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Extended essay cover

Candidates must complete this page and then give this cover and their final version of the extended essay to their supervisor.			
Candidate session number			
Candidate name			
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Examination session (May or November)	May	Year	2013

Diploma Programme subject in which this extended essay is registered: Peace & Conflict

(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay: To what extent can new engineering innovations such as the Shimizu Mega City Pyramid help us overcome the overpopulation problems the world currently has?

Candidate's declaration

This declaration must be signed by the candidate; otherwise a grade may not be issued.

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

This is the final version of my extended essay.

Candidate's signature: Date:

Supervisor's report and declaration

The supervisor must complete this report, sign the declaration and then give the final version of the extended essay, with this cover attached, to the Diploma Programme coordinator.

Name of supervisor (CAPITAL letters)

Please comment, as appropriate, on the candidate's performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate's own work. You may attach an additional sheet if there is insufficient space here.

does a good job with his topic. He has a great range of sources and demonstrates a good understanding of his topic. It's only challenge left is to tie together his arguments with analysis.

This declaration must be signed by the supervisor; otherwise a grade may not be issued.

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

I spent [3] hours with the candidate discussing the progress of the extended essay.

Supervisor's signature: Date:

Assessment form (for examiner use only)

Criteria	Achievement level				
	Examiner 1	maximum	Examiner 2	maximum	Examiner 3
A research question	0	2		2	
B introduction	1	2		2	
C investigation	1	4		4	
D knowledge and understanding	1	4		4	
E reasoned argument	2	4		4	
F analysis and evaluation	0	4		4	
G use of subject language	0	4		4	
H conclusion	1	2		2	
I formal presentation	~~X~~2	4		4	
J abstract	0	2		2	
K holistic judgment	~~X~~ 1	4		4	
Total out of 36	9				

To what extent can new engineering innovations such as the Shimizu Mega City Pyramid help us overcome the overpopulation problems the world currently has?

Total Word Count: 3166

The population of Planet Earth has been increasing like never before. Human beings need natural resources to survive and we only have a limited amount of these. Overpopulation can also lead to the expansion of cities and we also have a limited amount of space. Scientists and engineers are working very hard to find ways in which we can diminish these problems. Some of which are new engineering innovations and limitations to the amount of children a couple can have. With a high birth to death ratio we cannot keep operating the way we are or we will run out of resources and space, both basic necessities in life. Overpopulation is not something that can be solved from one day to another, but the human race needs to be concerned about this problem and take action for the greater good of the people and their planet.

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"The Earth is full. It's full of us, it's full of our stuff, full of our waste, full of our demands" (Gilding). Among all the major problems that are currently present in the world, one of the biggest ones is overpopulation, and humanity does not seem to realize what a big problem it is. However, overpopulation is not one single problem by itself. This raises many others like scarcity of space, scarcity of resources, climate changes, among many others. Tokyo, for example, is one of the most densely populated cities in the world that continuously keeps growing in numbers but remains the same in space. So, with a city with no space and a fast growing population, how can new engineering innovations such as the Shimizu Mega City Pyramid help us overcome the overpopulation problems the world currently has? These kinds of infrastructures, which will be able to sustain entire cities, are the new wonders of the world. Not only because they will be indeed an amazing engineering innovation that we never thought we could accomplish, but also because they will help us solve problems like overpopulation. We live in a world where human kind has evolved incredibly fast through technology and solved many problems with it. All we have to do is apply our technology and creative minds once more because overpopulation has a solution.

Over the past few years, the world population has grown significantly. According to the United Nations, the world hit a population of 7 billion on October 31, 2011 (Gallagher). The world population has been growing at a rate so fast that our planet will not be able to hold it after several years. If this continues to happen, "scientists calculated that we need about 1.5 Earths to sustain this economy. In other words, to keep operating at our current level, we need 50% more Earth than we've got" (Gilding). Overpopulation, however, is not only a problem due to the limited space that we have. This also brings other problems such as scarcity of resources, contamination of the air, and climate changes. More people means

more demands, therefore we need more resources, and the problem is that we only have a limited supply of resources on our planet. Also, when population grows, carbon dioxide emissions grow along with many other emissions. For example, more people lead to an increase in transportation, which means more vehicles, which means more contamination, which leads to even more problems. This not only implies that the contamination in the air grows, but it causes some climate changes as well.

