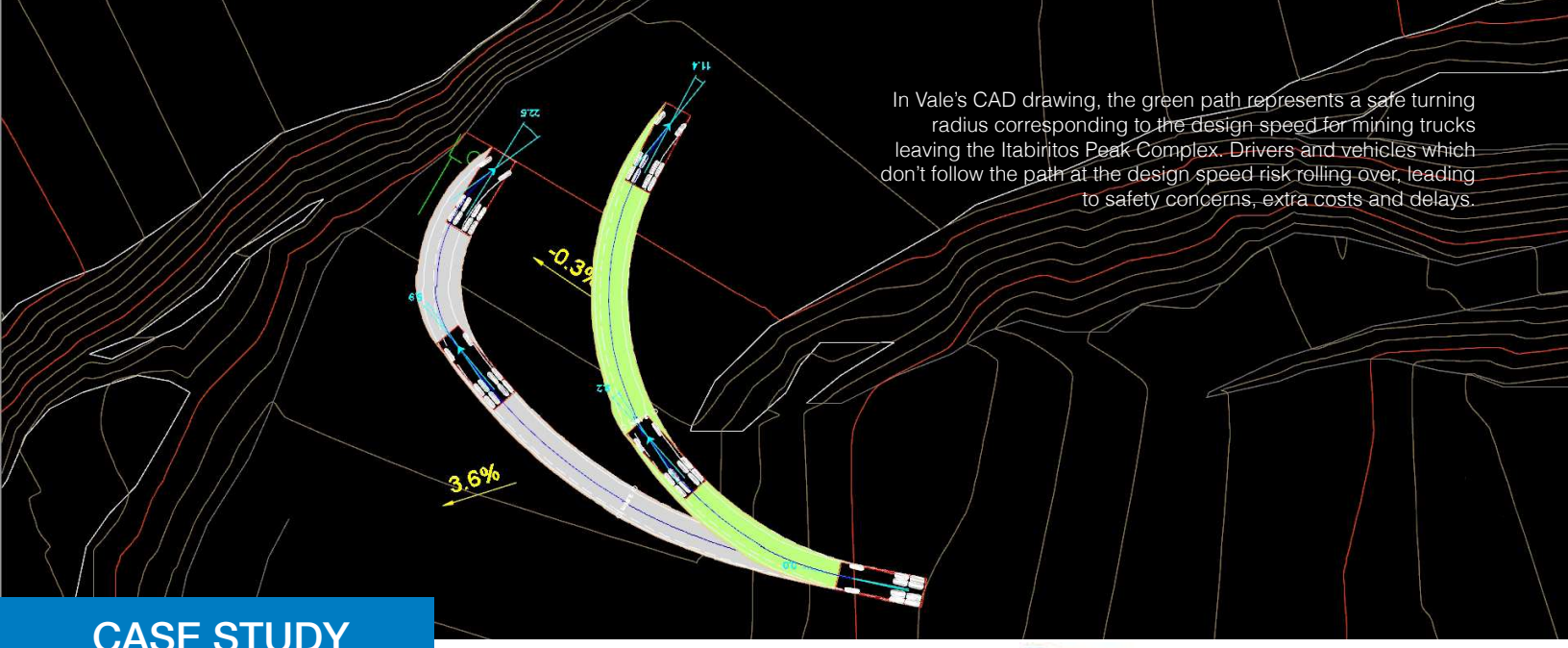


In Vale's CAD drawing, the green path represents a safe turning radius corresponding to the design speed for mining trucks leaving the Itabiritos Peak Complex. Drivers and vehicles which don't follow the path at the design speed risk rolling over, leading to safety concerns, extra costs and delays.

CASE STUDY

AUTOTURN

Mining Companies Use Technology to Avoid The Tipping Point

Planning safe routes down the mountain with AutoTURN

By Chris Johns, Transoft Solutions

When mining trucks and steep, winding roads meet, more emphasis must be placed on safety.

Around the world, mining companies face enormous time and financial pressures to get the natural resources out of the ground. If a truck tips over on the way from the mining site to the processing plant, the consequences can be serious. With today's road design software technology, that kind of mistake is a preventable one.

Vale S/A is one of the biggest mining companies in the world and they operate several mines in Minas Gerais in the eastern part of Brazil. In addition to iron ore, they have nickel, copper, coal and manganese mines throughout the country. With hundreds of trucks making trips to the various mines daily, the route they take must be planned carefully and Vale S/A relies on AutoTURN to plan the vehicle paths. The engineers and planners need to know how vehicles like the Mercedes 6x4 truck loaded with iron ore will behave when faced with sharp turns and changing terrain.

As one of the BRIC nations' (Brazil, Russia, India, China) leading the world in economic production, Brazil is developing its natural resources to fuel its growth. With wind turbines in the northeastern states and coffee, soy bean, citrus plantations and beef ranches in the south, Brazil has a variety of resources to sell to the world. In Minas Gerais, the fourth largest state in the country, the mountains and valleys are rich with iron ore deposits, which fuel the steel mills further to the south of the capital of Belo Horizonte. With dozens of mines in the area, big mining trucks are a very common sight on the roads. Roads are built based on the kinds of trucks needed for the mining operations and keeping them safe is an important job for the trucking companies.

One of the country's oldest ore deposits is located at the Itabiritos Peak Complex, consisting of the Chicken Coop, Pico and Sapecado iron ore mines. According to Antônio Carlos De Miranda Francisco, one of Vale S/A's production engineers who help design roads for the mines, there are many years left of production at the site.

"The operation began in the early years of the 1940s, so they have already had 74 years of operation of the project," said Mr. Francisco. "The expectation is that the mines in Sapecado and Galinheiro will be exhausted in 2035 and 2039, respectively."

Mr. Francisco began using AutoTURN in 2013 to perform investigative analysis when a Mercedes Benz 6x4 truck tipped over leaving the Itabiritos Pico mine area. The accident occurred at night, when the operator of the truck entered a roundabout too fast where the maximum recommended speed is 17km/h or less. In addition to the roundabout investigation, he has used AutoTURN to plan road geometry around the Itabiritos Peak Complex.

Mining companies in Brazil must follow guidelines from the Ministry of Labour and Employment, including NR-022. This

guideline states that the minimum width of lanes in open cast mines should be twice the width of the largest vehicle used in single lane roads and three times greater than the width of the largest vehicle used on a dual carriageway.

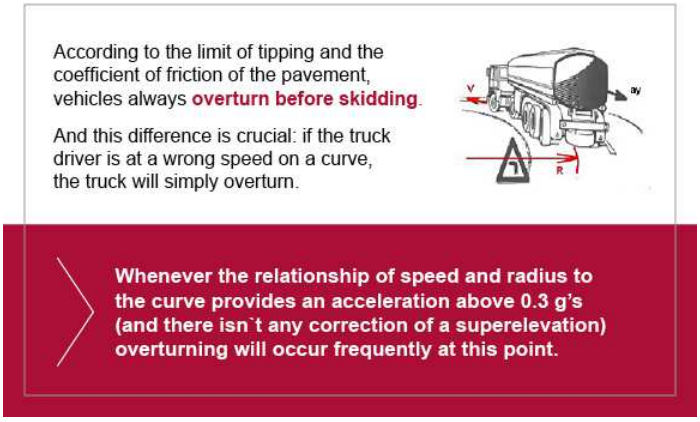
“The AutoTURN software played a key role in the analysis of road geometries in the mines, mainly in the width parameter of the curves, where we know there is a need to have a larger size than in the straight sections,” said Mr. Francisco. “Although we have to follow the NR-022 regulations of the labor ministry, it usually occurs in situations where the roads need to adjust to the various models of vehicles traveling to the mine. AutoTURN helps us streamline operations in determining bottlenecks in the flow of transport vehicles and also helps us improve the safety aspect.”

After the accident, Mr. Francisco used AutoTURN vehicle swept path, to evaluate the speed at which the truck was travelling and the turn radius the driver was using. The Vale S/A safety committee wanted to learn what speeds were acceptable within the safety ranges. He gathered data from the trucking company and from local authorities to make his calculations for the AutoTURN simulation.

“It was a question regarding the speed of the operator at the time of the accident,” said Mr. Francisco. “The safety committee approached us to help them identify the radius of the trajectory performed by the truck in order to then calculate the average speed.”

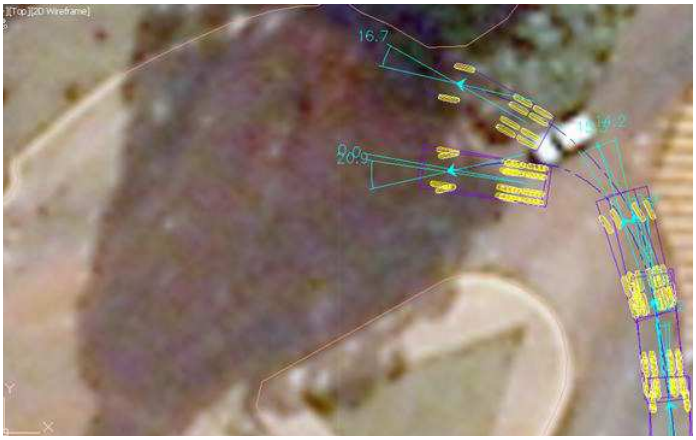
Engineers at Transoft Solutions have applied extensive research to the relationship between vehicle speed and turning radius and transportation engineers value this unique feature of AutoTURN. The software demonstrates that the higher the speed of the vehicle entering the turn leads to a larger turning radius. Mr. Francisco used the vehicle libraries within AutoTURN to find key measurements for the Mercedes Benz 6x4 truck and recreated the road geometry where the accident took place. With AutoTURN providing insights on the optimal path and speed of the vehicle, he could show what needed to change.

