Demolition of the Athlone Cooling Towers

DEMOLITION OF THE ATHLONE COOLING TOWERS

Technical Excellence category
Submitted by the SAICE Western Cape Branch

KEY PLAYERS

Client City of Cape Town – Electrical Services

Professional Team

Kayad Knight Piésold (consulting engineers), KP Energy, HB Architects, IT 90, Ward Karlsson, Engelbrecht & Associates

Main Contractor Jet Demolition

Major Subcontractor Ross Demolition

The Athlone Cooling Towers, also known as the "two ladies of Athlone", used to be a distinctive Cape Town landmark. In February 2010, however, the stiffening rings on Tower One failed and the entire tower was at risk of collapsing. Following inspection and evaluation of the towers, it was recommended that both towers be demolished as a matter of urgency. Kayad Knight Piésold Consulting was appointed as consulting engineers and on 22 August 2010 the towers were imploded, collapsing exactly onto their footprint, as designed. The demolition was a world first in terms of stiffening rings being imploded, and regardless of all the initial concerns and issues raised, the results were technically perfect

BACKGROUND

The Athlone Power Station and Cooling Towers were completed in the 1960s. Following the collapse of similar towers in the United Kingdom, the Athlone Towers were strengthened with stiffening rings in 1993. This solution was effective at the time, but 17 years later, on 14 February 2010 (many years after the cessation of power generation), the top ring on Tower One failed and came crashing down, taking the other rings with it. Tower One was at high risk of collapsing, and so was Tower Two, as the stiffening rings for both towers had been constructed at the same time. It was recommended that both towers should be demolished as a matter of urgency. A tender was called for by the City of Cape Town to implement this emergency project.

Kayad Knight Piésold Consulting Engineers was awarded the project on 10 March 2010, and through a tender process targeting the best demolition contractors in the world, recommended that the contract be awarded to Jet Demolition.

PREPARING FOR DEMOLITION

The towers would be demolished by means of implosion, using blasting. Implosion generally happens very fast, taking only a few seconds to bring the structure down, collapsing onto its own footprint.

The high safety risks associated with a project of this nature require adequate attention to the technical preparation for demolition. During the preparation phase a number of analyses were done to exactly determine the current condition of the towers. Specialist cooling tower consultants were brought in to give their expert opinion, and the services of a specialist surveyor were also used to produce a laser-generated three-dimensional survey of both towers.

The contractor had to produce a demolition design, and he chose a specialist firm from the UK for assistance. It was decided to perform a controlled demolition of the towers using explosive techniques. The combination of the explosives would have to be at a level of sophistication that would limit vibration as best as possible. This would be done by millisecond delays when detonating the charges to prevent the build-up of amplitude in the vibration waves. Earth berms were also placed in strategic positions to reduce vibrations and to help protect existing underground services. Calculations and method statements were received, reviewed and approved by Kayad Knight Piésold and by the client.

The charges used were water-based gelignite with attached explosive chord. More than 3 000 holes were drilled in the towers to place the charges securely for blasting. Holes were drilled using hand-held pneumatic drills which are powered by a mobile diesel-driven compressor. For the shell holes, access was gained from scaffolding platforms which were installed on the concrete lattice stack within the towers. Drilling the shell from the inside of the towers was safer as there was less chance of injury from loose concrete pieces falling from above. A protective tunnel was constructed to allow safe entrance and exit for the drilling teams.

1. Visible concrete debris on Tower One following the failure of the stiffening rings
2. The constructed access tunnel to Tower Two
3. Use of "test blast" to optimise charge sizes

The blasting technique also involved removing by blasting a portion of the supporting strut legs and a corresponding strip of the shell above the legs. This would bring about structural asymmetric instability and would lead to self-destruction of the cooling tower.

The charges of Tower One would be detonated first, with Tower Two following approximately one second later. The demolition was being planned in such a manner that the towers would fall slightly towards each other, but would be largely

contained in their own footprints. This was done to control the extent of debris and to protect nearby services.

Exact planning was essential. Any error in calculation or timing could have had disastrous consequences. One of the greatest dangers involved in implosions is flying debris which could cause serious injury. Even more dangerous is the partial failure of an attempted implosion – if one or both of the towers failed to collapse completely, the structure would be unstable, tilting at a dangerous angle. Another dangerous possibility involves un-detonated yet primed explosive charges. All these dangerous possibilities had to be planned for.

It is believed that the implosion of the Athlone Towers was a world first in the demolition of stiffened towers. Despite the best planning there were many uncertainties. The uncertainty about the condition of the Tower Two stiffening rings was one example. Drilling, for example, was not allowed on the outside, but had to be done from the inside, as mentioned above.

A further unknown was the influence that the stiffening rings might have on Tower Two during blow-down. The failure mechanism for imploding towers is typically a twist and fold, and it was feared that the rings might resist this. The contractor overcame this by innovatively building certain redundancies into his charge design configuration.

An emergency plan was put in place that would be activated should triggers arise. Triggers that would have set the emergency plan in motion included winds exceeding speeds of 60 km/h.

IMPLOSION

On Sunday 22 August 2010, just before midday, the countdown began and the towers imploded at 11h56 and 23 seconds, collapsing exactly onto their footprints, as designed. Tens of thousands of spectators were gathered at every possible vantage point – from Table Mountain to the immediate surroundings of the towers, to witness this historic occasion.

Subsequent to demolition, all the concrete (some 22 000 t) was used to make bricks which were distributed widely in the Western Cape. □

4 A view of the towers imploding, reflecting the tilt as designed
5 Tower One crumbling, followed by Tower Two
6 The bit that resisted the blast

Source:
http://www.saice.org.za/downloads/monthly_publications/2011/2011-Civil-Engineering-december/#/0