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ES2501 Intro to Statics
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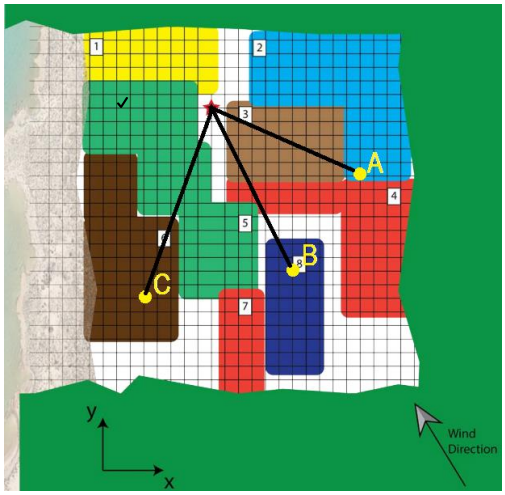
Wind Turbine Project

In order to service a remote community in the sub Saharan Africa with electricity, a balloon wind turbine manufactured by Altaeros Energies is to be installed. There are some complications with this installation however. The balloon must be tethered to the ground via cables attached to anchors in the ground. The placement of these anchors can have either a positive or negative impact on the community depending on the sector in which they are installed. Another complication is the cost of installation and the payback time of the product. The community is poor and can't afford to invest an incredibly large amount of money only to see it again three years later (for example). Our team has found anchor points that will maximize the efficiency or power production, minimize payback time, and yet have no overall negative impact on the community.

After a number of trials, we have found the single best setup for this balloon structure. The balloon is to be anchored in sectors 2, 6, and 8. Sector 2 has the lowest social impact score at -3 points. This is due to a rhinoceros migration route running through this area. Sector 8 has no influence on the social impact score, as it is scored at 0. Building in this site prevents a school from being built; however the school can still be built in zone 3 with no negative repercussions. Sector 6 outweighs the negativity of sector 2, with a social impact score of +8. This brings the total social impact score to +5, which is very good. The issue arises in sector 6, where it will cost $10,000 to build an anchor point. However, because of the high social impact score it is still preferred to build there over other sectors in consideration. The balloon is to be at a height of 59.60m (the highest height the cables can support), thus a length of 183.33 meters worth of cable will be needed. This amount of cable will cost $13,749.75. The tension in the cable cannot exceed 1,000N, and it was calculated that cable A feels a tension of 14.62N, cable B feels 10.46N, and cable C feels 999.93N. None of these tensions exceed 1,000N so it is safe to build. The total cost of this balloon project is $149,499.75, which is fairly expensive. However, the payback time is 502 days, so in about a year and a half the community will have made its money back entirely and profit off of this air balloon.



This configuration is ideal for the given scenario. The overall social impact score is +5, and the community will make its money back in a little over a year's time. This investment will serve the community in only positive ways. By providing electricity to the community, there would be much less house fires caused by candlelight, a medical infrastructure could be started to help fight sickness and disease, education access would be improved, powered water filtration systems could be installed, and many other benefits would be seen.

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Group E1a
Breakin' Wind in Sub Saharan Africa
Statics ES2501: 3D Particle Equilibrium Project

The cable configuration shown in the poster (configuration A) is an effective configuration that should be implemented in the community. For this configuration, our main goals were to have a high social score and a low cost. In order to fulfill these goals, we chose zones two, six and eight. These three zones effectively spread out the tension in the cables, increase the social impact score, and decrease the total payback time.

The zones in our cable configuration were chosen considering both cost and social impact score. The only zone of the three in our configuration that had a negative social impact score was zone two, which was in the way of the migration route of the rhinoceroses. However, zone two was also among the least expensive of all of the zones, bringing down the overall cost of the build significantly. Because zone three was left undeveloped, there were no issues in choosing to build in zone eight, which was also one of the less expensive build sites. The final zone, zone six, had the highest overall social impact score and drastically increased our total social impact score. By choosing to pay the higher cost and build in this zone, we were able support the start and growth of a local business, in effect giving the project a very positive look from the community.

Our cable placement helped to keep our configuration cost effective. It allowed us to keep the tension per cable low, enabling us to float the power generator higher, which in turn, increased the revenue per day. Thus, at forty meters high, we were able to make two hundred dollars a day and have our payback time be seven hundred and twenty-five days, or just under two years.

With such a high positive social impact score and a low payback time, it is clear that this configuration is ideal in keeping the payback time short, while keeping the community happy.

Group 3 - Essay

Written By: [redacted]

Date: 15 September 2016

[redacted] Wind Turbine Proposal

Wind power is a clean, renewable fuel source, which does not pollute the air and does not produce atmospheric emissions that cause acid rain or greenhouse gasses. The hot air balloon wind turbine by Altaeros Energies would provide clean energy to the community and provide the electricity to meet some or all of the community's requirements. The Altaeros Energies Wind Turbine would increase the number of people in sub Saharan Africa with access to electricity. Adding electricity to the community will help prevent house fires associated with using candle light, add medical infrastructure to help fight sickness and disease, improve access to education, power water filtration systems, and will provide many other benefits.

The wind turbine will need to be anchored in three locations to ensure that the balloon is held securely in place. The following locations for the anchors provide the optimal balance of cost, social impact on the community, and strength for the balloon. Anchor number one will be located at coordinates (13, 5) on the graph, which places it in sector two. This spot is ideal for low construction costs. Anchor number two will be located at coordinates (-8, -18) on the graph, which places it in sector six. This sector is currently privately owned land, but our company will pay the land owner for land use. The land owner can then put this money back into the community, therefore boosting the economy. Anchor number three will be located at coordinates (8, -19) on the graph, which places it in sector eight. This is also a great spot for an anchor, since this land is currently only an alternative school site. There are swamp gasses in this sector which can cause students to become sick. This makes it a better site for an anchor rather than a school. With the combination of these three locations, the final social impact will be plus one on our scale. The final cost will amount in the following way; balloon: $125,000, construction: $10,750, cable: $18,465, total cost: $154,215. The balloon will be at an altitude of 80 meters, and therefore generating $400 per day for the community. At this rate of income from the wind turbine, it will only take 386 days for the turbine to fully pay for itself. Not only will this wind turbine have a positive social impact of five, be paid back in slightly over a year, but will continue to be a source of income for the community will producing clean renewable energy which its inhabitants can use.

This configuration is better than placing the cables in the second configuration, which is constructing anchors at (13,5), (-8,-18), and (-8,-19) because the payback time of configuration one is significantly smaller than configuration two. Configuration one's balloon is 20 meters higher than the second configuration. This difference means that configuration one will generate $100 a day more than the second one, while managing to only be a tenth of a percent more expensive. Both have strong positive impact scores, but when it comes down to it, it is the money that makes the first one better than the second one. The extra $100 a day means the community will be debt free much quicker as well as bringing more capital into their economy.