Gotthard base tunnel essay

GOTTHARD BASE TUNNEL, SWITZERLAND 1.

INTRODUCTION Currently under construction to stretch a record length of 57 km, the Gotthard Base tunnel located in Switzerland spans the north of Europe, spanning through the Swiss Alps to the south of Europe. This railway tunnel has been designed to bypass the inefficient route of windy roads and cutting down travel time. The Gotthard Base tunnel consisting of twin tunnels is connected by cross passages at every 325m. The twin tunnels have been constructed to pass through the main body of Swiss Alps running along the ground level of the mountain massif .

The geological make up of the Swiss Alps are three crystalline bodies separated by sedimentary zones, hence making construction very difficult in some locations. 2. BACKGROUND In the past two decades the route over Gotthard pass has been one of most important routes through the Alps for cargo and transport. Only in the past decade, statistics show a dramatic increase of amount of freight being transferred: In 1990 an estimated 40m tonnes went by road, in 2001 that had risen to 90m tonnes, with further big increases expected by 2010 Currently the freight train running on the existing narrow rail system are only allowed to carry 2000 tonnes and travelling speeds are extremely slow. The Gotthard Base tunnel was designed to cut down the amount of traffic through the Swiss Alps and extend the 2000 tonnes restriction to a 4000 tonnes load. Freight trains will be able to travel 150km/hr, while passenger trains can hit 250km/hr, cutting down travelling time by almost an hour.

3. FORMATION OF THE SWISS ALPS The Swiss Alps are a mountain range formed by the convergence and collision of the European and African tectonic plates approximately 100 million years ago. As a result of this collision, the Tethys Ocean basin gets pushed upward by the African tectonic plate and into the Eurasian tectonic plate. The bottom of the Tethys Sea experiences enormous pressures, leading to large horizontal displacements and internal strain of rocks on the tectonic plate, and eventually disappears and forms great recumbent folds, or nappes These nappe stacks include, in the north of the periadriatic seam, three main nappe stacks: the Helvetic, Penninic, and Austroalpine nappes. The Helvetic nappes consist of Mesozoic marine limestone, shales and marls that were originally on the southern edges of the European continental plate. The Penninic nappes are in ophiolite sequences with deep marine sediments metamorphosed to phyllites, schists, and amphibolites, which are high grade metamorphic rocks of different paleographic origins.

The Austroalpine nappes are basically nappes thrusted on top of the Helvetic and Penninic nappes when the Apulian and Adriatic plate collided and thrusted over the European plate. It consists of fairly low grade metamorphic rocks from the Paleozoic, Variscan and Tertiary age, and Permian and Mesozoic sedimentary and volcanic rocks which are very vast with limestone ($CaCO_3$) and dolomite($CaMg(CO_3)_2$). The south of the periadriatic seam consists of materials from the Apulian and Adriatic plate which are mainly Mesozoic sedimentary rocks (limestone). 4. GEOLOGICAL PROBLEMS The Swiss Alps are primarily composed of limestone and carbonate rock.

In dry conditions, it displays stable geotechnical behavior providing optimum construction conditions. However, in regions where the Alps are karstic the limestone may be porous and aquiferous, associated problems include instability in the rock structure when tunneling and seeping and leaking of underground water into the underground worksite. Issues such as drainage facilities and pumping need to be considered when the invert grade of the rock is not provided. Another possible geotechnical problem during excavation for the Gotthard Base Tunnel would be the defects in the sedimentary rocks.

It is necessary to know how and where these defects are laid within the rock structure where excavation is undertaken in order to avoid or prepare for weak planes. This is particularly important along the periadratic seam, this region is a steep part of the rock structure. This steepness produces many weak planes which cause the rock to slide and collapse during construction posing a threat to worker’s safety and well being. 5.

CONSTRUCTION AND MACHINERY Due to the unique environment that the Gotthard Base Tunnel is situated, careful consideration in the construction of the tunnel is required. The Gotthard Base Tunnel is situated beneath 3000 m mountains (Discovery Communications, 2008) and spans the mountain massif across the ground floor. There are two access points, the first situated below Sedrun and the second at Faido. The first access point is at 1300 m below the surface and can only be accessed by a 1 km horizontal tunnel followed by two vertical lift shafts, the second via a side tunnel.

These are the only entrance points into the construction site for both personnel and machinery. The tunnel is constructed in five stages with a total of 153. 5km of tunnels, galleries and passages which need to be bored Two methods of excavation and construction of the tunnel have been utilized. These include tunnel boring and blasting.

Tunnel Boring Machines (TBMs) as shown in Figure 4, have been used in areas where the rock type is hard. This machine has dozens of rock cutting blades which rotate and chip away at the rock surface. A total of four have been used with two southbound and another two northbound. These are used to carve out the eastern and western tunnels. On the other hand, blasting is used to excavate soft rock. This is apparent in the disturbance zone of the Tavetscher Sub-Massif located below the Sedrun.

This rock material is known as kakirite which has been formed from tectonically ground rock. Once the rock is excavated reinforced steel rings need to be inserted in order to prevent the tunnel collapsing on itself. At the beginning of the project much of the geology beneath the mountains were unknown hence particular focus on issues and problems which may hinder the process of construction was taken into account and featured into the construction of the Gotthard Base Tunnel. Consequently, surveyors are constantly on site to exactly ascertain the direction of tunneling and to also avoid geologically difficult zones. 6. CONCLUSION The Gotthard Base Tunnel will not only be the longest railway tunnel to date but a great engineering feat of the 21st century for all engineers around the world.

This can be accredited to the better understanding of the construction and geological aspects of underground railway tunnels. This high speed tunnel is scheduled for completion of construction by 2017, with prospects of even faster travel than air as rail connections improve. This project is only the beginning of the many future connections of high speed rail lines in Western Europe. Train travel has many advantages in comparison to air travel, where check-ins are a consuming process, stations can be located in normal city centres and trains will be rarely held up or diverted as a process of bad weather.