain us some things going on in San Francisco. They told us where we can go in the evening to have some fun and what we have to see on the next day. During our stay at the piers we booked some tickets for Alcatraz next week. It was nice to see Alcatraz from the Piers and the streets up on San Francisco hills. We were glad to have tickets for Alcatraz and that we can see how the prisoners lived in this historical prison.

This day was a very great day in San Francisco because we could do what we want and we didn't have appointments. Finally we can say that it was a very great trip to San Francisco and we saw a lot of the city and the people living there.





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Some older people walked the streets of the Haight-Ashbury neighborhood and relived the sixties and seventies.





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## Sunday, October 20

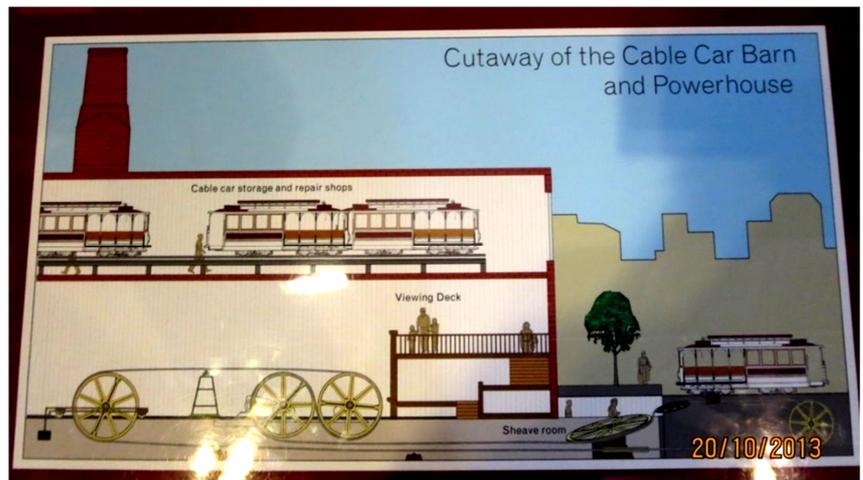
At the weekend, we had free time. So everybody used to visit the city of San Francisco by him or herself or in small groups.



We traveled to Chinatown by Cable Car.



After a small snack and a long shopping tour we visited the cable car museum.



These four Cable Car routes still exist.

That's the way the cable car system works. Between six o'clock in the morning and 10 o'clock in the evening some cable are running through a rail in the street. On these cable, the driver used to fix a kind of hand, to move the cable car. On that way, it is possible to drive without any electricity on board. To stop or to slow down, the driver has to open the mechanical hand and curb by the iron wheels.

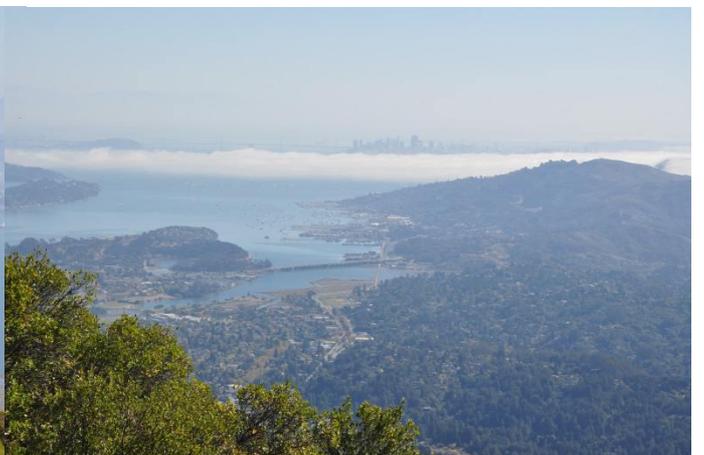
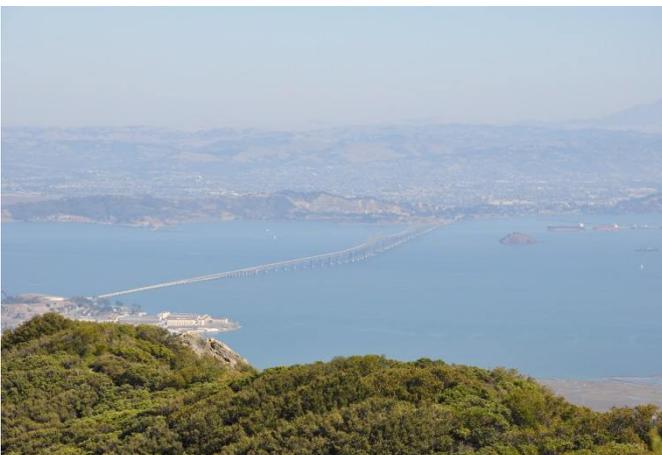


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Later we used a streetcar to drive to the harbor, where we've visited old ships and ate fish and chips.

Some of us hiked beautiful Marin County and climbed Mount Tamalpais from where we enjoyed gorgeous views of the San Francisco Bay Area.





