THE TOSHKA PROJECT OF EGYPT: A MULTIDISCIPLINARY ENGINEERING EDUCATION CASE STUDY

Dr. Wafeek S. Wahby

Eastern Illinois University, Charleston, Illinois

Abstract

Work is currently underway in southern Egypt to connect Nasser's Lake to a natural depression, located westward in Toshka, with a 300 km (185 miles) channel, then direct the lake's surplus water up North towards the Mediterranean Sea. Nasser's Lake is the world's third largest lake, and the largest man-made freshwater lake in the world, located upstream of Aswan High Dam in Egypt. The Toshka depression is located southwest of Aswan near the Egyptian-Sudanese borders.

Started in 1998, the Toshka Project will eventually create a New Valley in the western desert of Egypt, parallel to the well known prehistoric River Nile Valley. Some of the most sophisticated of the 20th Century technologies are applied in that project.

The project, scheduled to be completed in 2004, is expected to have far reaching effects, locally and globally, on many disciplines such as land reclamation, agriculture, water resources management, energy, housing, transportation, highways, industrialization projects, business, economy, infrastructure, construction industry, environment, ecology, geology, geography, archaeology, tourism, and others.

The author administered a study abroad course in Egypt from May 30 - June 11, 2001 to investigate that impressive project. This paper is a report that summarizes information and observations gathered first-hand in word, picture, and video, during that course.

The infrastructure of the Toshka project include the Intake Canal, the Main Pumping Station (or Mubarak Pumping Station -- largest in the world), the Toshka Canal (or Sheikh Za-yed Canal), Water Production Wells and Artificial Charging, and Wind & Sandstorm Breakers.

The Toshka Project of Egypt represents a useful multidisciplinary engineering education case study. This includes the technologies used in its construction and the project's

Copyright © 2002, American Society for Engineering Education

effects back on those technologies in light of lessons learned, as well as on other areas in the 21st Century and beyond.

Introduction

Some of the most sophisticated of the 20th Century technologies are applied to construct The Toshka Project in Egypt. The author administered a study abroad course in Egypt from May 30 - June 11, 2001 to study that ambitious project as it hits the halfway mark of its construction schedule. This paper is a fresh, up-to-date report that summarizes information and observations gathered firsthand during that study abroad course in Egypt.

The scorched landscape of Egypt's southern desert is suddenly merging into lush, neatly tended vegetable plots, drip-fed with water and fertilizer. ***The Toshka Project*** aims at making the Egyptian western desert bloom near the Sudanese border and northwest of Abu Simbel city – historically famed for the colossal Pharaonic temple rescued from being submerged under Lake Nasser after the Aswan High Dam was built in the 1960s.

A giant pumping station, (*Mubarak Pumping Station*), due to be one of the world's largest, is a hive of activity as workers race to finish it by mid-2002. The pumping station has 24 pumps -- requiring 200 to 375 megawatts of power to lift water from Lake Nasser into a new canal -- *The Toshka Canal*, also known as *Sheikh Za-yed Canal* -- that is 50 meters (165 feet) higher. Water production wells and artificial charging processes are also implemented, while tree fences are planted as wind and sand storm breakers to protect the project, and a network of roads and services is being constructed.

The Egyptian Survey Authority has completed an on site survey of the canal alignment and an aerial survey of the whole area of the project covering 540,000 feddans (one feddan = 0.99 acres, approximately). These surveys are used to produce maps of various scales, to be made available to investors in infrastructure and internal works. This includes surveying branch alignments with a width of 4 km (2.5 miles) on both sides of alignment and producing contour maps at a scale of 1:5000.

The Toshka Project is a part of the comprehensive Southern Valley Development Project (SVDP) that aims to double the amount of cultivated land in Upper Egypt at a cost of $100 billion by 2017 to develop Toshka, East El-O-Wee-Nat, and the New Valley Oases. Twenty percent of that money is pledged by the Egyptian government -- which is building the main canal and its four offshoots, the pumping station, major roads and main electricity network, with agriculture being only a base for the integrated development planned. Industry, mining, alternative energy production -- and possibly oil and gas production and storage, and tourism, are parts of the vision, with plans for desert safaris, car rallies, conferences, and medical tourism.