“The starting point of the work was to identify the correct position of the truck at the instant that the accident took place,” said Mr. Francisco. “This was achieved by simulating the overturning truck, placing it in the normal position, with all wheels on the ground and calculating the offset distance from the curb of the median island of the roundabout. This measure was taken by the safety team when the truck was still overturned. The actual distance was determined by subtracting the width of the vehicle,” he continued.



Truck of the drivers going to and from the Itabiritos Peak Complex sometimes contend with a lack of visibility on some of the turns and lane widths which are too narrow on some sections of road. Mr. Francisco studied the accident data carefully and showed the Vale S/A safety committee what speeds were recommended for safe transport of the iron ore to the processing facility. The use of AutoTURN puts important safety information at his fingertips.

“Our technical team can evaluate the truck routes to our iron ore mining sites with greater accuracy and confidence,” said Mr. Francisco. “We now know critical points along the route that must be changed to make things like the turning radii and working width safer.”



The vehicle swept path of the Mercedes Benz 6x4 illustrates the optimal path versus the path on a roundabout where the truck turned over.

Before starting his career with Vale S/A, Mr. Francisco used AutoTURN as a graduate student at Faculdade Pitagoras. He knew firsthand that the software could help him with his work with Vale S/A.

“We learned about AutoTURN through a term paper that I wrote with some other students as part of my program to graduate with a production engineering degree. After combining AutoTURN with InVision, we could analyze the safety considerations of our transport fleet of small, medium and large off-road trucks.”

From the early days of AutoTURN, accurate and reliable results and engineering controls have always been in place to give road engineers confidence that their designs were safe. If the software helps companies like Vale S/A operate more safely and efficiently, it has done its job.

“At Transoft, one of our most important design philosophies is to provide design and analysis tools that enable the designer to make their designs safer and more efficient,” said Steven Chan, Director of Product Management at Transoft Solutions. “Mining operations can be dangerous and we’re gratified that Mr. Francisco had used AutoTURN in his university studies and transferred his knowledge to his work with Vale S/A. The relationship between speed and turning radius is a key concept that is considered in AutoTURN. With this tool, an engineer can design with confidence.” ■

TRANSOFT
SOLUTIONS

Transporting one of the Vestas V112 turbine blades up to the Kingdom Community Wind Farm took careful planning to navigate the steep terrain and switchback roads.

CASE STUDY

AUTOTURN

Getting To the Mountain Top Just Got Easier

Wind energy companies are turning to technology for modeling sharp turns and complex geometry on projects across North America

By Chris Johns, Transoft Solutions

The sight of a 54-meter wind turbine blade is impressive. It's safe to say they stop traffic, literally and figuratively. Even for the wind energy companies that build the turbines and towers and for the transportation companies that move them across the continent, their sheer size does present some challenges.

Wind energy equipment is massive in scale, and it continues getting bigger. Project developers and their consultants have to turn to technology to model the vehicle swept paths and demonstrate safe clearances to freeway overpasses, roadside signs, light standards, and site access roads along their proposed routes. According to Alex Lockard P.E, civil engineer at Vestas American Wind Technology Inc., there are two pieces of equipment they worry about most.

"We have three main loads in the wind energy industry: the blades, the tower sections and the nacelle," said Lockard. "People don't generally model the hub and nacelle, but the blade and the tower sections govern the roadway design. We know that the tip of the blade overhangs quite far at the back end of the trailer. It swings way out as you go through tight radius turns, and it can hit all kinds of things like light poles, utility poles, trees, and structures. All these things have to be checked."

Trucking companies like Lone Star Transportation are responsible for obtaining permits from the local Departments of Transportation when moving large loads across state lines. Sometimes, additional permits are required to use county or municipal district roads. The governing bodies want to know if there are any hazards or dangers in moving the load through their jurisdiction. Trucking companies complete an initial transport survey, which is a run-through of the road way to identify what objects might be a problem.

"I wouldn't say specialized transport is getting more complex," said Brandon Brown, a senior project manager for Lone Star Transportation. "I've been doing it 17 years, and it really isn't that much different than it was back then. Wind energy is a whole different segment of specialized transport as far as the volumes and the site roads go. In the wind energy sector, you could definitely say that the components are getting bigger."

In 2012, Vestas and Lone Star Transportation teamed up on wind farm projects in Vermont and New York. A wind farm project in Lowell, Vermont called Kingdom Community, consisted of 21 turbines on a ridgeline of the Lowell Mountain Range. Working together with Vermont Electric Co-op and Green Mountain Power, Vestas supplied the blades and towers for the project. However, getting the equipment to the top of the mountain was an engineering challenge.

"One of the constraints we had was the 1 ½ mile road we had to travel up to the ridgeline," said Charles Pughe, project manager for Green Mountain Power (GMP) on the Kingdom Community wind energy project. "It was very steep, sometimes up in the 15 percent range, so we had traction issues in trying to get the equipment up to the site. The tower sections and nacelles were towed when they went up the hill."

Pughe continued, "We had an articulated tractor towing the prime movers going up the mountain. Most of the tower sections were on non-steerable low-boys. One of the tricks was to figure out

what the turns were going to be like. When the tractor was pulling the prime mover through the corners, the trailer wasn't tracking directly. It's like being on water skis – when the boat is pulling you, you don't ski directly behind it. The tractor was taking the corner a little wider than the truck, and it was difficult to figure that out ahead of time as the pitch of the roadway affected how far out in the corner the tractor would end up."

As we've seen, there are the clients like Green Mountain Power that own the wind farms and companies like Vestas Wind Energy that build the towers, turbines, and blades. Completing the triangle are the trucking companies like Lone Star Transportation that move the components across the country and sometimes right to the wind farms themselves. Brown has been working on specialized transport for years and he says that wind energy projects don't faze his drivers anymore.

"The Kingdom Community Project was similar to any other (wind) farm project," said Brown. "(Companies) don't want to spend money on roads and build them to what you need, so you have to make things happen in a field setting. That's a common issue in the wind industry-site roads. It's a huge cost, so the less they build, the more money they can make. It increases the likelihood they can make a project happen."

He continued, "In those cases, you rely on experience and because we have done so many (wind farm projects), our guys in the field know what they need. There are road specifications detailed into the contract that we had input previously, so we know what is required to deliver the turbines to their final destination."

Several months prior to moving the blades and tower sections, in February 2012, Vestas and Lone Star worked together with Transoft Solutions to perform a number of vehicle tests in a Vestas works yard in Brighton, Colorado. The Vestas project team wanted to know how the wind energy equipment would move when making specific turns. A driving course was built to replicate the critical roadway geometry of the planned access road for the complex terrain required in the Kingdom Community project. GPS coordinates from key points on the truck, trailer and loaded blade were recorded. Using AutoTURN from Transoft Solutions and AutoCAD software, the swept path of the simulated vehicle matched the swept path of the field test vehicle accurately, with variances consistently less than 30 centimeters.

"We took some of the geometry from the Kingdom Community Wind site access road designs," said Lockard. "I asked the customer on that project 'What curves are you most concerned about not being able to make?' The reason the geometry was so critical for this project is that they had a ridge top, mountain-side project. They were going to have to blast rock out of the way to construct the roads. Every square inch mattered to them and to us from a sustainability standpoint," Lockard continued.

"Ultimately, the software worked great. We made virtually no modifications to the road going up the hill based on our modeling of it, except filling in some ditches and giving ourselves some extra room in the corners by cutting down a tree or two."

Charles Pughe, project manager, Green Mountain Power

"Our biggest concern was getting the blades up (to the site), because they were 180 feet long," said Pughe. "We had a lot of switchback-type roads constructed to gain the elevation because we were trying to stay within a relatively small corridor."

"For the Kingdom project, GMP did upsize the turbines in the spring of 2011, after the civil engineering and associated permit applications were complete," said Pughe. "We used AutoTURN to verify that the roads would still work for the blades and the tower sections. One issue with doing this was that the blade trailer to transport the V112 blades hadn't actually been built yet. That is why it was so critical to have VESTAS do the mockup in Brighton once an actual trailer was available."

The Colorado field test served several purposes: It helped Vestas show Green Mountain Power that the road geometry would work, the test validated AutoTURN's reputation as accurate modeling software and it also helped Lockard gain some peace-of-mind that the blades would not get damaged on the way up the steep and twisting roads.

"At the time, Marble River and Kingdom were our first North American V112 projects, so we had not transported V112 blades

The exact location of the towers is determined after careful calculation of a number of factors. Coordinating the safe transportation of the turbines and towers and their placement at the site are key tasks for Vestas, Lone Star and Green Mountain Power.

The turbines required for the Kingdom Community wind farm actually stopped traffic briefly on their way to their final destination. The trucks needed both lanes of a two-lane highway to allow for the wide turns at some of the intersections.

Companies like Green Mountain Power use AutoTURN to plan exact routes with the large wind farm components, reducing costs for blasting and excavating bedrock.

before," said Lockard. "That was why we set up that exercise in Brighton, because we needed to answer that question for ourselves."

"Ultimately, the software worked great," said Pughe. "We made virtually no modifications to the road going up the hill based on our modeling of it, except filling in some ditches and giving ourselves some extra room in the corners by cutting down a tree or two. We did that just to be safe and we didn't want to find out after we bumped a blade into a tree."

The Marble River wind energy project in Clinton County, New York was also a successful collaboration for EDP Renewables, Vestas and Lone Star Transportation. Plans called for 70 Vestas V112 3-megawatt wind turbines to be installed across two upstate New York towns (16 in the Town of Ellenburg and 54 in the Town of Clinton). The 492 foot wind towers are the largest ever approved in the state of New York. The wind farm, which became operational in November 2012, is capable of producing up to 216 megawatts of power.