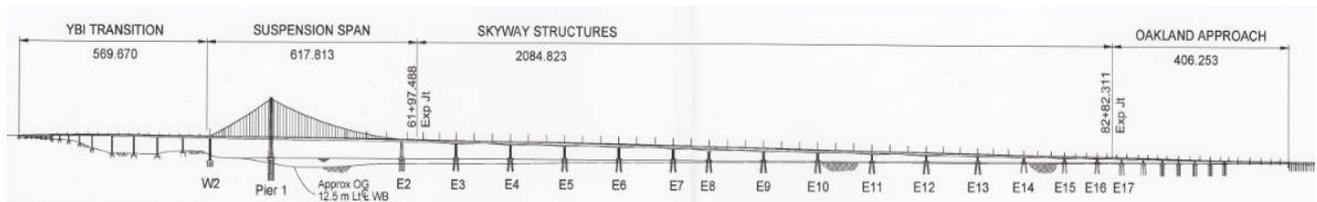
## Monday, October 21

### The New San Francisco-Oakland Bay Bridge



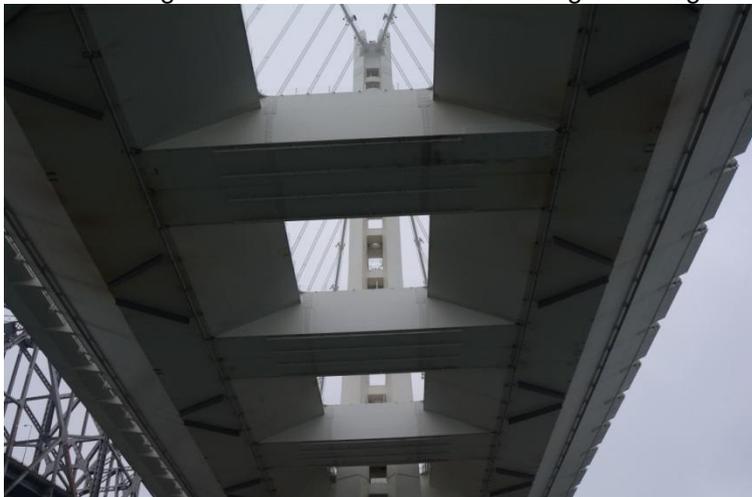
**Computer Model of the New Oakland Bay Bridge**

An old German song says: "Eine Seefahrt die ist lustig, eine Seefahrt, die ist schön, denn da kann man fremde Länder und noch manches andre sehn" which means roughly: "A seafaring is funny and beautiful, because you can see foreign countries and some other things". Our boat trip was not very funny and the weather was cloudy and windy so it wasn't neither beautiful, nor we have seen other countries, but we have seen "some other things" especially a bridge, which was the reason we made this trip. We visited the new San Francisco-Oakland Bay Bridge designed by T.Y. Lin International. It contains of several parts. The structure to approach the bridge from Oakland on the eastern side, the transition on Yerba Buena Island from the old-



er two-level-bridge to the new one and the skyway structure that spans most of the bay. These three parts are made of prestressed concrete, but the most impressive part is the suspension span, made of steel.

The bridge is about 3,6 km long, the self-anchored suspension span alone is about 620m, which is the longest SAS-Bridge in the world. The tower holding the bridge is about 160m tall. The Oakland Bay Bridge is designed for a safety evaluation earthquake (SEE) that occurs every 1500 years on average. Even if the chance an earthquake like this will happen during the lifetime of the bridge is very low, a lot of time, energy and money was spent in seismic design. There is no direct connection between the tower and the deck. The deck is only held by the suspenders. So the tower won't get seismic loads from the deck and is governed by his own stiffness and mass. The seismic loads of the deck are absorbed by the piers on the eastern and western side of the SAS Bridge.



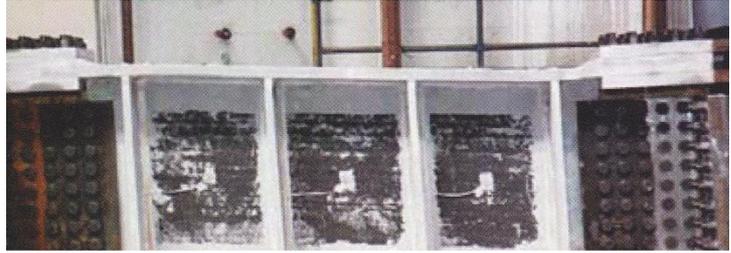
**Tower and deck**



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The tower is composed of four shafts only connected to each other with shear links. These links ensure the tower during earthquakes. It is fixed to a 6.5m deep pile cap, which is built on piles embedded to the rock.

The shear links that provide stiffness to the tower are planned to develop plastic behavior during an SEE and provide the shafts from being damaged. After an SEE the links can be replaced if it's necessary.



**Full scale test of a shear link used in the tower**

Due to elongation in longitudinal direction on both ends of the bridge hinges are built to allow the structures to move relative to each other. These hinges transfer "normal" vertical loads, but yield under heavy seismic loadings in order to protect other major structural elements.



**Hinge for longitudinal elongation**

The cable is anchored on the eastern side and is looped around the western side. Its diameter is about 80cm. The suspenders, holding the exterior sides of the deck, are spaced every 10m.

In total the SAS Bridge contains about 55.000 tons of structural steel (about 11.000 elephants or a third of the mass of the Cologne Cathedral) and 30.000km of steel wire, which is roughly 75% of circumference of the earth or a little more than three times the distance between Cologne and San Francisco (one way 9.000km).