The subsections of this paper are: *Background, The Southern Valley Development Project (SVDP), The Toshka Project, The Toshka Project Infrastructure, The Toshka Project Controversy, Future Expansion Plans, and Conclusions.*

Copyright © 2002, American Society for Engineering Education

Background

The River Nile is the longest river in the world, with the Amazon and the Yangtze Rivers being second and third, respectively. The Nile has its sources in the heart of Africa -- in Ethiopia, Uganda, Kenya, Tanzania, and Burundi. The River Nile starts as Luvi-ronza River in Burundi and terminates in northern Egypt at the Mediterranean Sea -- with its two branches, Rosetta and Damyetta, forming the Nile Delta. Its discharge is around 3.1 million liters per second, and its overall length is 6,670 km (4,170 miles), with a total surface area of 3,350,000-km^2 (1,310,000 sq. miles) -- five times the area of France.

Noticeably, almost 95% of Egypt's land is desert. The present course of the River Nile, crossing Egypt's land almost straight from South to North, is a determining factor of the topography of the region. The River Nile is the main artery for Egypt, so that Egypt is historically referred to as "The Gift of the Nile!" In a relatively rainless region, it is only because of the river's annual flood that those areas became habitable and arable.

The Nile carries water all through the year, but the amount of water it carries, varies depending on the season. The yearly flood of the Nile is caused by late summer rains in the plateau region of Ethiopia, which in turn swell the tributaries of the Nile. At the peak of the flood, the volume of the river's flow increases by as much as 16 fold.

Variable amounts of rainfall to Ethiopia cause stunning differences in the amount of flooding seen farther down the course of the Nile. A "fat year," such as 1878-79, saw the level of the river increase by 155 billion cubic meters of water (4200 billion cubic ft). In a "lean year," such as 1913-1914, only 12 billion cubic meters of floodwater (324 billion cubic ft) swelled the river. Alarmingly, in some years the river did not rise at all, causing widespread drought and famine.

Around 105 million people live along the Nile, with 2/3 (70 millions) of those in Egypt. About 95% (66 millions) of Egypt's population reside in the narrow strip of the Nile Valley and the Nile Delta to the North, both resembling only 5% of Egypt's land. During the 1890's, agricultural production was being outstripped by the growth of the population in Egypt and the Sudan. The Nile had to be controlled if there was to be agricultural stability along its banks. Harnessing the power of the Nile would also yield the hydroelectric energy necessary for industry.

To the increasingly industrial societies of the region, the choice was clear. In 1899, construction of ***The First Aswan Dam*** was begun South of Aswan -- 685 kilometers (425miles) South of Cairo. Completed in 1902, its height had to be raised in the subsequent building campaigns of 1907-12 and 1929-34. Even with these renovations, the first -- or "Low"-- dam proved to have an inadequate reservoir area. In the event of extreme flooding, it would be necessary to open the sluices of the dam to relieve the water pressure against it, flooding the areas thought to be protected.

Copyright © 2002, American Society for Engineering Education

The need for a second dam at Aswan soon became evident. In the early 1950s, designs began to be drawn for what was to become ***The Aswan High Dam*** **(**Es-Saad-del-Aa-lee**)** to achieve three main objectives: flood control, hydroelectric power, and irrigation. With the signing of the Nile Water Agreement by Egypt and the Sudan in November of 1959, work began on that second dam -- further South of The First Aswan Dam -- and was completed in 1970 with a cost of over US$ One billion. The Aswan High Dam was built across the River Nile to completely block its natural course for the first time in history. It forever stopped the annual flood cycle of the Nile for Egypt's part, downstream of it. Since then, precise control is practiced on floodwater -- now passing only through special sluice gates into the gigantic High Dam power generation station.

The Aswan High dam is a colossal work, and one of the largest and most impressive embankment, rock/earth, gravity dams in the world. Rock used in its construction is enough to build 17 Great Pyramids of Giza! The base thickness of the Aswan High dam is almost one kilometer (0.6 miles) -- which tapers off to 40 meters (135 ft) at the top -- while its length is 3.6 km (2.5 miles), and its height is 111 meters (370 ft).

Water retained upstream of The High Dam, created ***Lake Nasser***. With an area of about 4,015 square kilometers (1,550 square miles), and total storage capacity of 170 billion m^3 (5.97 trillion cubic feet), Lake Nasser is the world's third largest reservoir, and also the largest ever man-made, fresh-water lake in the world. It reached its full storage capacity for the first time in 1981.