Just before the construction phase of the project was about to start, EDP Renewables decided to change the size of turbines to maximize the amount of energy the wind farm could generate. Before they could finalize the deal, EDP Renewables and Vestas had to make sure the larger blades could still make it through all the roadway's curves. Vestas turned to AutoTURN to answer the key questions.

Transoft engineers offered their expertise and helped Vestas with analysis of some of the key road geometry. "It was critical to us in the sales phase of that project," said Lockard. "I was being asked 'Will the geometry work?' The project was designed not for Vestas turbines but a competitor turbine with different length blades and different diameter tower sections. The client had done the original civil engineering work for a different turbine, different manufacturer, different length, different everything. It was a good win for us and my role was to make sure we could do it safely."

For Pughe, return on investment was an important consideration. If it was possible to transport the bigger turbines up to the site, he felt it would pay off in the long-term.

"We were looking to maximize the size and generating capacity of the wind turbines on the site," said Pughe. "One of the reasons we went with the Vestas V112s which had the extra big blade was we found that would be the highest yield for our footprint of construction. We would get the most energy out of them. We ended up choosing the biggest machines that were available to us at the time, knowing that it would be difficult construction to get it up there. We felt it would be worth it in the end because (the site) would yield greater energy output for the amount of construction we had to do."

There were considerable time constraints to look at all the variables on the Marble River project. Using AutoTURN, together Vestas and Transoft evaluated close to 50 intersections along with the site roads for clearance issues. Over a three-to-four week period, they collaborated to deliver the information that Lockard and his team needed to move the project forward.

The field work and research Transoft Solutions has done over the past two years with special transport stakeholders puts the company in a unique position in the transportation engineering arena. Part of the work involves getting the different groups to start speaking the same language when it comes to the challenges they face. Steven Chan, Transoft's Director of Product Management, believes that projects like Kingdom Community and Marble River show that Transoft is a reliable partner in the wind energy world.

"The turbines and blades coming from companies like Vestas present unique engineering challenges and vehicle swept path software plays an important role in solving them," said Chan. "In working with these groups, we learn how the software works in the field and the upgrades we make directly impact the civil engineering work that is done. There's lots of collaboration ahead and we're pleased that companies like Vestas, Lone Star, and Green Mountain Power have used AutoTURN successfully in their projects." ■

Photo Credit: Green Mountain Power

TRANSOFT
SOLUTIONS

CASE STUDY

AUTOTURN™

The World is Coming to Rotterdam

Adding AutoTURN's technology to the bus loop design creates a Central Station fit for a King

By Chris Johns, Transoft Solutions

Recently, the New York Times rated Rotterdam as one of the top 10 cities in the world to visit in 2014.

Why? The better question is why not?

Rotterdam is a unique blend of history, architecture, infrastructure and innovation virtually unmatched in Europe. When Transoft Solutions Inc, a North American transportation engineering software company was looking for a European city to call home in 2001, CEO Milton Carrasco was initially looking towards London or Amsterdam as cities with a big population and established technology pedigree. However, Transoft's first European General Manager lived in the Rotterdam suburb of Capelle aan den IJssel and stressed the benefits of the up-and-coming city. Today, Transoft's European headquarters are located just seconds from the mighty Maas River, right in the city center.

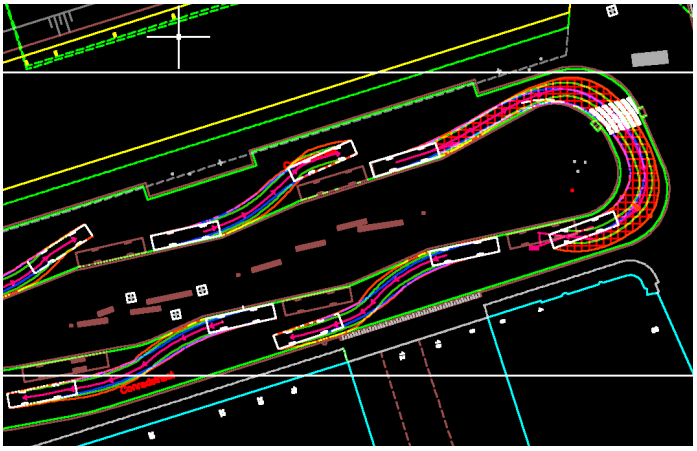
It's a good place to be with all the development that is taking place in Rotterdam. One of the new landmarks is Rotterdam's Central Station, a transportation nexus which now rivals Paddington Station in London or Gare de Nord in Paris or any of the leading cities in the world. With all the commerce coming into the city via the massive shipping industry, it stands to reason that upgrading the transportation network to encourage travel and tourism was top-of-mind for planners at the City of Rotterdam.

The original Central Station was known as the Delftsche Poort and Maas station. It was a key link in the Netherlands rail system until it was destroyed in the Rotterdam Blitz of May 1940. As the new Central Station took shape, the old station which served Rotterdam since the late 1950s was demolished. While some were sad to see an old building come down, many more were pleased to see the new Central Station adding beauty to the skyline. One notable Dutch citizen who is very interested in the beautiful new station is King Willem-Alexander, who will officially open the building on March 13, 2014. Once the project is completed, the station will accommodate 110,000 passengers per day and by 2025 the capacity will rise to 323,000 passengers per day. (Source: www.rotterdam.nl/rotterdamcentraal)

The new station was years in the making and the planning and design phases of the project really accelerated when the City of Rotterdam purchased a 10-seat license of AutoTURN for determining where the bus loop could go and how the station would integrate into the European rail system.

The Rotterdam Central project has been jointly facilitated by the Municipality of Rotterdam, ProRail, the Ministry of Infrastructure and Environment, the Dutch Railways and Rotterdam City Region.

> **"During the process, we changed the platform design and we checked with AutoTURN all the time to see if the changes were possible."**
>
> Marcus Edelenbosch, City of Rotterdam



The City of Rotterdam planners used a customized bus from the AutoTURN vehicle library to test the turning radius at the Central Station bus loop.

The new Central Station, opening in March 2014, matches the architecture of the surrounding buildings in downtown Rotterdam.

The new Rotterdam Central Station is an architectural marvel and an important transportation hub for the city. The City of Rotterdam's Department of Traffic and Transport took an active role in planning the bus terminal section of the Central Station and used AutoTURN from Transoft Solutions to ensure safe operation and design. With the upgrades, Central Station is now an international-caliber train station, with high-speed trains bringing passengers from Paris en route to Amsterdam.

AutoTURN is the world's leading software for vehicle swept path analysis. Transportation engineers have relied on it for decades to accurately visualize turning radii, transition curves, super elevation and lateral friction in all types of roadway, highway and site design projects. It was important for the station planners to have the most accurate data.

"The old bus station was originally located on the main square (Stationsplein) in front of the Central Station," said Marcus Edelenbosch, in the City of Rotterdam's Traffic and Transport department. "Part of the project Central Station was to create an attractive new entrance of the city. That's why the bus station got a new location on the side wing of the Central Station in the Conradstraat (Conrad Street). The old station did not conform to the European standard for accessibility and needed improvement."

The bus station is an integral part of the new Rotterdam Central Station. For the designers of the station, the traveler is central. For European travelers, a pleasant travelling environment and easy access to different modes of transport along with shops and services are important principles. And the new station has exceeded those expectations.

The bus station is located immediately next to the public transport terminal in Conradstraat (Conrad Street). The new bus station is comprised of eleven stops for the city bus services and one stop for international bus services. In addition, the bus station will provide direct access to the subterranean metro station. A section of the road is set aside for loading/unloading and Kiss & Ride passengers.

"We based the details from the very beginning on AutoTURN," said Edelenbosch. "During the process, we changed the platform design and we checked with AutoTURN all the time to see if the changes were possible."

The design challenges of the terminal were complex, due to the limited space available in the Conradstraat (Conrad Street). It is a narrow street surrounded by buildings, and it was important to check that the high boarding curb around the platform couldn't be run over by the buses' front overhang during a turning movement.

The planners at the City of Rotterdam used AutoTURN from the beginning and knew the types of vehicles that were expected to use the new bus terminal and added their dimensions to the AutoTURN vehicle library. Buses with lengths of 12 meters and 18 meters were part of the local fleet, passenger vehicles and several types of trucks were all evaluated in the design phase of the project.

"We started using AutoTURN after the first concept study to check if it was possible to make the bus station fit in the available space," said Edelenbosch. "With the help of the software, all entrance and exit angles and the required lane widths were checked. The dimensions of the Rotterdam Transit Corporation (RET) city buses deviate from the standard bus in AutoTURN. The software allowed us to manually customize these buses."

The relationship between the City of Rotterdam and Transoft Solutions goes back over a decade. Both the company and the city have transformed themselves in the past ten years; since 2001, Transoft has gone global with clients in 120 countries and Rotterdam has added De Rotterdam, the Markthal, the Central Station and many other unique structures to its skyline.

"Rotterdam is an interesting city to visit and the new Central Station is a striking example of the daring, new architecture people are talking about," said Yorick Keeven, regional account manager for Transoft Europe BV. "In an iconic building project like the Central Station, it was important for Marcus and his team to have an accurate picture of the vehicle turning movements for maximum safety and efficiency. We're pleased that our software played an important role in this centerpiece of Rotterdam architecture."