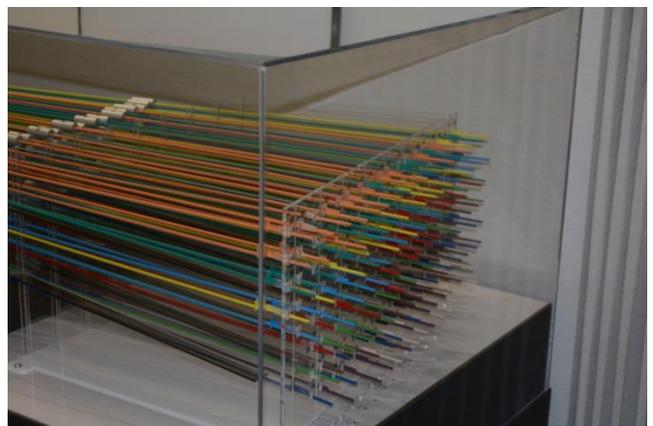
**Eastern End and "the loop"**



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Old and new viaduct structure



Small talk outside T.Y. Lin's field office

Many strands make a cable



Full scale models outside field office



The bridge made it into the world's most famous newspapers



## Transbay Transit Center

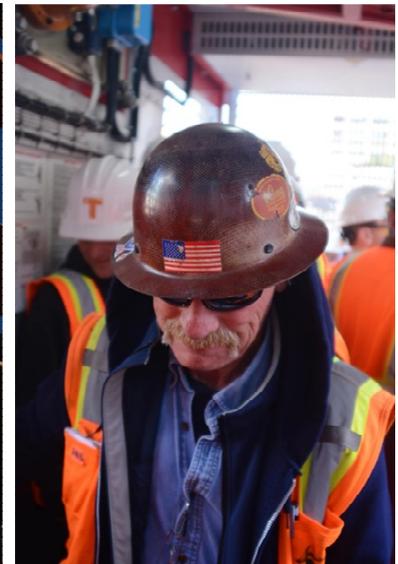


### Some made it to Treasure Island

### The station when it's finished

After our "bridge-experience" we headed back to San Francisco. A planned stop on Treasure Island wasn't completely successful because parts of our group missed the exit. Those who didn't enjoyed a stunning view of the city. More successful was our meeting at Turner Constructions. We met after lunch at Turner's in San Francisco's financial district. An executive engineer welcomed us and gave a short report about their current project, the Transbay Transit Center. The TTC is planned to be San Francisco's new big Central Station for public transport, including trains, busses and cabs. It will have a length of 1.3 miles and it's high rise building a height up to 1,000 feet. The building will have 5 levels with different types of use. Express trains will arrive in the bottom level with a ticket area on the top. The ground floor contains the entrance and small shops. Busses have their area at the first floor and the roof will be a green recreation area of 18.200 m<sup>2</sup>.

Beginning of construction was the 13<sup>th</sup> of august 2008 and it is supposed to be finished in 2017. The expected costs are about 4.2 billion \$. Following the presentation we visited the construction site. Climbing down shaky stairs, we were totally impressed by the huge dimension of the site. (God bless, we all had safety shoes with steel toe cap.) Down there we saw big reinforcement of the bottom plate which will have a thickness of 1.5 meter. Highlight was our way back up with the site's lift, with its awesome liftboy (see photo).



**Resisting soil pressure**



**Reinforcement of bottom plate**



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## Tuesday, October 22

On the fifth day of our trip to California we visited a Turner Office in Oakland and then continued our journey to Santa Clara where we had a guided tour of the new SF 49ers stadium (Levi's stadium). A small group of us took a detour to visit "The Cathedral of Christ the Light". Although we have many great churches and cathedrals in Germany as well, their architecture is completely different. While European churches in the Middle Ages and the Renaissance were almost entirely built of stone, this modern church combines concrete, wood and glass, giving it a completely distinct appearance.



### The Cathedral of Christ the Light

When arriving at the Oakland Turner office, we were sent to a room on the 21st floor of the building. From there one had a stunning view of the surrounding city and it's definitely a great opportunity being able to work at a place like this. We were then given a presentation about the philosophy of Turner and its business architecture, which are similar to those of companies in Germany, like Hochtief. After having some snacks and beverages, we then took our leave and went on to Santa Clara.



A dose of caffeine is a must



Oakland from the Turner Office





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After the trip to the building site of the Levi's stadium, we were given a presentation, which gave an overview of all construction phases, showing past and future steps that eventually lead to the opening in 2014. Having received our safety equipment and introduction the group was divided into two smaller groups. We then explored the actual construction site, which was one of many highlights of our journey. Like many things in the US the stadium looks different to what new stadiums in Germany would look like. Unlike our continuous stands, the Levi's stadium is divided into two separate structures, containing stands and suits.



**Looking for the right seats for the upcoming Super Bowl anniversary in 2016**

In the evening we went shopping in the Great Mall in Milpitas close to the stadium. Although trying to save some money, we still ended up buying as much as we could carry. Luckily for us the Euro/Dollar exchange rate was at a high at the time. After a long day and many new impressions, we passed the Bay Bridge for the second time, driving back to our motel in the Tenderloin.