Lake Nasser is 570 km long (360 miles) -- of which 150 km (95 miles) belong to the Sudan -- with its width ranging from 10 to 30 km (7 to 20 miles). Water level in Lake Nasser ranges between 187 ms -- 620 ft (highest) and 134 ms – 445 ft (lowest), with almost 15% of its water lost annually to evaporation. Before The Aswan High Dam was built, the River Nile overflowed its banks once a year and deposited 4 million tons of nutrient-rich silt on the valley floor. Now, that same amount is deposited on the floor of Lake Nasser.

Toshka is a region located to the South in the Egyptian western desert – specifically to the South-West of Aswan. As ***The Toshka Project*** is discussed, it is important to differentiate between the following:

- Toshka Region
- Toshka City
- Toshka Depression (*Mon-kha-fadd Toshka*)
- Toshka Bay (*Khore Toshka*)
- Toshka Spillway (*Ma-feed Toshka*)
- Toshka Canal (*Sheikh Za-yed Canal*)

The Toshka region is located South-West of Aswan. *Toshka city* is a new metropolitan city that is planned to serve a future population of 5 million. *Toshka depression* is a natural depression in that area with an average diameter of 22 km (14 miles), and a storage capacity of 150 billion m^3. *Toshka Bay* is a shoot of Lake Nasser towards Toshka. *Toshka Spillway* is a 21 km (14 miles) man-made canal connecting Toshka Bay with the

Copyright © 2002, American Society for Engineering Education

Toshka Depression that works as a safety valve upstream the High Dam -- a free spillway discharging the water of Lake Nasser that exceeds its highest storage level of 178 ms.

Toshka Canal or *Sheikh Za-yed Canal* is the soul and heart of the Toshka Project. It is a new canal conveying the water of Lake Nasser that is pumped into it through a giant pumping station to elevate it about 50 ms (165 ft) then flows through it to reclaim and irrigate 540,000 new feddans (533,520 acres) in the western desert of Egypt.

The Toshka Project simply involves excavating that canal to carry about 5.5 billion m^3 of water from Lake Nasser to the New Valley. The canal inlet starts from a site lying 8 km (5 miles) to the north of Toshka Bay (Khor) on Lake Nasser. The canal course moves westward until it reaches Darbel-Arbee-een route, then moves northward along Darbel-Arbee-een to the Baris Oasis, covering a distance of 310 km (190 miles). The Toshka Project is an integral part of a much larger, mega project: "The Southern Valley Development Project" (SVDP).

The Southern Valley Development Project (SVDP)

Background

The Southern Valley Development Project (SVDP) is a multifaceted, multiphase, development project of the southern part of the Nile Valley in Egypt that mainly involves horizontal expansion and land reclamation projects.

SVDP is not a mere irrigation or agricultural project. Rather, it is a national, integrated, massive development project, aiming mainly at creating a balanced, re-organized Egyptian map from the demographic, habitation, economic and security points of view. Total investments for implementing this project by 2017 are estimated at some L.E. 305 billion (US$ 100 billion), of which 20% - 25% are to be contributed by the government and the remaining part by the private sector.

Objectives

1. Adding new areas of agricultural land lying in the Southern Valley region.
2. Establishing new agricultural and industrial communities based on the exploitation of the agricultural raw material available in the new land.
3. Attracting and retaining work force, thus gradually dealing with the problem of over population in the old valley.
4. Constructing an efficient network of main and side roads in accordance with the development objectives and plans.
5. Promoting touristic activities in such regions rich in ancient monuments.

Development Locations

Development is currently being carried out in three regions:

1. East El-O-Wee-Nat: Located about 500 km (170 miles) to the west of Aswan.
2. Darbel-Arbee-'een: Located to the south of the Kharga and the Dakhla Oases.

Copyright © 2002, American Society for Engineering Education

3. Toshka: Located about 250 km (85 miles) south of Aswan, and 50 km (20 miles) to the west of Abu Simbel.

The Toshka Project

The area of land to be reclaimed during the first phase of the project is estimated at about 540,000 feddans (533,520 acres). Land of the project will be irrigated through the currently-under-construction main pumping station -- 8 km (5 miles) North of Toshka spillway -- with total capacity of about 25 million m^3/day (675 million ft^3).