Passengers are already enjoying the streamlined travelling experience of the bus loop and the re-designed Central Station. With the station designed to handle substantially more passengers, Rotterdam will become a popular destination for European travelers. If you go, make sure you stop in the city center. It's a great place to be. ■

TRANSOFT
SOLUTIONS

CASE STUDY

AUTOTURN™

The Logging Road Less Travelled

Leading engineering companies use AutoTURN to complete projects efficiently

By Chris Johns, Transoft Solutions

When resource companies develop an oil well or get logging rights to a particular forest, one of their first questions is 'Do we have to build a road?' Their next question is 'Who can help us build it?' That's where McElhanney expertise comes in handy. They provide surveying, engineering, mapping and other specialty services to resource-based clients across Western Canada and beyond.

Wil Moroz is a GIS Civil Technologist working for McElhanney's Penticton, BC office. He has worked in the resource sector for about 20 years, helping companies with building roads and bridges to gain access to the project areas. As he'll tell you, the roads are rarely perfect ribbons of asphalt. During his career, he has helped design both conventional and unconventional roads, using AutoTURN from Transoft Solutions.

Resource roads are sometimes built with gravel or sand and for Moroz, being efficient through cutting down the fewest number of trees is high on the priority list. Designers like Moroz must account for changes in topography, elevation and other natural obstacles during construction. He refers to some resource roads as 'more like a roller coaster' but likes the challenge.

"When it comes to a resource road, every dollar counts," said Moroz. "So if I build a road that's a bit too wide, or a little too narrow, there are cost over-runs and constant maintenance issues. For major resource clients with projects going on in Northern British Columbia, they don't want to spend any more money than they have to. They want to be in and out and get the job done. AutoTURN plays into that by demonstrating that if I only need a 5 meter road, why would I build it to 7 meters? Only if I think the truck (we need) isn't going to make it."

As many engineers already know, AutoTURN is built on tried and true engineering principles and an understanding of what happens in the field. Engineers can design with confidence knowing that they can depend on AutoTURN to produce accurate results and generate a clear picture of whether a truck can maneuver a specific turn.

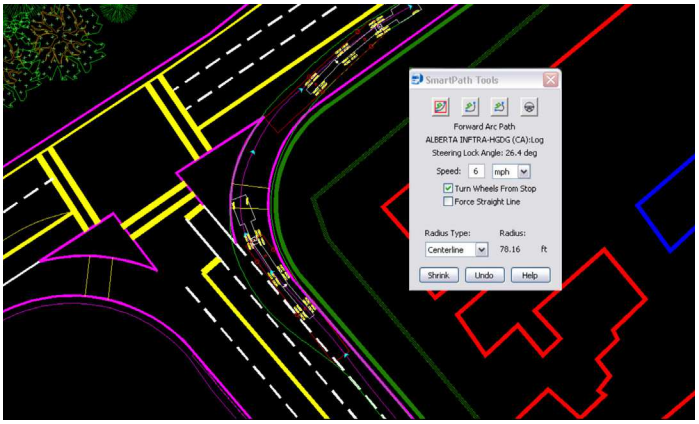
"I've seen what happens when tabular data is the only data used," said Moroz. "It's a 50/50 hit or miss. With AutoTURN, it bounces my level of confidence up to about 90 percent. I'm pretty darned sure. If the road is where it's supposed to be and the structures are where they are supposed to be, the widths should work. Bringing up my confidence level in what I do is huge. Not only that, but I can then present it to the client who is about to contract someone to build these structures, which gives them the confidence that we had the right solution for them. It's tried and true. The more I use AutoTURN and see the results from it, the more it builds my confidence. I might have started at 50 percent and now I'm about 90 percent."

Moroz recalled one example where the visualization aspects of AutoTURN turned an engineering puzzle into an opportunity. "There was one site we worked on with a very steep grade with a hairpin turn at the bottom, right where we wanted to put a bridge. There was no way to get this road to not have a curve on the bridge. It was almost impossible. I used AutoTURN just to see what the width of the bridge would have to be to make that work."

He continued, “Just through me playing with AutoTURN, we came up with a solution to the problem. We double-laned the bridge and put a curve at the bottom. Twenty years ago, with a site like this we would have said we’re not going there. We can’t get a truck in there. We now have this whole valley that we’ve opened up for logging just through the use of AutoTURN. The program spurred on more thought from an engineering point of view: How are we going to get this to work?”

Moroz has about 10 years of experience using AutoTURN, beginning when he was working for smaller consulting firms at the start of his career. His level of skill has increased as his projects have increased in complexity. “Using AutoTURN was a corrective measure at first,” said Moroz. “Now it’s a preventative measure. I’m going to prevent a lot of errors and save cost over-run on the construction end by having this product run through my design and make sure I didn’t make any mistakes. That was the key. We could show the client that we had run the project plan through the product. We could show them in a presentation, ‘Here’s your horizontal and here’s the truck going through it. What do you think?’ Once they saw it, they were fine with it. They would tell me ‘If the program says it’s OK, then we’re good to go’,” explained Moroz.

One aspect of Moroz’s engagement with AutoTURN is his experience designing custom vehicles in the software. In consultation with his clients, he learns what kind of vehicles is required for each project he works on and then tests those vehicles in the CAD environment. If a special truck is needed, he has learned how to build a custom vehicle to add to the AutoTURN vehicle library. There are numerous variables that go into designing a custom vehicle which require an understanding of how the vehicle might perform in the project environment.



Technologists like Moroz can see how trucks navigate turns in a CAD environment before they build a road in the field.

“The first vehicle I ever did, I didn’t know I had to have it checked,” said Moroz. “So I went through the process of customizing it and thought I had this lovely truck. Look at the turns it can make. Richard (his contact at Transoft) asked me if I had it checked. I gave it back to Transoft to have it reviewed and there were errors all through it.”

He continued, “I’m far from a specialist. I know what the program can do and I’ve seen manipulation of the program to things I’ve wanted to do. I’m nowhere close to a guru when it comes to changing the (specifications) of the trucks. I’ve seen how it’s done but my time is better utilized on designing other features and letting Transoft take care of the particulars of the vehicle and how it reacts.”

“The more I use AutoTURN and see the results from it, the more it builds my confidence. I might have started at 50 percent and now I’m about 90 percent.”

Wil Moroz, GIS Civil Technologist, McElhanney

When clients like Moroz have questions, they can get the answers they need by calling the Transoft IT Support line. The working relationship has evolved to the point that Moroz has one member of the IT Support team on speed dial. Moroz calls or emails Richard Fronda directly so he can get support from someone he’s worked with before.

“I appreciate that,” said Fronda. “It’s true that he either asks for me directly when he calls in or he emails me personally. The email usually starts with, ‘Richard, I have this AutoTURN issue’.”

“I think it’s his familiarity with what AutoTURN can do that makes him unique,” said Fronda. “AutoTURN is fairly simple software in that someone can put in specifications and it does all the hard work for you.”

Fronda continued, “He’s very familiar with how the vehicles are put together but sometimes he has questions about how those dimensions translate to AutoTURN simulations. He often is transferring his schematics and the documentation he has over into his design vehicles. A lot of the time the vehicles he is creating are not manufactured vehicles. They are design vehicles so he’s creating a design template for them for worst-case scenario and best-case scenario.”

Transoft’s Product Management team collaborates with ‘power’ users like Wil Moroz to create new innovations for software like AutoTURN and AutoTURN Pro 3D. This type of work leads to better software for all users. The functionality to create custom vehicles is there for users like Wil Moroz. With only so many hours in a day and competing priorities, sometimes users need expert help to make their deadlines As long as there are complete specifications for the vehicle, Transoft Solutions can create a custom vehicle for a fee through Project Support Services (PSS).

“It’s always a very positive experience working with engaged AutoTURN users like Wil,” said Johann Flores, a member of Transoft’s Product Management team. “Some of our clients have specific ideas when it comes to building custom vehicles in the software and Wil brings an experienced eye to his design vehicles - He usually has a project’s constraints in mind and we do our best to design according to what he needs. Transoft has had the pleasure of collaborating with Wil for a fair number of years and we look forward to continuing this relationship in the years ahead.” ■

TRANSOFT
SOLUTIONS

The size of the turbine blades present unique challenges to the trucking companies hired to transport them to the construction sites. Careful planning is needed to ensure there are no conflicts with the topography or with fixtures along the route.

CASE STUDY

AUTOTURN

AutoTURN Helps Brazilian Firms Capture the Wind

Ensuring safe passage of massive wind farm equipment on Brazilian roads is job #1 for engineers

By Chris Johns, Transoft Solutions

There is far more happening in Brazil than volleyball games on Copacabana Beach in Rio de Janeiro. Head north for about 2,500 kilometers to the states of Rio Grande do Norte, Paraíba, Ceará and Bahia and one will find one of the true drivers of the most robust economy of the Southern Hemisphere. In these four northeastern states, there are over 600 wind turbines and with steady winds coming off the Atlantic Ocean, the Northern states of Brazil are in prime position to provide megawatts of power for years to come.

Hosting the 2016 Olympic Games and the World Cup of Soccer in the next few years, Brazil definitely has some wind in its sails. And what better to harness that wind than a forest of wind farms?

Located in Natal, Rio Grande do Norte, the consulting engineering firm of Próxima Engenharia has its offices on the doorstep of some of the most active wind turbine projects in the country. They are actively involved in constructing wind energy sites across Brazil and specialize in design work for highways, land developments and wind tower parks. They have also designed wind tower projects in Spain and Poland.

There are wind energy companies from all over the world who are trying to get a foothold in the rapidly expanding Brazilian power generation market. Próxima Engenharia leveraged its location close to the projects and its years of experience to become influential in the marketplace.

“We have designed several wind farms in Rio Grande do Norte, Paraíba, Ceará, Bahia and Rio de Janeiro,” says Fernando Cesar de Oliveira Furtado, Chief Executive Officer of Próxima Engenharia. “We feel in the Northeastern states of Brazil have the greatest wind potential in the country. In the southern part of Brazil, we have the state of Rio Grande do Sul with great potential as well.”

