LESSONS FROM THE PAST

Steel offers the faster method of construction when it comes to headgear.

Concrete or steel?

What is the preferred option when it comes to headgear design and construction – steel or concrete?

The South African Institute of Steel Construction recently held the Structures for Mining & Related Materials Handling Conference 2009, which is claimed to be the first structural event aimed at the mining sector. At the conference, Nicholas Henderson of Hatch tried to answer a commonly-asked question at the start of a project, namely: what type of headgear should be used – steel or concrete?

He notes that the factors influencing the choice of headgear include construction costs, maintenance costs and demolition costs, all of which make up the entire lifecycle cost of the structure. Another important aspect is the construction schedule, and environmental issues and the recycling of material are also important considerations.

Henderson's comparison shows that a structural steel headgear would have a lower capital cost, whereas a concrete headgear would have a lower lifecycle cost. From the analysis conducted, the cost difference between a concrete and a steel headgear is negligible when compared to the schedule implication of constructing a concrete headgear. As Henderson notes, reducing time on the critical path, thereby bringing product to the market earlier, is the overriding consideration when selecting a type of headgear where both options are technically feasible.

As part of the comparison, Hatch developed a bill of quantities for both options. Henderson tells that, in terms of a concrete headgear, the quantities were split into the main components, namely concrete volume in the walls, floors and foundations; the formwork required; and the reinforcement. A concrete headgear would also require some structural steel in the floors at various levels.

On the other hand, a structural steel headgear was assumed to have concrete below the bank, with steel above. Beams were sized and the tonnage of steel in the primary and secondary members was estimated. The cladding and insulation were also measured in the bill. This would be applicable to the Canadian pricing option and excluded from the South African pricing option. Henderson notes that, according to the bill of quantities, the total capital cost of a steel headgear was R53 655 550, while the concrete variety cost R58 661 125.

In terms of maintenance, Hatch assumed that a design life of 100 years was required for the project and that routine maintenance would be undertaken on both headgear options. The steel headgear would have an annual maintenance cost estimated at 1% of the capital cost of the structural steel, including the cladding, amounting to R161 550. In terms of the concrete type, the steel floors within the concrete headgear will have a routine annual maintenance cost estimated at 1% of the capital cost of the structural steel, amounting to R20 250. In terms of a steel headgear, every 10 years 5% of the cost of the structural steel, including the cladding, will be used on more expansive maintenance, amounting to R807 750. Maintenance costs every 10 years on a concrete structure, however, will total R101 250. Every 20 years 5% of the cost of the concrete in the headgear will be used for maintenance, totalling R546 625, while the maintenance costs of a concrete headgear over 20 years will amount to R1 393 207.

The final stage in the lifecycle of a headgear comprises the costs for demolition. It was assumed that both headgears would be demolished at the end of the 100 years. In terms of a steel headgear, the demolition cost was assumed to be 50% of the value of the concrete portion of the estimate for both headgears, amounting to R5 466 250. This is opposed to the R13 932 075 associated with the concrete type. Henderson imparts that the salvage value of the structural steel would fully offset the cost of demolition of the steel portions of both headgears. In terms of a concrete headgear, no salvage value was assumed to be derived from the reinforcing steel in the headgears.

Henderson notes that the time taken to construct a concrete headgear has significant implications concerning the critical path of a project. A structural steel headgear is typically favoured as it can be fabricated off site and assembled in large portions next to the shaft before being positioned over the shaft. This limits the delay in the critical shaft sinking schedule. In the case of a concrete headgear, it is envisioned that the shaft time required is in the order of six months, as opposed to three months for a steel headgear. ●