Water pumped from this station will be jetted out through a main canal -- ***Sheikh Za-yed Canal*** – that branches into four sub-canals, with a total length of about 250 km (160 mile). The lifting station is expected to start operating in 2002. To serve ongoing reclamation projects, the area is equipped with a power grid and an excellent network of roads. Over 140 km (90 miles) of new passageways and asphalt roads, besides another 600 km (375 miles) of rehabilitated roads were completed, which form an efficient and vital communication and transportation network.

Excavation work in the Toshka Project is sizable. Total excavation work is 85 million m^3 (3,100 million ft^3) -- seven times that needed in the construction of Aswan High Dam (only 12 million m^3 -- 445 million ft^3). To date, 75 million m^3 out of the total 85 million m^3 that are expected for the Toshka Project are complete, while 8 million m^3 out of 15 million m^3 of sand filling work are accomplished.

Basalt and gravel for concrete work are provided locally from Toshka area, while sand is transported from the nearby Kom-Ombo (100 km – 65 miles), and the cement from AssYoot (350 km – 220 miles). Patching plants are located at 5 km (3 miles) intervals and eight mixing units produce over 1000 m^3 (37,000 ft^3) per day. Special chemical additives are incorporated to the water used for mixing and curing concrete to keep its temperature at 7^o C (45^o F).

Currently, 5 companies are working on the site using 7 padding machines to pad the sloping sides, and a short horizontal part at both the berm and the bed levels. The bottom segment of the canal padding is manually lined using mechanical concrete mixers, pumps, and vibrators for concrete pouring and placement.

The Toshka Project Infrastructure

I. The Main Pumping Station (*Mubarak Pumping Station*)
II. The Toshka Canal (*Sheikh Za-yed Canal*)
III. Water Production Wells and Artificial Charging
IV. Wind & Sand Storm Breakers

I. The Main Pumping Station

The Toshka Project starts with the main pumping station – also known as *Mubarak Pumping Station* -- located on the left bank (West) of Lake Nasser, North of Toshka Bay

Copyright © 2002, American Society for Engineering Education

(Khore Toshka). More specifically, the Pumping Station is located 8 km (3 miles) North of Khore Toshka spillway canal, 45km (15 miles) South of intersection with the Abu Simbel /Aswan main highway. From this intersection it is 215 km (72 miles) to Aswan Northward, and 60 km (20 miles) to Abu Simbel Southward. When completed, it will deliver 334 m^3/sec in the main feeding El Sheikh Za-yed Canal, also under construction to irrigate 540,000 feddan (533,520 acres).

The Mubarak Pumping Station Project (MPSP) is also an integral part of the New Valley Development Project (NVDP), the purpose of which is to establish an agro-industrial development in an area of about one million feddans (400,000 hectare or 988,000 acres).

The multi-stage pump station is the world's largest, designed to have a maximum static head of about 52.5 ms (158 ft) to guarantee its operation when the water level in Lake Nasser reaches its lowest level of storage, namely 147.50 ms (490 ft), while the main canal water level at its head is 201 ms (670 ft).

Twenty-four pumps, (12 each side), each with a discharge capacity of 16.7 m^3/sec, will be housed inside the pumping station. The design discharge of the pumping station is estimated to be 25 million m^3/day.

The maximum energy necessary to operate the station during maximum lifting is 375 M.W. The station will be fed with 11 kV electrical power through a transmission line from a substation constructed close to the 11 kV switchgear building that is linked to the electric power double 220 kV line from Aswan High Dam with a length of 250 Km (160 miles).

Excavation works have started at the station site on June 1,1998. The station is scheduled to be completed in 2002, at a cost of LE 1.48 billion (US$400 million). Under a turnkey lump sum contract, with operation supervision during a guarantee period of 48 months, the MPSP includes the design, construction, and maintenance of the following:

- An intake channel, 4.5 km (3 miles) long, conveying water from Lake Nasser to the Suction Basin of the Pumping Station. Part of the channel -- 1.5 km (one mile) -- is dry excavation (volume of excavation is 5.2 million m^3), and the rest -- 3 km (2 miles) is wet excavation (volume of excavation is 5.45 million m^3). The wet excavation is done using 3 gigantic dredgers -- world's largest: 60 ms arm length (200 ft), for excavation under water down to level 134 m.
- A reinforced concrete pumping station having length x width x height dimensions of 140 x 40 x 70 ms (420 x 120 x 210 ft) located as an island in the center of the Suction Basin. The lower 50 ms of its height will be submerged underwater.
- Twenty-four discharge concrete ducts having width x height dimensions of 2.70 x 2.40 ms (8 x 7.2 ft) delivering the water from the pumps to the Sheikh Za-yed Canal via the Discharge Basin.
- Two annex buildings housing the 11 kV switchgear and the diesel generators.
- Three workshops: electrical workshop with laboratory, mechanical workshop, and automotive workshop.