In the state of Rio Grande do Norte, Proxima Engenharia has participated in approximately 10 wind farm projects with the first one designed in 2008. They have also designed two farms in Paraíba State, two parks in Bahia, and one preliminary wind farm in Rio de Janeiro which is yet to be constructed. Two of their wind farms projects in Rio Grande do Norte include Santa Clara and Macacos 1, which are capable of producing 260 megawatts of electricity annually.

The construction of a wind turbine farm is an engineering challenge for any company involved. Sometimes the sites are easy to reach via a highway and sometimes the route can be challenging. Sites like Santa Clara have 35 kilometers of internal roads connecting all the turbines.

Variables like tight radii turns, elevation changes, narrow roads, low clearances on bridges are combined with special transport considerations, including the number of axles, the distance between the axles and wheelbase and the overall vehicle width. Fernando Cesar Furtado began researching suitable software solutions and discovered AutoTURN could handle all the variables.

“I learned about AutoTURN in 2010 by searching the Internet,” says Mr. Furtado. “Soon after, we made contact to purchase it. It really helps us by facilitating the geometric design (of the roadway) in plan view and its profile, especially for large compositions.

AutoTURN allowed Próxima Engenharia’s engineers to evaluate the swept path envelopes of both the vehicle body and the cargo on specific transportation routes, potentially preventing damage to the load or surrounding structures.

Within the vehicle libraries of AutoTURN are 6 specialized vehicle configurations allowing the creation and simulation of independent rear-

steering systems critical to the maneuvers required for these projects. These include a 19-axle heavy hauler trailer, a Wind tower trailer (or Schnabel trailer), a Wind blade trailer, a Beam transporter I and II and a Booster trailer.

There are decades of research behind standard vehicle swept paths and the proprietary algorithms built-into AutoTURN, so trucking companies who need to move beams, turbines and other wind energy equipment can trust its reliability. In speaking with representatives of the North American trucking industry, Transoft has learned the challenges they face and are building their requirements into the latest versions of the software. Transoft has also collaborated with Vestas and Tecsis, one of the world's leading builders of wind energy equipment.

In February 2012 a series of driving tests were performed in a Vestas works yard in Colorado. A driving course was built to replicate the critical roadway geometry of the planned access road for a complex terrain in a future project. GPS coordinates from key points on the tractor, trailer and loaded blade were recorded. Using AutoTURN and AutoCAD® software, the swept path of the simulated vehicle matched the swept path of the field test vehicle accurately, with variances consistently less than 30 centimeters.

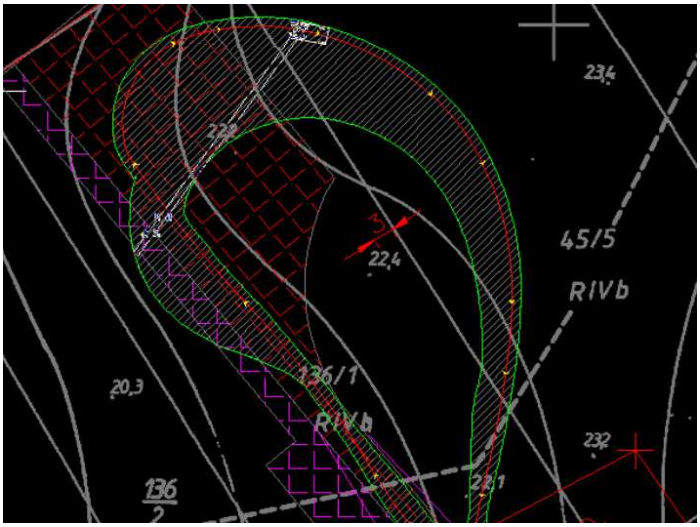
"AutoTURN was born from the Master's thesis of our CEO, Milton Carrasco," says Steven Chan, Transoft Solutions' Senior Product Engineer. "From the very beginning, our focus has been on ensuring that our tool accurately simulates vehicle paths. The result from the Wind Transport field test gives us confidence to stand by our product."

Three hundred and sixty degree turns and figure-eight maneuvers were also performed during the field test to determine the mechanical limitations of the vehicle. These properties were entered into the AutoTURN vehicle model to ensure that simulations were realistic and would not exceed the mechanical limits of the vehicle.

Especially in the wind energy sector, with large and expensive parts over 100 feet in length moving along the highway, it pays to know in advance how they're going to get to their destination. In North America, there is a movement towards standardizing some of the industry's policies and procedures about transporting OSOW (over size, over weight) equipment. There is also a strong belief that technology can go a long way towards making special transportation vehicles safer and making the trips more economical for all interested parties.

In March 2013, a Wind Energy Transportation workshop was held in Portland, OR, where trucking companies and engineering staff from Transoft Solutions met to discuss the use of vehicle swept path software like AutoTURN to plan transport routes when large equipment was involved. When truck drivers can see exactly how their truck and trailer will behave during turning maneuvers, they have greater confidence the route can be traversed safely.

In Brazil, some of the wind farm locations are quite remote and the roads



Once the variables were entered into AutoTURN, engineers from Próxima Engenharia evaluated the vehicle swept path and the in-swing/outswing of the turbines and blades on the route to wind farm sites.

"In the beginning, most of the difficulties encountered were in designing internal accesses inside the farms, especially areas of maneuvers. But in these cases we relied on AutoTURN heavily in order to facilitate these projects."

Fernando Cesar de Oliveira Furtado,
Chief Executive Officer of Proxima Engenharia

aren't always perfect ribbons of smooth asphalt. In Northeast Brazil, many of the roads are made of sand dune soil and the majority of wind farms are in the coastal regions. Some of the bridges the special transport trucks have to traverse are only rated for loads up to 36 tons and specialized equipment like the nacelles weigh much more. The truck drivers also have to deal with oncoming traffic and navigating narrow roads.

"In the coastal region, the wind farms are near federal or state highways," says Mr. Furtado. "In the mountains, there is a greater shortage of major roads, so there are situations where we need to build access roads of 10 to 15 kilometers in length." Alegria 1, located on the sand dunes of Guamaré was easy to get to while the Santa Clara wind farm, near the town of Parazinho was just over 11 kilometers off a main road.

He continued, "Our roads do not have enough lane width, and our highway interchanges often aren't designed for such large combinations as the truck and trailer. These combinations need special permission to travel and also need leader cars to facilitate efficient movement throughout the trajectory of the turns. In the beginning, most of the difficulties encountered were in designing internal accesses inside the farms, especially areas of maneuvers. But in these cases we relied on AutoTURN heavily in order to facilitate these projects," said Mr. Furtado.

Companies like Vestas and Tecsis are responding to the global demand for wind energy equipment by building larger nacelles and turbines. Towers that started out at 75 meters in height and featured 0.9 megawatt potency turbines are now considerably bigger. "Everything depends on the type, height, and power of the turbines," said Mr. Furtado. "Today, we work with towers up to 120-meter tall, and turbines with 3 megawatt potency,"

Demonstrating the company's global reach, Próxima Engenharia was called in to help plan the route to a difficult wind farm site in Poland.

"In the specific case of the project in Poland, there was a question regarding the viability of the wind farm project by the Spanish construction company, because (the site) was located on top of a mountain," said Mr. Furtado. "So we made an (AutoTURN) simulation for them with a composition that had the steerable rear wheels. We proved that it was possible for the trucks to reach the site and have room to maneuver around for returning."

Successful field tests and public consultations are just part of the commitment Transoft Solutions has made to being a thought leader in the special transport sector. Information gathered through all channels is added to the development stream for future versions of AutoTURN.

"Through our discussions with consultants like Próxima Engenharia, DOTs and trucking companies, we've seen the complexity involved in many of these special transport projects," said Transoft's Steven Chan. "Modeling the vehicle swept path accurately is important to ensure designers can plan safe and efficient routes for the super loads. It's no fluke AutoTURN performs brilliantly. Our on-going investment in research and development to support the industry puts Transoft on solid footing now and for the future." ■

TRANSOFT
SOLUTIONS

CASE STUDY

AUTOTURN

Simulating oversize and heavy vehicle manoeuvres using AutoTURN® from Transoft Solutions.

Use AutoTURN® to design infrastructure adjustments to safely operate trucks transporting wind turbine components.

By Engineer Alessio Gori, collaborator at POLITECNICA INGEGNERIA ED ARCHITETTURA SOC. COOP. (Infrastructure division - Head Office Firenze)

Narrow mountain roads, steep hills and challenging 'S' curves are just part of the landscape in the 'toe' of Southern Italy, where wind farms are becoming a common part of the countryside. With green technology like wind farms gaining popularity as generators of clean, efficient energy sources, technology and engineering are coming together to make these projects as safe and cost effective as possible.

In Reggio Calabria, the ENEL Green Power project proposed 2 wind farms development to be constructed in two areas: Piani di Lopa with 14 wind turbines rated output 0.85 MW and Campi S.Antonio with 25 wind turbines rated output 0.85 MW, within the boundaries of the three southern Italian municipalities of Bagaladi, Montebello Jonico and Motta San Giovanni.

The Aspromonte region infrastructure network has a limited number of paved roads. They are mostly classified as "mountain roads", both for the geometric road characteristics and for horizontal curves of low radii. The location of Piani di Lopa and Campi S.Antonio wind farm sites, which experts say are excellent for the wind and the rated power output, means engineers must study and plan the routes carefully prior to the transportation stage of the wind turbines components.

