



The Design and Construction of the World's Largest Surf Pool

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INTRODUCTION

Tourism is increasingly one of the top income earners in Malaysia and many other countries, with millions of tourists visiting Malaysia each year and even higher numbers expected in 2007 - the Visit Malaysia Year (VMY).

Tourist arrivals have steadily risen from 3 million in 1983 to about 16.4 million last year. Tourist spending has also experienced similar increases from just RM 5 billion in 1990 to RM32 billion last year [1]. The positive impact of tourism on the national economy represents significantly higher revenues for the Malaysian private sector, from hotels and airlines to consumer goods.

Some countries assisted by the blessing of mother-nature possess beautiful natural landscapes that attract millions of tourists every year. Places like the beautiful South Island of New Zealand, the scenic snow capped mountains of the European Alps, the World Heritage listed Jiu Zhai Gou valley in China that is home to the Giant Panda, the awesome Niagara Falls in America and many other natural scenic locations attract million of tourists every year. Other places need to supplement their natural environment with structures to attract tourists.



Figure 1: The Great Wall of China

When the first emperor of China, Shih Huang Ti ordered the construction of the Great Wall 2000 years ago, the only intention was to prevent the Tartars from invading his empire. Little did he realise that the wall he had built would become a world famous tourist attraction and the most photographed structure in China. Every year millions of Chinese make a

pilgrimage to the Great Wall to visit the world's largest man-made structure.



Figure 2: The Great Pyramid of Cheops

A few thousands years earlier, the Egyptians constructed the pyramids as a tomb for their dead pharaohs and their treasures. Today, the awesome and inspiring structure of the Pyramid of Cheops, the magnificent and stately structure of the Great Sphinx and the Step Pyramid of Zoser has completely surpassed the intentions of their ambitious builders. They not only symbolize Egypt of today but they are also the country's main tourist attraction. Millions of tourists from all over the world regardless of nationality visit these structures every year.

These two examples illustrate structures that unintentionally have become magnets for attracting tourists. There are many examples of temples originally built as places of worship that have become major tourist attractions including Angkor Wat in Siem Reap, Cambodia, and Roman and Greek temples built during the glorious years of the Roman Empire and the early Greek civilization.

Today, many structures are built around the world every year with practical and commercial intentions, that also have the secondary aim to woo tourists. The recently completed Taipei 101 - the world's tallest and most technologically advanced skyscraper constructed to date, our own Petronas Twin Towers and the numerous arenas and stadiums, and convention centers in the world come to mind. While the

pyramids are recognised as the sole remaining example of the Seven Wonders of the Ancient World, a modern-day structure is being hailed as a worthy contender. This author has had the privilege of personally witnessing the completion of the Eden Project at Cornwall, England. The Eden Project (Figure 1) is a large-scale environmental complex with transparent tropical biomes housing plants from around the world. The Eden Project has become one of the most popular tourist attractions in the United Kingdom since the site was opened in September 2005.



Figure 3: The Eden Project in Cornwall, England

THE SUNWAY THEME PARK SURF POOL

The majestic figure of the Lion's Head at the entrance of the Sunway Shopping Mall has become synonymous with tourism in Malaysia. Therein lies the gateway to the city of Sunway, its landmark hotel, the glitter of the Sunway Shopping Complex and the Sunway Lagoon Theme Park.

The Sunway Lagoon Theme Park is renowned for its Surf Pool, which has a surface area of approximately 20,000 m² and it is the largest wave pool in the world. The Sunway Lagoon Theme Park Surf Pool is located in the centre of Bandar Sunway on an existing lake.

The design and construction of the world's largest wave pool was a challenge to the engineers and builders involved. Suncity, the client of the project, placed enormous emphasis on the environmental aspect of the project, and stressed that the construction of the wave pool must not



Figure 3: Installation of micropiles from a pontoon

negatively impact the existing lake. Retaining the functionality and beauty of the lake was a prerequisite and Suncity rejected a more cost effective option of back filling part of the lake to construct the surf pool on reclaimed land.

The entire wave pool is supported on 1597 micropiles driven into the limestone bedrock. The micropiles were designed for both compression and tension to satisfy the three load cases. The micropiles not only support vertical loads, but also resist the lateral loads created during the generation of the 2.4 metre wave. Raking piles are provided at the platform that houses the wave generating machine. Raking piles were also provided systematically along the floor of the Surf Pool.

A total of 12,000 m³ of concrete and 2,500 tonnes of steel were used in the construction of the wave pool. At the plant room, the columns rising from the pile caps supports the beams and slabs and the 12 wave generating machine. At the other area of the wave pool, RC beams frame onto the individual micropiles, which acts as a column. The volcano on top of the plant room is supported by a structural steel frame



Figure 4: Aerial view of micropiling works

which rises 23 metres above the plant room. A total of 170 tonnes of structural steel was used for its construction.

The construction of the wave pool displays subtle innovation in both the piled foundation and the structure works. The whole construction of the wave pool is carried out by lowering about 1 metre of the water level. Micropiling machines were mounted on pontoons and anchored onto the bed of the lake before drilling began. The micropiles were installed using the Octa system, where the casing is driven into the limestone as the hammer advances into the limestone. When the required socket length is achieved, Grade 30 cement mortar is then pumped to the base of the micropiles until the mortar rises to the top of the casing. This method not only ensures that the cement mortar column is not tainted with impurities, but the high pressure also forces the cement mortar into the rock fissures, thus cementing the base of the micropiles.

The structural elements were formed using precast 'U' trough and hollow core slab as permanent formwork supported by temporary steel staging and Brackets with Lysaght Bondek steel decking used at the plant room.

At the wave pool, steel brackets were welded to the casing of the micropiles. Due to the sloping and radial shape of the wave pool in the plan, the level of the steel brackets is determined at each micropile location. Precast 'U' troughs were launched onto the steel brackets from the pontoon initially and later, on the partly completed RC deck. Subsequently, precast hollow use slabs were placed to span the precast 'U' trough, thus forming a trafficable deck for the placement of reinforcement and subsequent concreting. At the plant room, temporary steel staging and the combination of temporary formwork and Bondek was



Figure 5: Aerial view the construction work in progress



Figure 6: Precast 'U' trough supported by steel brackets

used for the construction of the soffit of the plant room and wave machine.

The Sunway Lagoon Surf Pool provides a surfing area of 800m² and an 11,000m² beach front for beach activities. The Surf Pool not only provides the opportunity for the swimmers to swim amongst the waves but it also allows surfers to ride on the 2.4 metre high waves. This feature has created opportunities for surfing to be a sport away from the sea. The Surf Pool also incorporates a stage for concerts and restaurants. Overlooking the facility is volcano created on top of the plant room that emits fire and smoke with a waterfall gushing out from the cave. The initial success of the surf pool as a tourist attraction and landmark, combined with the beauty of the lake, has achieved all of the aims of the Suncity developers. ■

REFERENCES

- [1] Statistics from the Ministry of Tourism Website [Online]. Available: http://www.motour.gov.my/laman_web/index.php?page=statistik [Accessed 13 November 2006]