Copyright © 2002, American Society for Engineering Education

II. The Toshka Canal

Also known as *Sheikh Za-yed Canal,* is the main canal of the project, having a length of 70 Km (44 miles) that branches into four sub-canals, with a total length of 250 km (160 miles). The canal is designed to carry a discharge of 25 million m^3/day to reclaim and irrigate 120,000 feddans, 120,000 feddans, 200,000 feddans, and 100,000 feddans, respectively -- total of 540,000 feddans -- an area equivalent to the combined areas of three neighboring governorates: Aswan, Kena, and Sue-Haag.

The maximum design water depth in the canal is six meters (20 ft), and the bed width is 30 meters (100 ft), with a longitudinal slope of 10cm/km (6.5 inches/mile). The side slopes of the canal are 2:1, making the width at its top 60 ms (200 ft). While the evaporation from the canal is estimated to be 0.7%, its cross section is being lined with dense concrete to prevent any water leakage. After excavation to the required section, a 20 cm thick layer of stabilized soil -- compacted sand/cement mixture is placed. Before pouring the final 20 cm padding concrete layer onto that sub base, polyethylene sheets, 1 mm thick, are placed on top of the sub base stabilized soil layer to completely cover and "seal" it.

Two aggregate excavating and processing systems have been constructed and are able to supply coarse and fine size aggregates for concrete mixing. With the addition of two other concrete batching plant systems, the concrete production rate could reach 2,380 m^3 (86,000 ft^3) per hour, which can satisfy the capability of 550,000 m^3 (20 million ft^3) per month concrete placing. Each batching plant has its own cooling system that guarantees a 7^{o} C temperature for cooling concrete even in extremely hot weather.

To date, 110 km (70 miles) have been completely excavated, of which 40 km (25 miles) have already been also padded. The strict commitment to the work-plan helped complying with the schedule set for concrete-padding works, even under extremely unfavorable weather conditions. The operating rates amounts to more than 110 longitudinal meters (370 ft) per day and in some cases might exceed 130 (440 ft) longitudinal meters per day. Quality assurance and quality control procedures guarantee that code requirements, technical specifications, proper work practices, and safety measures are rigorously followed in all engineering works.

III. Water Production Wells and Artificial Charging

The pumping station and the main canal with its four branches are scheduled to be completed in 2004. Currently, water required for various applications is supplied through the available groundwater stored in the local aquifer. Along the main canal, 5 productive wells were constructed to irrigate about 750 feddans (740 acres). However, to fully utilize the available ground water, another 200 wells are being dug to serve an area of about 30,000 feddans (29,650 acres). The construction of those wells is scheduled to be completed in 2002.

Meanwhile, the Ground Water Research Institute (GWRI) carried out studies to use the excess in floodwater, which has been discharged to the Toshka Depression since 1996/97

Copyright © 2002, American Society for Engineering Education

to charge the Nubian ground aquifer. Artificial charging is now being carried out with an expected initial cost of about 7 million Egyptian pounds (US$ 3 million).

IV. Wind & Sand Storm Breakers

Wind & sand storm breakers comprising two rows of Kaya and Ponsiana trees are being planted on each side of the main canal as well as its four branches to protect them from the wind and the sand storms that ravage this region throughout the year. Almost 100 km (65 miles) of trees have been planted to date.

The Toshka Project Controversy:

The Toshka Project has attracted the attention of many individuals and groups in Egypt as well as worldwide and created much controversy on whether it is a mirage or marvel? Some are so enthusiastic and optimistic about it, to the extent of calling it "The New Delta Project" or "The Inverted Pyramid Project." On the other hand, The Toshka Project also has fierce critics, ranging from environmentalists worried about its demands on Nile water to economists who question its profitability.