Special Software Required

Due to those conditions, the use of specialized software simulating oversize vehicle paths is important for evaluating how the transportation of wind turbine components along the provincial roads might be achieved. Two routes in particular, Strade Provinciale (SP) 3 and 107, from Reggio Calabria harbour to the project sites presented challenges to the engineers.

The objective of the path simulation along the provincial roads SP 3 and SP 107 was to verify the a priori conditions of the existing infrastructures. The actual tests have been set aside because they would have affected the road traffic and delayed the project schedule. Moreover, it has been possible to identify possible adjustments to the existing infrastructure in order to safely operate the oversize vehicles. Local engineering professionals were

called in to inspect the overall topography of the route to assess any challenges. They measured the topography and the most critical curves along the route. They also tested the vehicle swept path of an oversized vehicle with an unloaded trailer.

The aspects listed below are potential issues in the traditional approach, which is suitable for short routes and/or simple studies:

- The route length (40km)
- The number of potentially critical points (about 150);
- The presence of bridges, with geometry shown to be unsuitable for oversize vehicle paths.

AutoTURN, developed by Canadian software developer Transoft Solutions and distributed by One Team S.r.l in Italy was selected as the software for the simulation. The software allowed ENEL Green Power to perform vehicle swept path analysis and simulate the driving conditions of the area.

AutoTURN® includes a large selection of predefined vehicles, organized in international libraries and the software performs the simulation of “elementary” manoeuvres as well as of “simple” vehicles, trucks and special vehicles. The last ones are mainly common in Australian and North American regions (called “road train”, combination of truck and 2 or more trailers). With the possibility of customizing the AutoTURN® library, defining the “vehicle type” and “ad-hoc” simulation profiles have been fundamental design aspects.

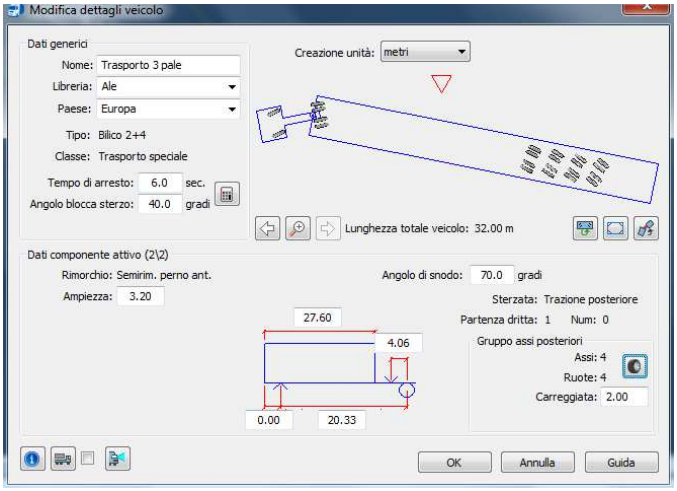


Fig. 1

The oversize vehicle geometry and the steering characteristics of each component have been reproduced in a plan and meets the guidelines regulating the automatic steering of rear axles of the semi-trailers in relation to the front truck axles (Fig.1). Through a range of speeds, from 5km/h to 20km/h, each iteration showed the swept path of the simulated vehicle matching the swept path of the field test vehicle accurately. (Fig.2)

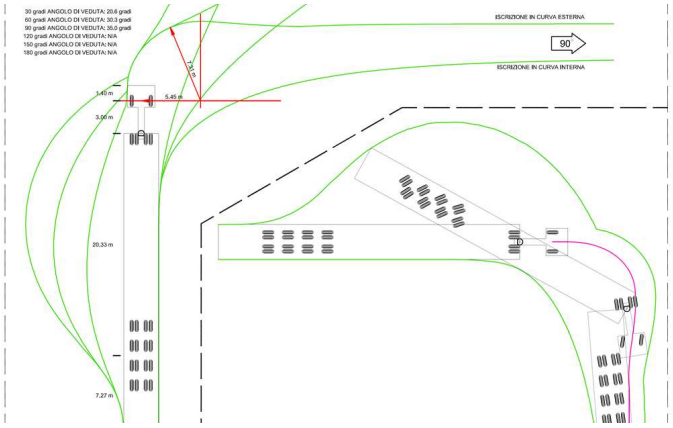


Fig. 2

Choosing the Vehicles, Simulating the Route with AutoTURN

Melca Transporti worked with ENEL Green Power to conduct the path simulations. The inspection process designed by the two companies helped identify critical points along the route and the company made adjustments to ensure the equipment could be transported safely. After this process, the companies used an unloaded vehicle to successfully test the path and the convoys drove the route safely without delays or issues.

The vehicle type was selected by determining the characteristics of the three basic components that have to be transported from the production site to the building site. The basic components are:

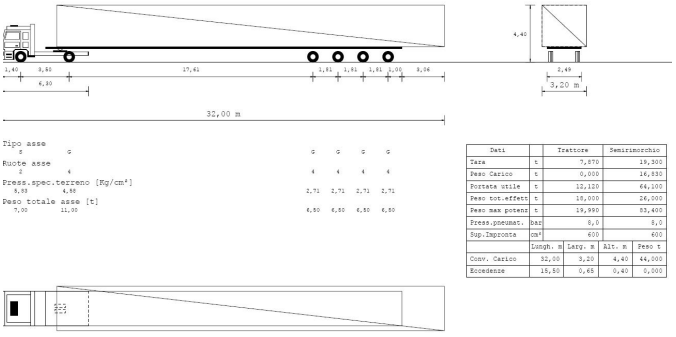
- fibreglass blade : length 26m, height 2.50 m
- single section tower: width 3.60m, height 3.60m, length 25m
- nacelle (to be installed at the top of the generator): width 2.50 m, height 3.00m, length 7.00m, weight 40 tonnes

The components are assembled with a mobile crane (Fig.3)


Fig. 3

Wind turbine components are transported to the project site with wheeled vehicles, classified as “oversize transport vehicle”, pursuant to Nuovo Codice della Strada (the new Highway Code). In accordance with the indications of the wind turbine producers, two “vehicle types” have been defined:

1. Semi-trailer truck transporting a metal structure containing 3 “blade” components;
2. Semi-trailer truck transporting the tower sections (Fig.4): the evaluated section is the critical one for its geometry; it is where the nacelle sits on the trailer. The nacelle also houses the rotational movement of the 3 fibreglass blades.



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Tara	t	7,870	19,300
Peso Carico	t	0,000	16,830
Portata utile	t	12,120	64,100
Peso tot.effett	t	18,000	26,000
Peso max potenz	t	19,990	83,400
Press.pneumat.	bar	8,0	8,0
Sup.Impronta	cm²	600	600
	Lungh. m	Larg. m	Alt. m	Peso t
Conv. Carico	32,00	3,20	4,40	44,000
Eccedenze	15,50	0,65	0,40	0,000

Fig. 4

The two “vehicle types” definition has been fundamental because type 1 has optimized the dimensions related to the length of the freight while the type 2 has shown the issues related to the semi-trailer truck width. The vehicle manoeuvre was conducted on both types of vehicles concurrently. The analysis was based on the hypothesis of keeping general traffic on the Piani di Lopa roads separate from the lower speed semi-trailer traffic. In order to ensure the safety margin between the simulation and the real path, the semi-trailer truck with steering axles have been taken into account. However, they have been not provided with a remote control of the steering angle of each axle. The decision to not include this variable in the path simulation is related to a larger flexibility in the vehicle selection for the company responsible for the transport execution.

Simulations and other editing operations are managed within the CAD-based program and this kind of versatility is built into the software. Customization of design attributes is an integral part of the software allowing simultaneous visualization of multiple vehicle combinations including:

1. The precise position of the truck and semi-trailers during the manoeuvre;
2. The convoy path with distinct single paths of rear and front wheels;
3. The vehicle clearance, including the trailer ground clearance.

After topographic measurements were made, the 40 km delivery route from Reggio Calabria to the project

Fig. 5

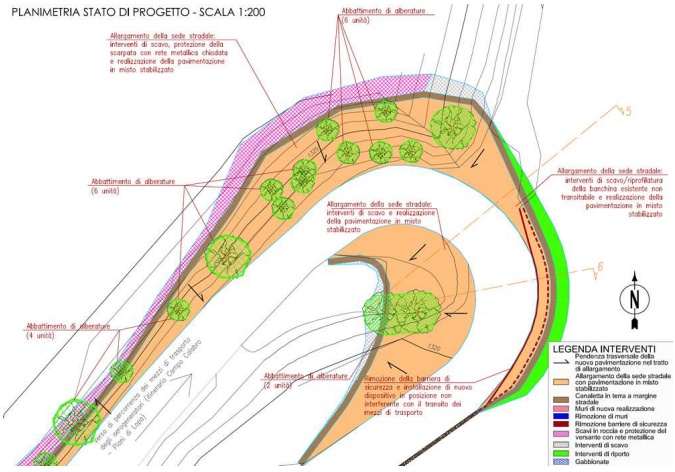

Fig. 6

site has been performed, revealing several adjustment points. (Fig.5, 6)

The articulated vehicle simulation was performed with AutoTURN® and the path manoeuvres have been defined and designed, preventing errors in path modelling due to possible design inexperience with the semi-trailer truck. Without the aid of AutoTURN®, the path analysis would have been performed qualitatively, deducing the vehicle clearance from the turn radius values and then overlapping the oversize vehicle swept paths to the topographic measurements.

This qualitative approach doesn’t consider system analysis; in fact in the typical “S” road curve case, the use of the geometric method would mislead the engineers because it doesn’t correctly analyse single critical points in relation to the project plan. The close distance between two “S”-curves suggests a behaviour which is difficult to define with “swept path” analysis. In AutoTURN® this problem is avoided because the design path is built into the software’s vehicle libraries for the exact vehicle type being studied.