In the last few years we have experienced climate changes unlike any others. We have had some of the hottest and driest summers, and the glaciers in the North Pole have been melting incredibly quickly. This is part of a process that most scientists have called global warming. Animals, such as the polar bear, are also affected by this event due to the fact that when swimming long distances they are not able to find a small glacier where they can stop for a rest. Global warming however, affects every single species in our planet. If glaciers keep melting, sea levels will begin to rise. Therefore, coastal cities could end up under water when the majority of the world's population lives near water. Another problem with the melting of the glaciers is that a great percentage of the fresh water supply in planet Earth comes from glaciers. If glaciers melt, then we would have to rely on groundwater and rain. Global warming could just be another cycle of our earth, however, if we take action and try to diminish what is happening, it would take longer and give humankind more time not only to realize what is happening, but to overcome such a great obstacle.

Also, Australia's East Coast lacks guaranteed water supply due to the dry climate and the continuous growing population and demands. Areas like these are growing rapidly due to the amount of space available. However, the reason why there is so much space available in these areas is because living conditions are very harsh and lack many resources like water. More importantly, densely populated areas, such as Tokyo, Japan, are

experiencing some of the worst problems that overpopulation can bring. Tokyo, which has a population of almost 37 million (List), "has become so crowded that scientists say the accumulated heat from all the human activity is changing local weather patterns. A sort of global warming but on a scale of a single city" (Tadmalge). If this is what happens with 12 million people in a single city, imagine the climate change that body heat alone is provoking in a world with more than 7 billion people and counting. If these are all things that are brought along with overpopulation then overpopulation is truly the only problem that we have. There are some countries where the government has set some legal regulations that limit the birth rate. China, for example, has what they call the one child policy which says that a couple is allowed to only have one child. However, this is not enough to improve our situation. So how can we solve these problems in cities like Tokyo which have a lack of space? One way could be through engineering innovations such as the Shimizu Mega City Pyramid.

The Shimizu Mega City Pyramid is basically a giant pyramid that has the necessary resources to support an entire city of 750,000 people. This pyramid however, would not have to compete for space in land because it would be built over Tokyo Bay. This would be a multi-purpose city combining business, residential, commercial, and leisure functions. As every engineer knows, a design is worthless if it cannot be built. It is a noble thing to dream big, but it is quite another to make those dreams a reality. However, Shimizu Corporation has been working very hard to put together this city, which would rise 12 times higher than Egypt's Great Pyramid of Giza.

According to Shimizu Corporation and Discovery Channel's - "*Extreme Engineering*", the giant pyramid would be an assembly of regular octahedral units composed of shafts made from lightweight materials such as carbon fiber. Each octahedral

unit would be formed vertically by joining two square pyramids at their bases. These units would then be combined both vertically and laterally to enable flexible expansion to suit specific purposes. The wind-permeable design would reduce wind load, while each octahedral unit would support an integrated building on all sides. Each unit would contain sufficient space to accommodate an entire 100-story office building which would be supported from both the top and the bottom. Structural stability would be enhanced by the distribution of load on various shafts. Horizontal shafts, each measuring 10 meters in diameter and 350 meters in length would contain networks and transportation. Basically, residents would actually move through the city's hollow exoskeleton via accelerating walkways, driverless pods and inclined elevators. Diagonal shafts on the other hand would each measure 16 meters in diameter and 350 meters in length. Each node would be covered with a 50 meter diameter sphere made of crystallized glass that collects sunlight and transmits it throughout the city.