**Harmonic colors inside stadium**

**The devil is in the detail**



**Don't mess with Turner/Devcon**

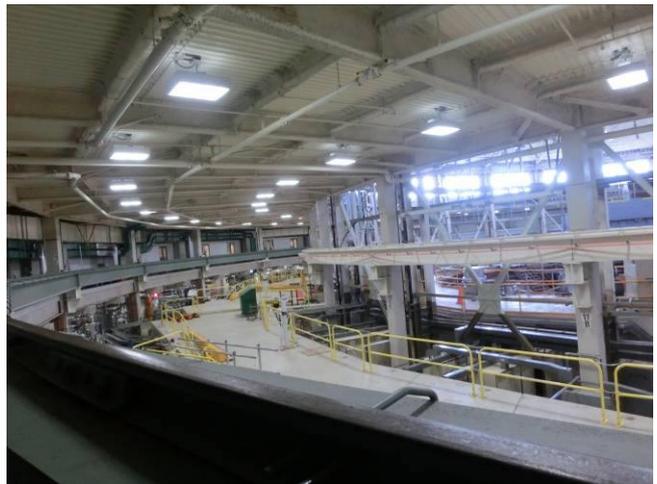


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## Wednesday, October 23

### Lawrence Berkeley National Laboratory

On this day, early in the morning, we went to Berkeley. We've had a visit of the particle accelerator in the "Lawrence Berkeley National Laboratory" in our schedule. Arrived at the research center we got a short talk about the center itself, the emergence and the task fields. Following that first talk we got a presentation about a research task they were working on. It was about climate change, groundwater and energy resources programs. They told us, that they were not just working in the laboratory but also making on the field researches and special simulations. A second presentation was about the storage of CO<sub>2</sub>, which seems to be a big problem. They told us about a possibility of geological storage and explained details about it. In a last lecture they told us about the research with the particle accelerator. They explained the application of it at the research center and then showed us the accelerator on site. While going through the particle accelerator they told us more details about the many different units.



### Tipping Mar

After lunch at Lawrence Berkeley National Laboratory we went over to Tipping Mar, a small office, which concerns with structural engineering and highly specialized seismic and sustainable design. Our visit was organized by Billy, Ansgar's former student. But we didn't visit a Swedish furniture store. To get a general idea of their field of work, they showed us some presentations of their projects like the UC Berkeley's Hearst Greek Theatre. A very detailed and realistic video sequence, of the execution during construction, was a part of any presentation. The Videos also demonstrated the buildings under seismic exposure.

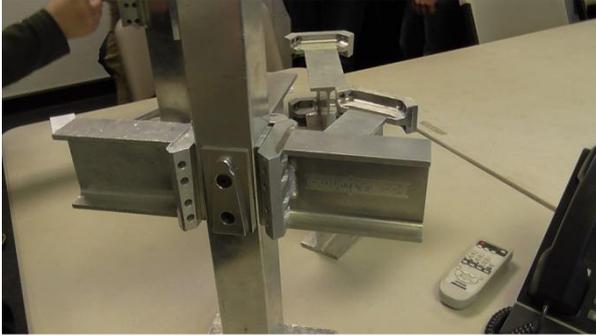




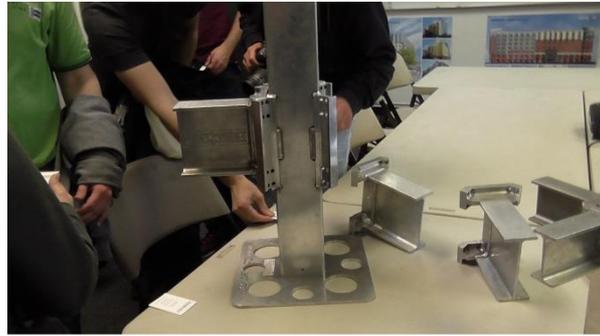
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### ConXtech

In the afternoon we visited ConXtech. “The company has developed ConX®, a revolutionary Chassis Based Modular™ structural steel building system which enables rapid delivery of robust, cost efficient and sustainable structures.” The founder of ConXtech wanted to create a building system that would be faster and more cost effective than conventional wood, concrete or steel framed methods. Kelly first showed us some details like cost and construction time of projects with their system compared to conventional methods. It is unbelievable that the building shell of a construction like our university in Cologne-Deutz grows up in maybe two weeks or less. We also made a tour through the company. In the factory we saw how the components of the systems assemble to a whole system like the ConXR Connection or the ConXL Connection.



ConXR Connection

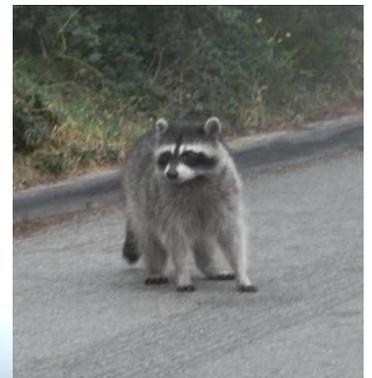


ConXL Connection



### The whole group at ConXtech

The Aachen and Cologne groups separated on Wednesday after our visit at ConXtech. While the Aachen group returned to San Francisco to stay two more days, the Cologne team headed on to Los Angeles for four more days. After an organizationally challenging but informative day, we finally set out for our trip to Los Angeles. To split the eight-hour drive into two parts, we added a night in a luxury Hotel in Carmel, which offered us a comfortable and enjoyable stay with pool, Jacuzzi and a beautiful landscape.