Advantages of the Toshka Project:

For the enthusiasts and the optimistic, the advantages of the Toshka Project outweigh the disadvantages, though both seem equally compelling. Obviously, however, the decision-makers in the Egyptian Government seem to believe more in the advantages, which made the project move forward. Some of those advantages may be summarized as follows:

1. Dealing with the complex problems arising from skyrocketing population growth in Egypt including jobs, food, housing, health, education, and transportation.
2. Doubling the amount of cultivated land in Upper Egypt.
3. Utilizing the massive amounts of water stored in Lake Nasser.
4. Power generation projects.
5. Navigation and water transportation.
6. Promotion and development of fishery, tourism and recreational activities.
7. Reaching new areas with fresh water and creating favorable conditions for the South-to-Northwest Water Transfer.
8. Possible new archeological discoveries.
9. Relieving Lake Nasser from silt accumulating on its bed since the building of Aswan High Dam in the 1960's and alleviating its negative effects on the Lake's capacity as well as the High Dam Stability.
10. Construction of the new Toshka city that would serve a population of 5 million to relieve the over crowded old valley.
11. Available botanical and animal resources can be utilized in several pharmaceutical and fish-processing industries.
12. The development in the environment in the area of the new project is expected to attract wild birds and animals.
13. Solar and wind energy can be used in generating clean electrical power to meet expected demand.

Copyright © 2002, American Society for Engineering Education

Disadvantages of the Toshka Project:

The critics of the Toshka Project raise serious points to support their opposition to that project; points unaccepted by the decision makers as the project moves forward. Some of those disadvantages may be summarized as follows:

1. Economists question the project's profitability and claim that Egypt is pouring money into desert reclamation; wasted finances that could have been used more productively in health care, housing and education urgent needs.
2. This project, in addition to other concurrent mega-projects in Egypt, is causing liquidity and cash flow crises by sucking the lifeblood out of the economy.
3. Poor cost-benefit analysis of the project.
4. Historically, Egyptians resist moving from their homes to new settlements in the desert, and the Toshka project is no exception.
5. Environmentalists are worried about the project's demands on Nile water, claiming that diverting water that is badly needed in the traditionally most fertile land of the Nile Valley is poor and unrealistic water resources management.
6. Egypt could even run short of water if other Nile basin countries to the South should build dams and divert some of the flow.
7. The negative effects that such project may have on the River Nile ecology.

Future Expansion Plans

A minimum of 20 billion m^3/year of water at Aswan can be saved by implementing water conservation projects in the upper Nile sub-basin, through the cooperation between Egypt and the Nile basin countries. This excess amount of water would be used to completely fill the Toshka Depression -- through the Toshka Canal and the Toshka Spillway -- turning it into a permanent storage reservoir that could be used as a stable water supply for irrigation.

A new canal would then be constructed to convey water from the depression northward towards the Cut-taara Depression through the western desert of Egypt, forming a new green valley parallel to the existing valley. This would create new communities aiming to expand the Egyptian habitation land from the current 5% to about 25% of Egypt's area. Water would eventually be directed northward, as a second branch of the Nile and parallel to it, towards the Mediterranean Sea.

Conclusions

The construction of The Toshka Project is already in its 4^{th} year, and is expected to be completed by 2004 with an estimated cost over L.E. 6 billion (US$ 2.5 billion). The Egyptian government wants to reclaim and cultivate some 540,000 feddans (533,520 acres -- 2,268 sq km -- 890 sq miles) around Toshka to deal with Egypt's population explosion, crowded cities and falling per capita farm output.

Copyright © 2002, American Society for Engineering Education

Technology is stretched to the limit in the construction of The Toshka Project in Egypt. Production rates never before attained are becoming the norm in order to get the sizable project on schedule. Technology is being challenged as never before and the same technology applied will never be the same after the completion of the project in light of lessons learned.

The first fruits of the promising success of the Toshka Project can be witnessed in many locations such as that around the productive well No. 21 at the 72 km landmark. At that location, the volume and density of the green color of vegetables, fruits, and flowers, extend for almost 60 feddans -- wholly cultivated in an area previously thought of only as barren, uncultivable desert.