A support system for such a huge city would have to be immensely strong. "Each of the 36 footings would have to support at least 50 million tons. That is 50 times the weight of the golden gate bridge" (Discovery). The multipurpose structure would have a foot print of about 3 square miles. Its open air constructions would allow sunlight to reach the interior and a network of optical fibers would serve the purpose of transporting sunlight into areas that are poorly lit. There would be no cars in this city. Much of the getting around would be done by personal rapid transit pods, which are non-polluting, computer-driven vehicles that could travel throughout the hollowed, interconnecting trusses. Due to the angles and structure of the pyramid this would be a very dangerous job for any worker out there. Therefore, the fanciful architectural plans would call for some of the city to be built by robots. The problem is that we still do not have the technology for robots to take on such a

huge and complicated task. However, not only would the base have to be extremely strong, but also the exoskeleton of the pyramid which would not only hold every single building in the pyramid, but would also be the transportation methods for the 750,000 people that could live here. Therefore, scientists have recently discovered that if this is ever accomplished, the supporting structure would have to be built out of extremely lightweight and strong materials such as carbon fiber. "This could reduce the weight of the pyramid as much as 100 times. Nanotubes can also be easily shaped into any form, and they also can last for very long periods of time. Under the right conditions, carbon atoms form nanotubes on their own and this is what scientists call self assembly" (Discovery).

Although it may sound like scientists and engineers have all of this figured out, they are still dreaming of the day when this Mega City Pyramid will become a reality. They may have found the ways in which they could build the pyramid to be able to support its immense weight, but they still have many problems in their way. First of all, carbon fiber can be very strong and lightweight, but we still have to find a way in which we can apply it for building purposes. Another problem encountered is that there's still not a strong enough concrete that can hold 50 million tons, due to its sheer weight, the pyramid would collapse on its own. Most importantly, however, Japan has a very unfortunate history of natural disasters. The "ring of fire", which is an area where a large number of earthquakes and volcanic eruptions occur in the basin of the Pacific Ocean, cuts right through Japan. The pyramid would have to be built to withstand earthquakes, tsunamis, and volcanoes. It would also be totally open to the elements and have to stand up to a powerful typhoon where wind speeds can go up to 130 miles per hour, or to a tsunami where waves can reach very high altitudes. "Since 1900, there have been a total of 17 extremely deadly earthquakes in Japan" (Hake). In fact, on April 11, 2011, an 8.9 earthquake hit Japan and

also caused a 30 foot tsunami (Alabaster), and just a few days after its one year anniversary, on March 15, 2012, a 6.1 magnitude earthquake hit just south of Tokyo (Tovrov). As we all know, the 2011 8.9 magnitude earthquake was devastating for Japan. Not only did it destroy most of the communities that were affected by it, but it destroyed families too. This is the main reason why the Shimizu Mega City Pyramid is just a dream for engineers. For this incredible structure to be built, it would have to be able to withstand these devastating natural disasters.

One can easily see why this Pyramid is just a dream. There are many problems encountered with such a huge structure in a place like Tokyo Bay. However, if this is ever accomplished, not only could it become one of the wonders of the world, but it could become one of the greatest achievements of humankind. We will still be fighting for resources and we will run out of resources in the future, but this extreme structure would be able to create new options for humankind to forget about lack of space. Cities like the Shimizu Mega City Pyramid could help us overcome overpopulation in many ways. First of all, we would stop competing for space, and cities like Tokyo would become less crowded which would lower the climate changes due to body heat concentration in a single area. Although there will be a new highly concentrated area it will not be nearly as concentrated as Tokyo. This pyramid could only sustain 750,000 people while Tokyo is home to 37 million. Carbon dioxide emission would still keep rising due to the rising population in our planet. However, other emissions that are given off by the technology that we use every day would stop growing. This is due to the enclosed transportation system that the pyramid would have. There would be no streets, everyone would travel by foot through accelerating walkways, driverless pods and inclined elevators. Therefore there would be no cars which not only means less contamination, but it also means less competition for resources like

petroleum to create gas for cars. By reducing all this contamination and conserving energy through optical fibers that would light most of the city, we could also reduce the climate changes that we are currently experiencing. If such an extreme city is ever built, we would basically commence to solve the overpopulation problems that we have in the world and we would also be finding solutions for some other major problems that come along with it, like climate change, lack of resources, and lack of space.