### The beautiful beach of Carmel

The Aachen group drove to a viewpoint, because they want to make some pictures of San Francisco and the landscape. But the fog was so heavy that they were not able to see anything. But at the end, they discovered a raccoon in the wild nearby so the journey had a good at the end.



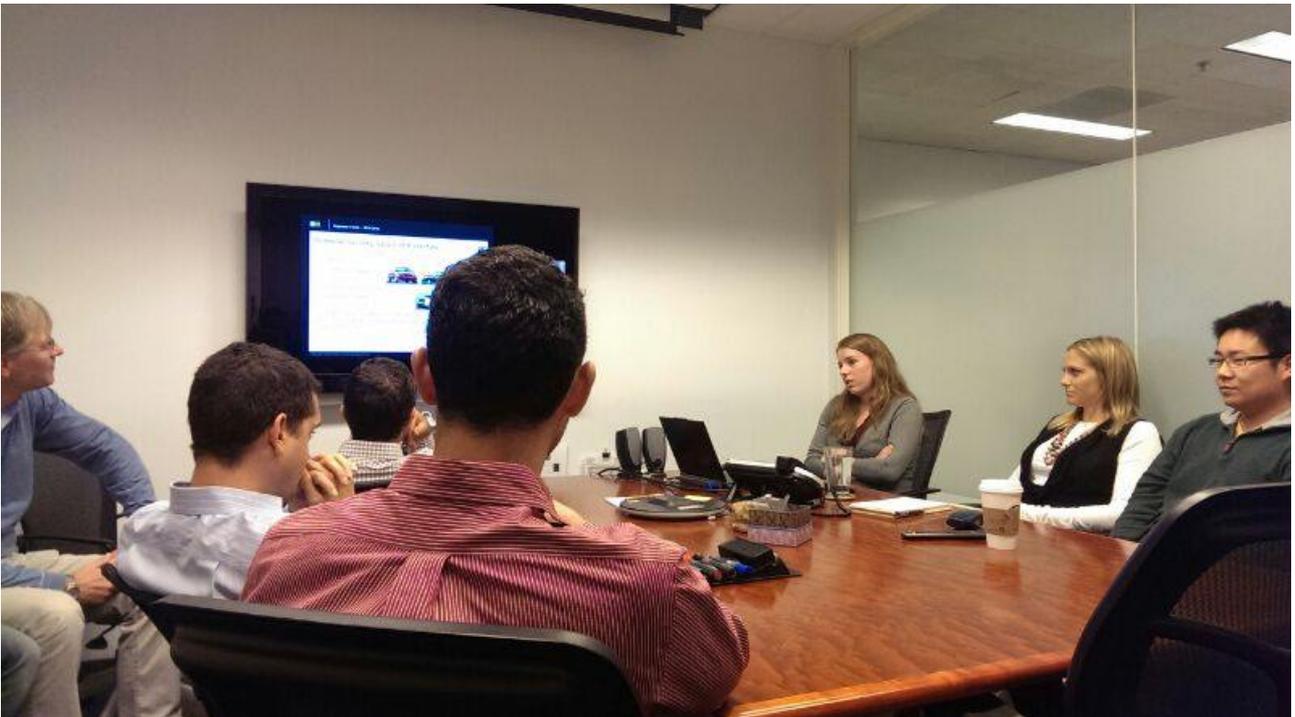
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## Thursday, October 24 (Aachen Group)

Thursday 24<sup>th</sup> of October was the first day when the group gets splitted. Our group shrank to only eleven people including Prof. Vismann. Meeting was at 8:30 am in the lobby of the motel as every morning. The plan for the day was to visit three different places in San Francisco and Berkeley. The program for the morning was to visit the company Hinman. In the afternoon we wanted to visit Berkeley university and in the evening we wanted to go to the Academy of Science.

### Hinman Consulting Engineers

The office of the firm Hinman is directly in the center of San Francisco so we were able to go there by feet. It took only about 30 minutes till we arrived at one bush street where we reached a big office block. In one of the upper floors Hinman has it's headquarter. The firm has also two other offices in the USA. We were warmly welcomed in the conference room. At first we got some interesting information about the firm. Hinman is a company with the focus on risk-management. They often work in cooperation with other engineer corporations and are specialized for the situation of a serious case. This could be for example effects by impacting, explosion and fire caused by terror-attacks. We also learned that Hinman cares about its employees. They should be able to have a balance in their lives. After the performances which were very interesting, we were allowed to experience a conference call between employees of the headquarter and another office of Hinman. The main topic was a presentation of an upright which secures the passage against bigger cars and trucks. After this we were invited to lunch with some of the employees where we were also able to talk to them.