At a later stage of the two vehicle types path simulation, the required adjustments to the existing infrastructure

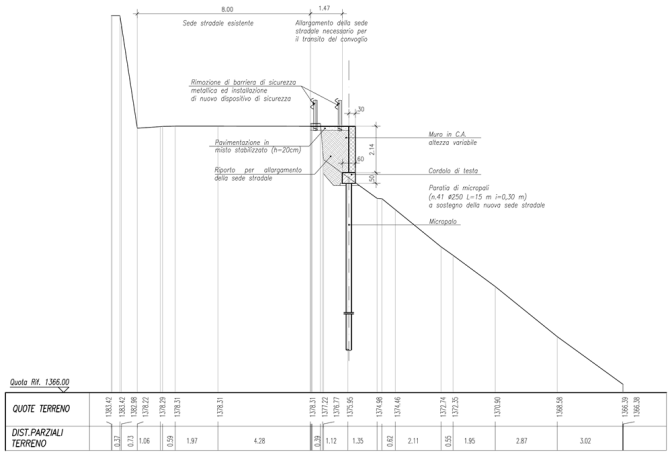

Fig. 7

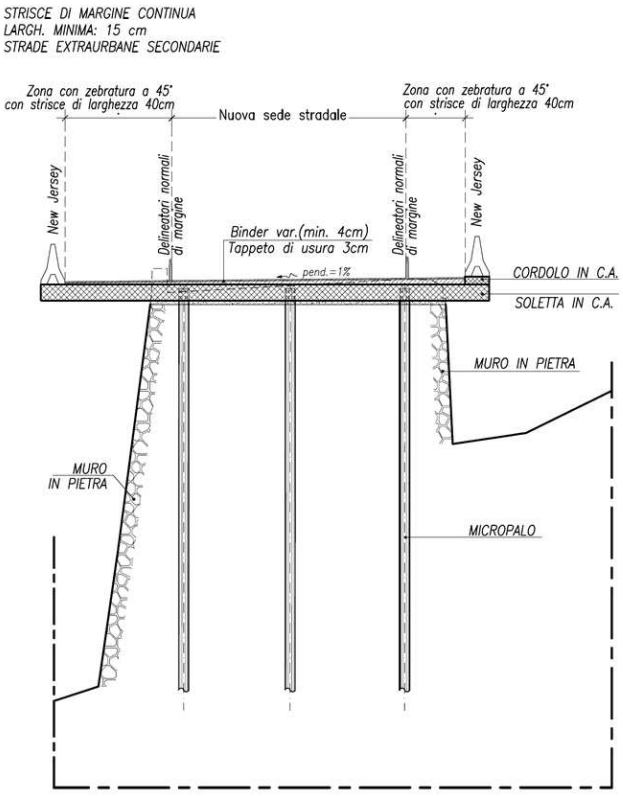

Fig. 8

were identified including, about 100 small scale “ad-hoc” projects, like: bedrock excavation to widen the road, pile bulkhead structures (Fig.7) creating manoeuvring space, removal and replacement of direction signs and safety barriers and removing trees. From an economic standpoint, it is important to identify any conflicts along the route (Fig.8), including lighting and telephone wiring. AutoTURN allows the planning to take place ahead of time, speeding up the permit stage and allowing for repositioning or replacement of any obstacles along the way.

Fig. 9

Fig. 10

The oversize convoy path along a 40 km route, with more than 100 adjustment points, did not encounter issues or conflicts with any obstacles along the path geometry (Fig.9, 10), showing the reliability of AutoTURN® for projects of this kind. ■

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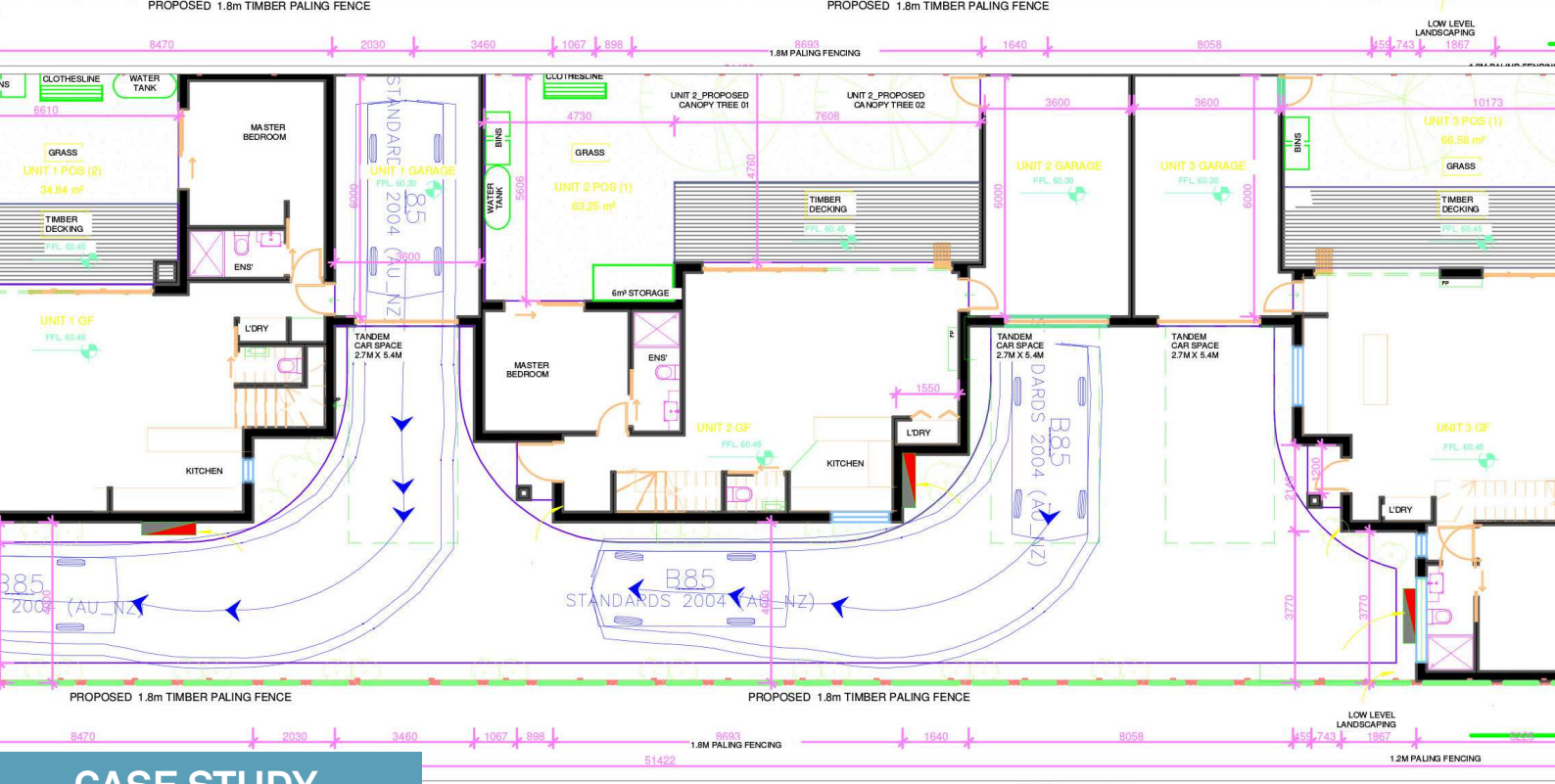
TRANSOFT SOLUTIONS



CASE STUDY

AUTOTURN

Melbourne's Streets are Safer with AutoTURN

In Australia, there are more deadly creatures than almost anywhere else on earth, from box jellyfish to great white sharks. When Australians go to the beach, there is a lifeguard there to protect them. In a way, traffic engineers are like lifeguards; they protect us from unsafe roads. Instead of a whistle and a float board, they use the latest geometric design software. While traffic engineers like Evan Boloutis won't pull you out of the surf when you are swimming, he ensures that when his fellow Australians get behind the wheel, they have confidence that the roads they drive on are safe.

Evan Boloutis has been a traffic engineer in Melbourne for 30 years. He's seen the city grow to its current size of 4.5 million people and worked on projects to expand the network of roads to handle increased traffic demands. During his career, he has worked with both State and local governments in Australia and in early 2014 he started his own traffic engineering firm EB Traffic Solutions.

According to their website, EB Traffic Solutions Ltd has extensive experience in providing swept path analysis diagrams using AutoTURN™ computer software. They use the software to assess the turning implications of a wide variety of vehicle types on design layouts in the early stages of the design process. They use that assessment to inform the design process and deliver a fast and cost efficient method of determining alternative car park and loading dock layouts, intersections and other design layouts for their clients.

EB Traffic Solutions is a one-man show (with consultants hired as needed) and Boloutis was looking for software that would do two things for his company: 1) simulate virtually any traffic/vehicle scenario with a high level of accuracy and 2) software that could save him time and money.

On any given project, he might need to show how a truck could turn into and out of a loading dock. It might seem simple, but designers need to account for variables like slope and height and they need to know what kinds of trucks can access the loading dock. Sometimes trucks can tip over if they approach the dock from an odd angle. For Boloutis, traffic engineering was always about solving problems.

"When I started out, I was always interested in the traffic engineering requirements to provide swept paths to establish whether cars and trucks could maneuver into/out of access points, parking spaces and loading bays," he said.

As Boloutis launched EB Traffic Solutions, he started seeing vehicle swept path reports created with AutoTURN associated with projects with the local governments and through private consultants. He thought the software had potential to help his company achieve similar results. "to help his company achieve similar results, since purchasing the software in 2014." he said.