Planet Earth is full of obstacles placed by nature. However, overpopulation is one that we are placing upon ourselves all because of selfishness. Unfortunately, we live in a world that is not perfect where there are people who only think about themselves, and the despairing part is that most of us are like this. People only think about their future, about what will happen to them, and this all revolves around money. A business will just exploit the earth's natural resources because they, of course, get paid for the production that they accomplish. If the consumers see so many resources in stock, they are being blinded from the reality. They are forced to believe that there are plenty of natural resources and that we can just keep consuming these as much as we want. A contributing factor to the solving of overpopulation is that more partners are deciding not to have children, which is seen in the birth rate changes in the past years. However, this is also causing problems because if a couple does not have any children, they will really not care about what they leave behind for the sake of this planet and future generations. Therefore, just like the producers, they will exploit our resources and will use them for their own benefit. If we are careful with our resources and we use them intelligently, we could be able to solve problems like overpopulation. Engineers would be able to build in places where they couldn't before, and they would also be able to accomplish this without damaging the human race and more importantly they would decrease the damage that is done to our home, Planet Earth. By

building on water, some sea life is destroyed. However, there is always an opportunity cost. We have to make a decision in what is more important to preserve. If we build in land, we have to cut down plants and trees which are a basic necessity to life because without any plants or trees we wouldn't have any oxygen to breathe. As a result, building on top of a bay that has been slowly contaminated throughout the years is better than building on top of land where trees could still grow.

Overpopulation will always be haunting the human race. Population will grow in some years and it will decrease in others. However, it is such a big obstacle right now because for the past thousand years our population has been growing almost exponentially and we do not have the technology or resources required to deal with such a huge obstacle. There will be many technological advancements in the future and we will find ways through engineering innovations to temporarily stop worrying about overpopulation. However, although our planet is big, we are getting bigger. Natural resources are not infinite, we have a limited amount of resources and these are irreplaceable. Our technology is created through these resources, and many problems are created through our technology. However, if we use them carefully and intelligently we will withstand any obstacle that is put in our way. Whether it is through giant pyramids on top of the water, or creating bases on the moon, humankind will find a way to overcome overpopulation. Extreme engineering will develop very fast in our economy, but we need to start from small scaled models and test different scenarios before we jump right into Giant Pyramids on top of Tokyo Bay.

The Industrial Revolution is currently in the history books due to the rapid changes in agriculture, manufacturing, mining, transportation, and most importantly technology. This was also a period when we began to build buildings upwards to consume less space. Just like the Industrial Revolution, the Shimizu Mega City Pyramid will be in the history

books due to the new engineering innovations that helped find solutions for some of the greatest problems that we have, and that is lack of space. I believe that there will be a day, not very far from now, when engineers and scientists find a way to make this Mega City in a Pyramid a reality. In the past twelve years, we have evolved so much through technology, and we will soon enough find a way to sustain 50 million tons on top of Tokyo Bay and still be able to withstand Mother Nature's obstacles. Engineering innovations are the ones that will help us overcome overpopulation and the problems brought along with it through eco-friendly, immense cities that do not fight for space like the Shimizu Mega City Pyramid. In the past, we have gone through many problems and have been able to solve them. We have fought through obstacles and accomplished great achievements that are now seen as legendary.

Since the moment the first human was brought to this world whether by a divine power or a scientific, logical process, humankind has fought for power and territory at all costs. "Like generations before us, we'll be growing up in a war, not a war between civilizations, but a war for civilization" (Gilding). The ironic thing about this though, is that the war for civilization was not a concern when there were wars between civilizations. Overpopulation was not a problem before because death rates were higher than birth rates due to war. However, as soon as the war between civilizations slowed down, death rates decreased while birth rates increased. This meant that population was going to continue to grow which through time led to the overpopulation problems that we currently have in the world. However, for one problem to go away another does not have to rise. Unless we take action and begin worrying about overpopulation, take care of our resources, and apply them for technological purposes for new engineering innovations like the Shimizu Mega City Pyramid, overpopulation will be the last human generated problem we had.

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