**Conference call of Hinman employees**



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## Berkeley University

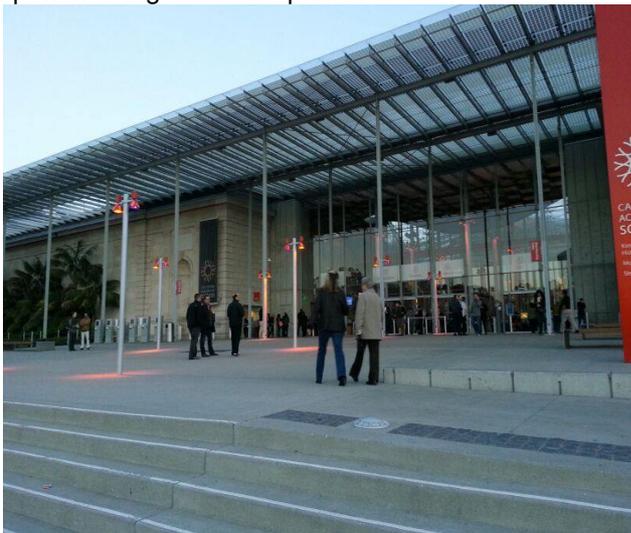
At 12:45 we left Hinman. Our next target was Berkeley University. We decided to go there by BART (Bay Area Rapid Transit, a train in the local public transport) which only took about 40 minutes. When we arrived at the campus of Berkeley we were at a loss for words. It is an amazing and huge campus. Not similar to any German university I know. In the Afternoon we made a guided tour around the campus. The leader was a humorous student of the university. At first he showed us some administration buildings. After that we were allowed to visit the library. It was a very impressive building. We were also allowed to enter the basketball hall which has more space for visitors like the halls of German professional teams. At least we climbed a tower on which you have a great view over the whole campus of Berkeley. After this the members of the group explored the campus for their own for the time till "BART" brought us back to San Francisco.



**Campus of Berkeley University**

## The Academy of Science

After a short break in the motel we wanted to visit the Academy of science in Golden Gate Park. Every Thursday it is opened also in the evening. The event starts at 8:00pm and you are able to have some drinks and listen to loud music played by dj's. The atmosphere is a little bit like in a night club. In the academy there are many things to explore. There are big aquariums with all kind of fish, even a white alligator and sharks. They also have a planetarium and the natural history museum. The trip was very informative and we could experience a great atmosphere.



**In front of the Academy**



**Part of the Exhibition inside the Academy**



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## Thursday, October 24 (Cologne Group)

Early in the morning of October 24th we left the beautiful hotel in Carmel and started our journey to Los Angeles. We drove along the famous Highway 1 in southern direction. But before we could actually leave, some of us insisted to visit the beach in Carmel.



**Hotel in Carmel**



**Beach in Carmel**

While driving down the Highway 1 we stopped at many places to enjoy the beautiful landscape and to take vast amounts of pictures



**The coast**



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**The coast**

For impressive pictures some also took daring situations into account, with success.

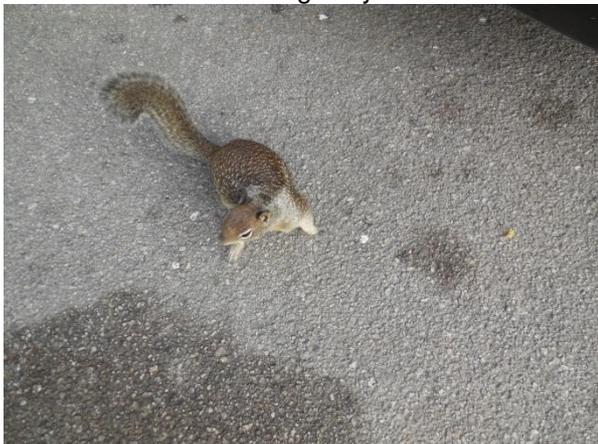


**Daring situations**



**Successful pictures**

Besides these adventures we met wild animals which live on the banks of the highway.



**Animals next to Highway**



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Some proved to be quite trusting.



### Feeding the sweet squirrel

In that location a sign made clear that feeding the squirrels is not permitted – too late -

At the next stop we could take pictures of a vast group of sea lions taking a sunny nap on the beach.



Sea lions

After a further stop in San Luis Obispo where we took the chance for lunch we left the Highway 1 and took the freeway 101 for the final leg to Los Angeles. During this leg we had a short and impressive conversation with a Highway-Officer fortunately without further consequences. Arriving in Inglewood, Los Angeles, we were struck hard as we discovered and checked into the hotel for the next days.



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## Friday, October 25 (Aachen Group)

On day 9 we had the day off to go wherever we liked in small groups or on our own. Of course we could not accompany all the groups so we decided to write about the different things you can do or places you should visit when you are in S.F.



On the one hand, San Francisco has lots famous touristic places. The Sea lions at Pier 39, the old Cable cars or the special and very beautiful routing of the Lombard Street are just a few of them.



It is fascinating to see the old transport system of Cable cars still running. So engineers in the old days did a good job.



On the other hand the city has lots of places which are also attractive to the people living in S.F. You can spend a nice sunny day in the Golden Gate Park or you can take a walk along the peers and sit down in one of the little cafes or bars and enjoy the special atmosphere of this unique city.



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Later in the evening we met in a very nice Italian restaurant for dinner. We talked about the last days, the different places, buildings and people we met and planned the last things for our flight back to Germany the next day.



