

# **Analysis of the Technical Characteristics of the Construction of Extra-long Tunnels under Complex Geological Conditions in the Event of Large-scale Water Surges and Blasting.**

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## **Abstract**

2012-2022, China's investment ratio in the construction of basic transportation facilities gradually increased, the railroad and highway increased mileage of about 1.1 million kilometers; especially for the central and western regions of the continued investment in infrastructure and transportation, sichuan province as a large inland province in southwest China, "twelfth five-year plan" at the end of the total mileage of ordinary highways in the province amounted to 289,000 kilometers, the Regional development imbalance is prominent, the breadth of the road network is insufficient, the depth is obviously insufficient; ten years, the province through the reconstruction and expansion, now the province's total mileage of ordinary highway more than 390,000 kilometers, ranked first in the country, one year ahead of schedule to complete the goal of transportation out of poverty, "dense road network" aims to strengthen connectivity; do strong hubs, can improve transport efficiency! In addition, it can even promote the economic development of towns and cities, strongly guarantee the stability of economic operation, promote the level of regional coordinated development and continuously improve, but also to support the national strategic ability to continuously increase the basic ballast stone. Sichuan is surrounded by mountains on all sides, with large differences in landforms, complex and varied terrain, located in the transition zone between the first level of the three major terrain gradients of the Chinese mainland, the Tibetan Plateau and the third level of the middle and lower reaches of the Yangtze River Plain, consisting of mountainous terrain, hilly terrain, plains, basins and plateaus. As the saying goes, "the road to Shu is difficult, more difficult than the sky", in order to turn "the road to Shu is difficult" into "the road to Shu is smooth", the builders of the mountains and water bridges, and tunneling is essential to the main event. The construction of tunnels is the most important part of the project.

## **Keywords**

**Basic Transportation; Railroad and Road; Tunnel Construction; Regional Coordinated Development.**

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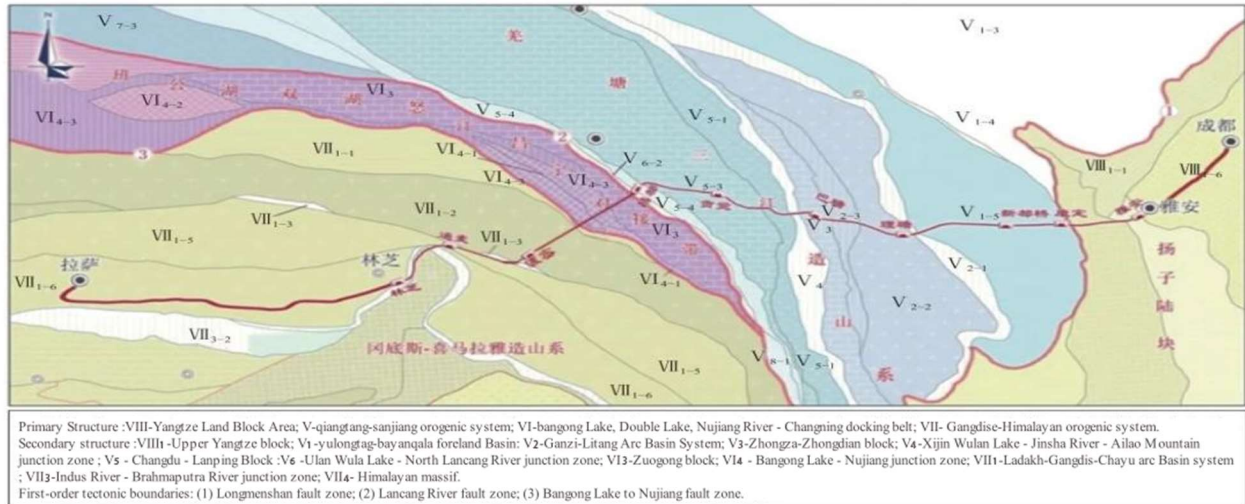
## **1. Introduction**