AutoTURN® is the vehicle swept path analysis software of

choice for transportation engineers, architects, and planners worldwide. Trusted in over 120 countries and available in 7 languages, AutoTURN is used to analyze road and site design projects including intersections, roundabouts, bus terminals, loading bays, parking lots or any on/off-street assignments involving vehicle access checks, clearances, and swept path maneuvers.

As the designers and engineers at EB Traffic Solutions have discovered, AutoTURN is built on tried and true engineering principles and an understanding of what happens where the rubber meets the road. Engineers can design with confidence knowing that they can depend on AutoTURN to produce accurate results and generate a clear picture of whether a vehicle can manoeuvre a specific turn.

> **"AutoTURN provides me with a high level of confidence."**
>
> Evan Boloutis - EB Traffic Solutions Pty Ltd

Boloutis was hired by an architecture firm in Sydney to help them design underground parking for a multi-level residential development. He had to show the Bankstown Council that cars could safely navigate the turns along the internal ramp system and in the parking area. He developed a traffic report for the architecture firm that included an analysis of the swept paths for several types of vehicles.

The Bankstown project presented several traffic and turning scenarios that EB Traffic Solutions had to simulate to ensure the safety of the vehicles. Boloutis had to work within strict geometric parameters of the existing car park layout and the clearances were small for some of the designs.

"Basement car parks are often challenging given the constraints of ramps widths, lengths, columns, headroom clearance, ramp systems and trying to accommodate as many parking spaces as possible in a constrained environment," said Boloutis. "I was able to demonstrate that simulating different vehicle types would assist in providing an improved design which accorded with Council's requirements," he said.

An important feature within AutoTURN is the vehicle libraries, built by Transoft Solutions Product Management team. Designers often want to test the "worst case" scenario and for part of the project, Boloutis was able to use the B99 car, which was already in the library. By using this particular vehicle, he was able to show the architects where their design needed tweaking.

"The ramp and parking bays adjacent to the base of the ramp were required to be modified to accommodate the B99 car movements," said Boloutis. The underground parking garage featured two-way traffic and there had to be sufficient clearance for two cars to pass and turn safely.

AutoTURN proved invaluable for EB Traffic Solutions to simulate several kinds of vehicle types during the course of the Bankstown project. In addition to simulating cars turning into and out of parking bays in surface and basement car parks, Boloutis evaluated vehicles turning into and out of access points including access ramps, checking for conflict areas.

He was also asked to simulate different types of trucks entering and exiting loading dock facilities in industrial estates. Another important question he was asked: Could a 9.5 metre truck make the turn into and out of the construction site? Would the trucks make the turn at the beginning of the construction process and at the end? Keeping people and motorists safe was a top priority.

This software is now applied to numerous construction projects in Melbourne and Sydney, testing the ability for a range of trucks from small vans to large 25 m long mobile cranes to turn safely into and out of construction sites.

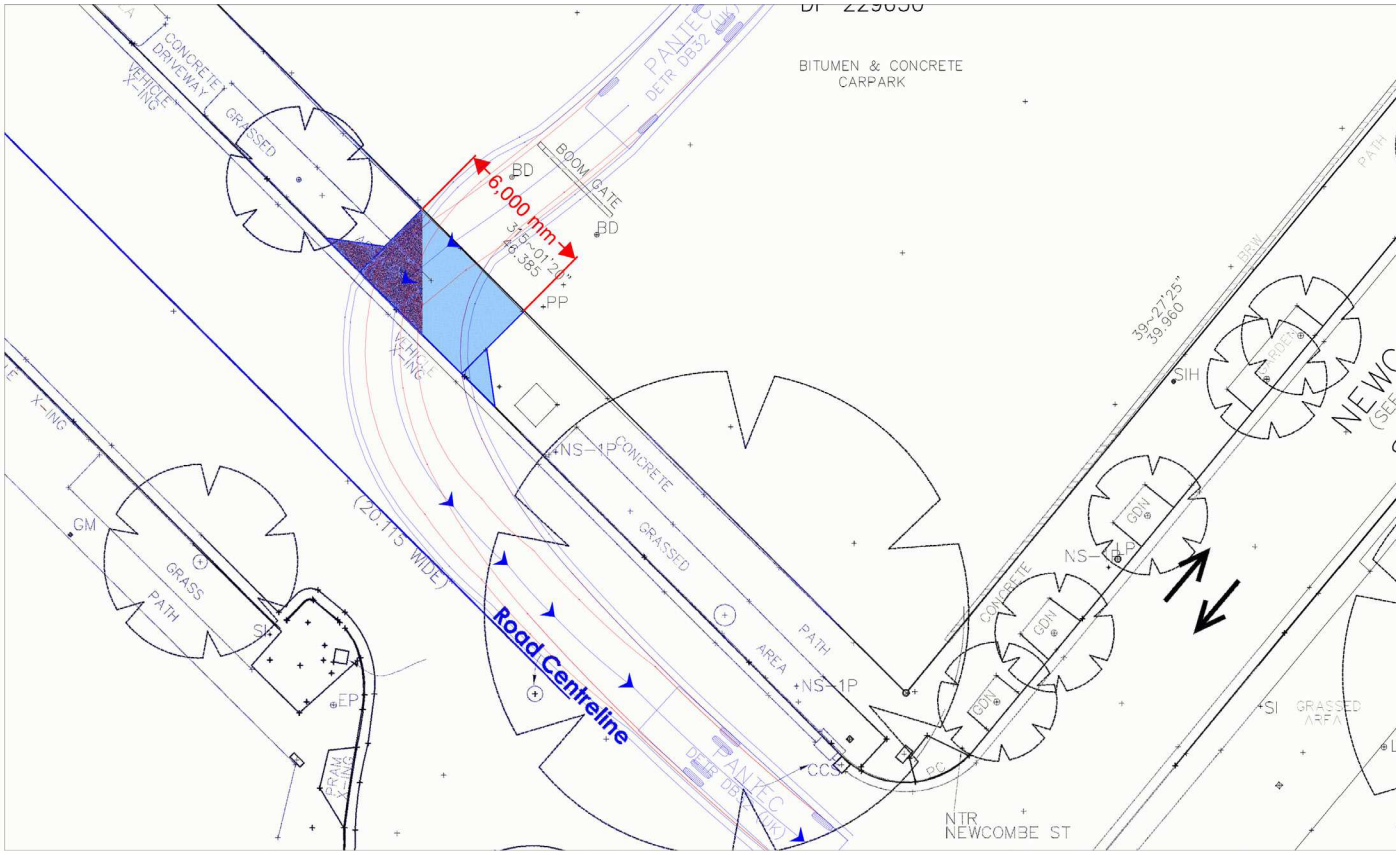
When AutoTURN was created in 1991, engineering controls were in place from the beginning to give road engineers confidence that their designs were safe. For the Bankstown project, safety was an important consideration. "I needed AutoTURN to be very precise and in this case literally within centimeters," said Boloutis.

It's because of the extensive testing that Transoft does in the field that traffic engineers like Boloutis can trust the software to produce results within centimeters. For example, in 2012 Transoft worked with two clients to test the accuracy of the software. A driving course was built to replicate a specific geometry of a planned access road. GPS receivers were placed at key points on a truck and trailer to record the location of the vehicle as it traversed the course.

Using AutoTURN and CAD software, the swept path of the simulated vehicle was matched against the recorded position of the field test vehicle. The results showed that the software produced accurate results – the maximum differences being 7 inches, which was deemed accurate enough for the scale of the project.

One of AutoTURN's greatest strengths is the software's ability to dynamically show how changing one variable can affect the entire design. Vehicle paths can be fine-tuned quickly and easily through the interface by selecting a point, clicking and dragging and the software re-calculates all the swept path information.

The relationship between speed and turning radius is a key concept that is considered in AutoTURN and the software allows engineers like Boloutis to simulate multiple vehicle types to achieve the desired results. He likes the iterative aspect of the software and when he first started using it, he enjoyed "experimenting with different vehicle types and



testing the different settings to gauge the difference in the resultant swept paths."

The software produces vehicle simulations quickly and the interface is intuitive, so evaluating different vehicles in a short period of time is easy. AutoTURN's interface and editing tools dramatically reduces the amount of frustrating trial and error efforts. For Boloutis, "It would have been too onerous and time-consuming to undertake the calculations manually," on this project.

Before Boloutis found AutoTURN, he was using manual templates published by Austroads, the association of Australasian road transport and traffic agencies. The vehicle libraries in AutoTURN were created to ensure they match the dimensions and turning characteristics of the standard vehicles for regulatory organizations like Austroads, AASHTO 'Green Book' and many other leading regulatory bodies. The vehicle simulation tools incorporate other elements like speed, super-elevation and friction that influence turning movements.

As any engineer will tell you, manual templates leave too much room for error. There are many variables to account for and mistakes could happen if the calculations are incorrect, resulting in projects not meeting the design standards.

At its core, AutoTURN gives engineers and designers confidence. The geometric calculations are built in to the software based on the real-world experience of Transoft engineers and designers. He said, "AutoTURN provides me with a high level of confidence."

With successful projects like the Bankstown residential complex in recent months, EB Traffic Solutions has the tools to bid on many different types of traffic engineering work. Within Victoria and New South Wales, Boloutis is developing an expanding client base of local government council's and Planning consultants, Architects, Construction companies, Developers and Lawyers.

"At Transoft, one of our most important design philosophies is to provide design and analysis tools that enable the designer to make their designs safer and more efficient," said Peter McIntyre, Vice President, Asia Pacific at Transoft Solutions. "Architecture firms and construction companies have to maximize the space they have and we're always pleased to see our software put to the test and pass with flying colours."

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