## Friday, October 25 (Cologne Group)

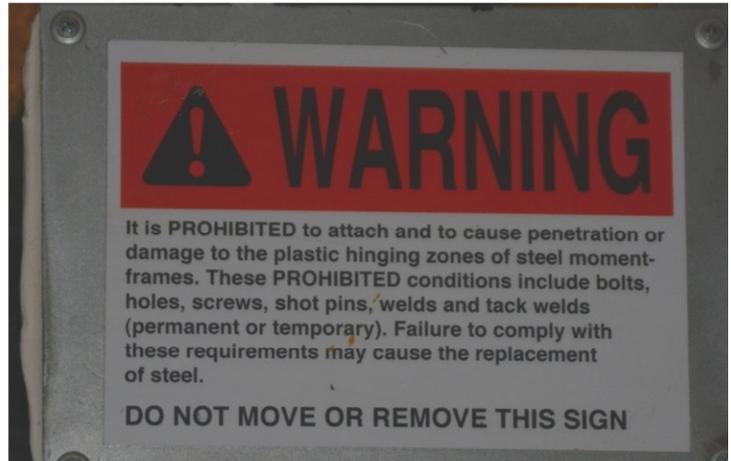
After our long journey from Carmel to L.A. we had a very relaxing short first night in the “best” Motel in town. In the early, dark morning we got a few donuts from a 7/eleven and a wishy-washy coffee for breakfast. According to this a few of us “depend” to stay in bed and get better over day. The main part of the group met in the lobby, ready to have a great day in Los Angeles. Before leaving, Ansgar introduced us to the schedule of the day. So we had forenoon to have some sightseeing and some of us visited Hollywood, especially to see the famous Walk of Fame, Chinese Theater or the Hollywood-sign. Our part of the group took the long way to Venice Beach. We had some Hot dogs, while we were watching various artist, sportive people and tourist under the warm California sun. Feeling the sand between our toes, the sun on our skin and the soft wind in our hair gave us a short holiday experience and let us nearly forget our “luxury” accommodation in Inglewood (between Interstate and Airport). At 1 p.m. we met at ARUP. They appreciated us very well with snacks and drinks. A short introduction by a representative gave us an impression of ARUPs work. ARUP was founded in 1946 and involved in many well-known buildings like the Sydney Opera House, the Centre Pompidou in Paris or the Allianz-arena in Munich. Luckily for the most of us, ARUP has also establishments in Germany and so we enjoyed an outstanding presentation from a German native speaker. He explained to us his current project at the Los Angeles International Airport, the LAX Central Utility Plant. This Project is part of a modernization plan of the airport. The very special difficulty of this development is the work during the going business of the airport. The challenge was to switch an old utility plant to a new one, without causing any breakdowns of the system during construction. Therefore ARUP needed a highly efficient time and place management. Following we visited the construction area itself, which gave us a further impression of its complexity.



Construction site



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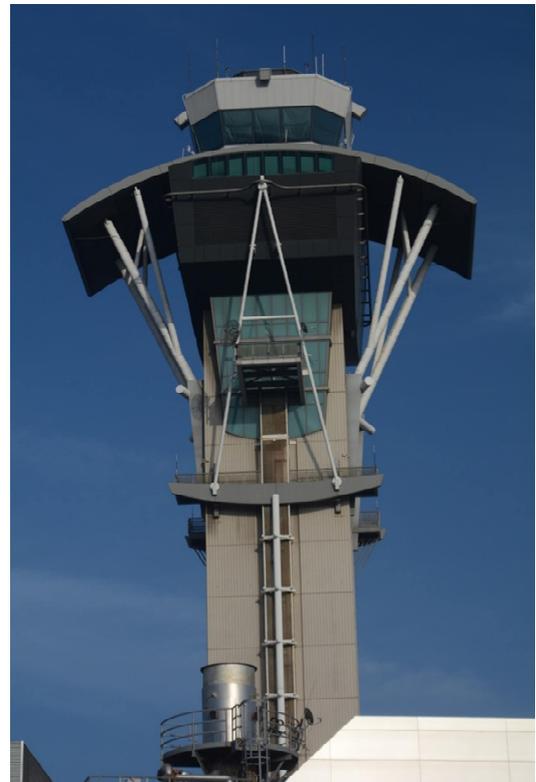


**Well defined location of plastic hinge protecting the beam-column connection**

Afterwards, in the evening, we went out for dinner in an Italian restaurant next to Venice Beach, suggested by our ARUP-guide (Thank you for calling and reserving!). That was our last “day of duties” so we enjoyed our leisure-time with delicious food and beverage.



**Dinner at the Restaurant**





## Saturday, October 26 (Cologne Group)

Although we always enjoyed the interesting lectures in all the different engineering firms, every one of us was happy to have free time on the weekend. And for sure there were a lot of things to do in L.A.! Because it is hard to find activities that everyone is satisfied with, our group split up into three. One group went on a sightseeing trip. In L.A. of course you should not miss the Walk of Fame. So they went along the Hollywood Boulevard by watching all the famous stars on the ground. It was a pity that the rest of that road was not that glamorous how many imagined. Furthermore they took pictures at those huge “Hollywood”-sign that everyone till then just knew from cinema. They also tramped through the sand at Venice Beach and watched the skaters and basketball-players. Worth mentioning is the dinner: some real American steak or smoked rip including a trip on a bull riding machine!