References:

1. ***"The Southern Valley Development Project (SVDP),"*** Official Publication, Ministry of Water Resources and Irrigation, Arab Republic of Egypt, October 2000.
2. ***"The Toshka Project,"*** Official Publication, February 1999.
3. Wahby, Wafeek S.; **"Egypt 2001,"** Report on a Study Abroad Course in Egypt, Eastern Illinois University, Charleston, Illinois, May 30-June 11, 2001.
4. Younan, N.A., ***"Horizontal Expansion Projects in the Southern Part of the Nile Valley,"*** Toshka Project Consultant, Consultative Bureau for Civil Constructions, Alexandria, Egypt, June 2001.
5. Ramsis, Hatem, ***"Construction Details of Toshka Project,"*** Toshka Site Engineer, Consultative Bureau for Civil Constructions, Alexandria, Egypt, June 2001.
6. Kadry, Ekram, ***"Toshka Project Soil Investigations,"*** Toshka Office Engineer, Consultative Bureau for Civil Constructions, Alexandria, Egypt, June 2001.
7. Abdel-Rahman, Mohammed, ***"Mubarak Pumping Station,"*** General Manager Mubarak Pumping Station, Toshka, Egypt, June 2001.
8. Hass-ssan, Abdel Fat-Tah, ***"The Toshka Project Construction Works,"*** General Manager of Toshka Research and Engineering Studies, Toshka, Egypt, June 2001.
9. Taha, Hussain, ***"The Toshka Project Construction Works,"*** General Manager of Toshka Quality Control, Toshka, Egypt, June 2001.
10. Abol-Hag-Gag, Saay-yed, ***"Experimental Plantation Projects in Toshka,"*** Manager of Abu Simbel Station for Agricultural Engineering, Abu Simbel, Egypt, June 2001.
11. El-Hag-Gar, Mohammed, ***"New Crops Bloom in Toshka,"*** Manager of Toshka Department of Plantation, Toshka, Egypt, June 2001.
12. http://www.planetark.org/dailynewsstory.cfm?newsid=9340&newsdate=17-Dec-2000 Nabil El-Khodari, ***"Toshka: Mirage or Marvel?"*** Reuters News Service, December 2000.

WAFEEK SAMUEL WAHBY

Wafeek Samuel Wahby is an Associate Professor of Construction Technology, and the Industrial Technology Program Coordinator at the School of Technology, Eastern Illinois University, Charleston, Illinois. He is also an active member of the American Society for Engineering Education (ASEE), the American Society for Civil Engineers (ASCE), The Masonry Society (TMS), the American Institute for Timber Construction (AITC), the American Concrete Institute - International (ACI) and its Committee 548-Polymers in Concrete, and others. Dr. Wahby received his Ph.D. in Civil Engineering from Alexandria University, Alexandria, Egypt, in 1988.

Copyright © 2002, American Society for Engineering Education

Acknowledgement:

The author is indebted to a long list of colleagues, friends, and staff at Eastern Illinois University and elsewhere for their help, advice, and support of "Egypt 2001" -- the EIU study abroad course. Special thanks are due "my friends"-- Egypt 2001 participants -- for their enthusiasm and interaction that made the course a memorable success. My deep appreciation goes to Dr. Mahyar Izadi, Chair, School of Technology, Dr. Ted Ivarie, Former Dean, Dr. Martha Brown, Acting Dean, Lumpkin College for Business and Applied Sciences, and Dr. Bob Augustine, Dean, Graduate Studies and International Programs for their continual and unfailing support of Egypt 2001 since its inception. For valuable information and warm hospitality, a word of gratitude is due our Egyptian officials, colleagues and friends in Egypt: The Honorable Dr. Yousif Waaly, Minister of Agriculture, The Honorable Eng. Ibrahim Khalil, Deputy Minister and Senior Under Secretary of Agriculture, Dr. Mamdooh Riyadd, Director of the Central Office for Environment, His Excellency Eng. Mohammed Saddeek, Mayor of Abu Simbel, Eng. Abdel Fat-Tah Hass-ssan, General Manager of Toshka Project Research and Engineering Studies, Eng. Hussain Taha, Manager of Toshka Project Quality Control, Eng. Mohammed Abdel-Rahman General Manager, Mubarak Pumping Station, Eng. Mohammed Khala-Fal-lah, Director of Toshka Projects Follow-up, Eng. Saay-yed Abol-Hag-Gag, Manager of Abu Simbel Station for Agricultural Engineering, Eng. Mohammed El-Hag-Gar, Manager of Toshka department of Plantation, Prof. Dr. Nazieh Younan, Civil Engineering Consultant of Toshka Project, Eng. Hatem Ramsis and Eng. Ekram Kadry of the Consultative Bureau for Civil Constructions. Special thanks are due Lisa Dallas, Assistant to the Dean, for her help with the PowerPoint presentation of this paper.

Copyright © 2002, American Society for Engineering Education