With the increasing pace of highway and railway construction, Under construction in Sichuan include Sichuan-Tibet Railway, Chengdu-Kunming double-track (open to traffic), Chengdu-South Da-Wan high-speed railway, Xi-Chongqing high-speed railway, Han-Banan high-speed railway, Du-four railway, Chongqing-Kunming high-speed railway, etc., The expressways under construction include Yanjiang Expressway, Ehan Expressway, Jiuma Expressway, Guangmian Cangba Expressway, Zhengguo Expressway, Lushi Expressway, etc., All of these projects climb over the famous mountain

system in Sichuan, From Daba Mountain, Micang Mountain and Huaying Mountain in the northeast of Sichuan, To the southeast edge of the Qinghai-Tibet Plateau mountains, Qionglai Mountains, The Hengduan Mountains, southwest of Sichuan, And the bridge-to-tunnel ratio is extremely high, More than 80 percent, In some key and difficult road sections, Every meter forward is a great test for the construction. The Section from Xindu Bridge to Miami of Sichuan-Tibet Railway is scheduled to start on December 1,2021. the construction period is 11 years and is expected to be completed in November 2032; the schematic diagram of the railway line direction is also announced, which shows 3 tunnels at 20-24km and 17 tunnels at 30-39km. There are 31 tunnels with a maximum buried depth (2080m), accounting for 62.6% of the main line length. Its construction is faced with a large number of difficult deep rock mechanics engineering and scientific and technical problems that need to be solved. From 700 meters of Ya'an to the west, between Tianquan and Luding, it is necessary to more than ten kilometers long, 1500 meters deep tunnel through Erlang Mountain and climb more than 600 meters, to the Dadu River, 1330 meters above sea level in Luding County. Next, in Kangding, the seat of the prefecture of Ganzi Prefecture, but only 30 kilometers as the crow flies, the elevation suddenly increased to 2,200 meters, equivalent to a slope of 40 per 1000 (40 meters for every 1,000 meters). The first climb of the 600 meters and 1,200 meters is just a little warm-up. From Kangding to the west, we will continue to climb 1,800 meters, through the 4,300 meters of the "Kangba first pass" fold more mountain, into the real sense of the Tibetan area. Pass Litang, pass 4,650 meters, drop 1,000 meters in just 14 kilometers, and then continue to fall 1,100 meters along the valley, to Batang County, 2,550 meters above sea level, here across the Jinsha River into Tibet. Current Sichuan and a from Chengdu from north to south of the railway artery-the double line railway, into double line in the railway length shortened more than 200 kilometers, line to roughly the same, are understandable through the "geological museum", similar to the Sichuan-tibet railway under construction, the whole line special tunnel is a big problem, due to the regional geological conditions are extremely unstable, river canyon layout, seismic zone, broken zone, geothermal, dark river, etc., in this environment, railway construction will face a lot of irresistible factors. The construction unit will face geological disasters such as high ground stress, highland (rock, water) temperature, high intensity earthquake and frequent active faults. In the dense development zone, the tectonic movement is active. The resulting tunnel engineering problems, such as the construction of deep buried long tunnel, rock explosion, large deformation, water and mud penetration, collapse and other engineering disasters, are more prominent. However, these disasters do not appear alone. When these problems appear centrally staggered, they cause great difficulty to the site construction operation.