### Two of those many stars

The second group did a trip to an amusement park: the Six Flags Magic Mountain. With its 17 rollercoaster it sets up a world record. So this park guaranties much fun, tension and action but also long queuing and queasiness. But everyone that took part was thrilled by it.



The last group decided to go for bargain hunting in the Citadel Outlets. In the round about 200 shops everyone was able to find not just one nice thing to take with. After six hours the bags were full, the purses empty and everyone got satisfied. In the evening they wanted to see the sunset at the Griffith Observatory, a wonderful viewpoint to marvel at Los Angeles by night. Unfortunately many others had the same plan so that they could not get to it because of overcrowding. In the end they drove the Sunset Bld. and the Santa Monica Bld. for looking at all the rich houses and to get to the beach. There is a great Indian restaurant located in which the day finished off with a delicious curry.





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## Sunday, October 27 (Cologne Group)

At the Weekend we had Free Time. We traveled in little Groups separate throw Los Angeles. I was with my Group in the California Science Center. There we visited the Space Shuttle Endeavour. The Museum in front of the Hanger was very interesting. We get information about using a Toilet in the Space Shuttle and about the Foot of an astronaut. At Friday 25 of October we visited Arup construction. The static Office built the static bearings for the Space Shuttle. They must be very strong, because in Los Angeles are a lot of earthquakes.



Static bearings for the Space Shuttle Endeavour



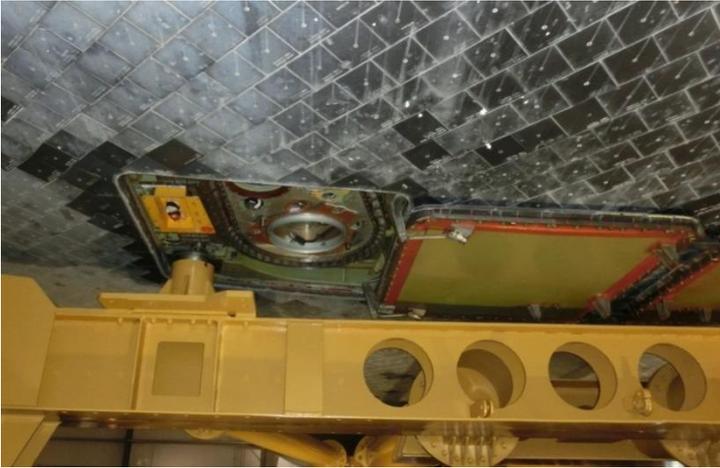
Toilet of the Space Shuttle Endeavour



The Space Shuttle Endeavour



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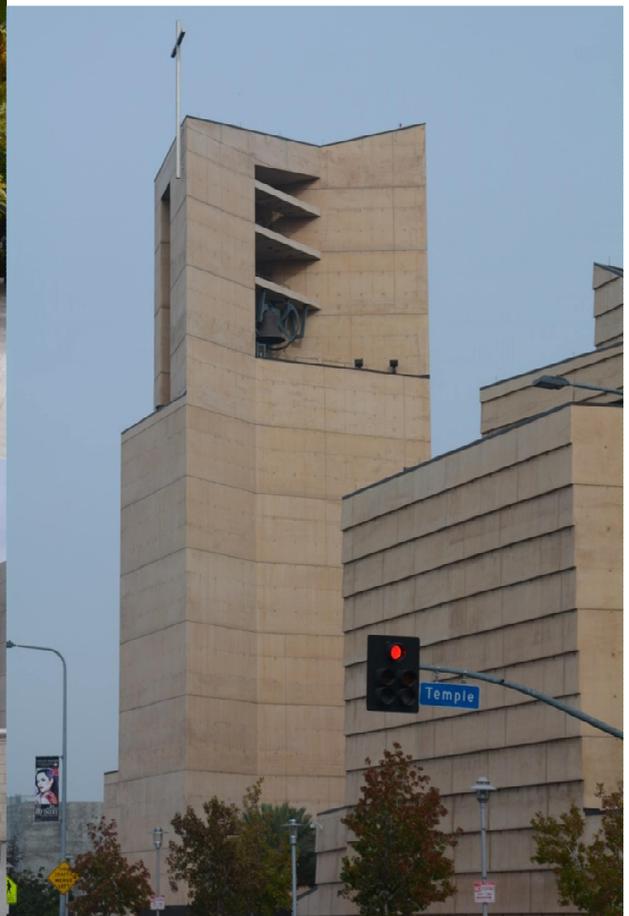


Static bearings for the Space Shuttle Endeavour



The end of Route 66

After this we navigated to the beach of Santa Monica. There we saw how a lot of men to restore the old pier of Santa Monica. At the end of the day we visited the end of Route 66. The Route 66 is one of the famous streets in the USA and starts in Chicago. Two weeks ago we started our trip in Chicago. We will end our trip tomorrow when we fly back to Germany. In this time we never traveled on Route 66, but we saw the beginning and the end.



Walt Disney Hall and the Cathedral, two other LA highlights