Fig.1 Sichuan-tibet Railway route and topographic map



**Fig.2** Geological structure diagram of Sichuan-Tibet Railway corridor

Southwest China is affected by the topography and terrain, many deep buried long tunnels in the construction process are inevitably encountered deformation of the surrounding rock, water surge mud, rock burst collapse and other engineering problems, causing great obstacles to the construction and even a threat to the safety of the construction personnel, which is the foreign counterparts in the construction of the construction of the problem has not been encountered, even when similar problems are encountered in a single place, or the emergence of the problem of the complexity of the situation is far more than the domestic. The situation is ideal, leading to similar problems in the international solution and experience is relatively blank, can not provide direct guidance to the construction of more mature experience to learn from. Domestic builders in the long-term construction gradually find out a set of solutions to related problems and experience, and on this basis, according to the different construction conditions and the surrounding environment, and constantly summarize and optimize; according to the data show that the whole line of Sichuan-Tibet Railway, hard rock tunnels measured geostress reaches 53.06MPa, the maximum measured geostress of the soft rock tunnels 44.30MPa, and almost every tunnel will be different degrees of large deformation and rock explosion disaster. Almost every tunnel will be different degrees of large deformation and rock explosion disaster. Such a high degree of disaster destabilization has a great impact on the construction of the construction, and has a huge consumption of manpower, material and financial resources. With the opening of various types of tunnels in China in the past two decades, the construction technology has been explored continuously, and accumulated a lot of rich and valuable experience in the original technology on the continuous development, continuous innovation, forming a set of Chinese builders unique bag of tricks, can do both the symptoms and the root causes of the problem. China's infrastructure in the great journey of going out, also got the full and flash performance, China and the old Kunwan Railway, Yawan high-speed railroad in the construction process, the builders also encountered long distance tunnels with complex and special geological environment, and ultimately used the "Chinese medicine" to remove the "root cause" of the tunnel construction, and exceeded the specifications and high quality of the tunnel. Finally, they used "Chinese medicine" to remove the "root causes" of the tunnel construction, and completed the construction of the whole line of railroads with high quality and high specifications.

Internationally, in the construction of road and railroad tunnels, Switzerland, Norway, France and Germany due to the influence of domestic terrain conditions, the overall tunnel construction technology is relatively advanced. The world's first and second largest tunnels are located in Norway and Switzerland respectively. Switzerland as a mountainous country in the tunnel and its underground engineering construction has accumulated a wealth of experience, Switzerland Lech Mountain Tunnel is located in the Alps, a total length of 34.57km, is currently the world's third-longest railroad tunnel, in February - April 2021, the tunnel has occurred in three surges of water accidents, after the owner's

investigation, the surge of water is located in the tunnel lining at the joints, which happens to be the diversion pipeline by the sealed system with the cast-in-place concrete lining into the interior of the tunnel. After ruling out any quality issues with the waterproofing membrane, the problem was ultimately directed to a failure of the waterproofing seal at the point where the overdrilled borehole tube entered the tunnel. The first two gushes of water were about 1000m<sup>3</sup> and 700m<sup>3</sup> respectively, and after the first gush of water, the east tunnel was closed; on the evening of February 7, the west tunnel was also closed for half a day. on February 21, the construction team cleaned up the mud inside the tunnel and set up a temporary diversion channel to channel the water into a sedimentation tank and then discharged it into the tunnel's drainage system. Soon after March 13, water gushing occurred again, the two tunnels were closed at the same time. During the closure, the temporary wooden basins set up after the first water surge were replaced with steel measuring basins, with a total of six 5m<sup>3</sup> measuring basins set up in the two tunnels. Until permanent repair work is carried out, the technicians will inspect the measuring basins in the tunnel surges at least once a week and clean them if necessary. The incident is currently being evaluated and in the future measurements, drilling and even the removal of part of the tunnel lining may be carried out to investigate the exact cause of the water seepage. In Algeria's northern mainline railroad - Gantas Tunnel, as the longest tunnel in North Africa, its geological conditions are exceptionally complex, the project is led by China Railway Construction and Turkey (OZGUN) OZGUN formed a consortium to implement the project, the design of which invited the French company Cesta, Cesta had designed the Anglo-Chinese Sea Tunnel, which is also well known in the world. Gantas Tunnel rock layer is mainly Department of the Tertiary Miocene sedimentary marl, marl is a significant characteristic of water expansion, water loss contraction, a common understanding, the original is a stone, after encountering water into a pile of mud, and in accordance with European standards, the process of repairing tunnels dug out a hole, to fully expose the inside of the rock layer, and so on it stabilized and then go to reinforcement, but the longer the exposure of marl, the expansion of the more powerful, and now The longer the marl is exposed, the more it expands, and now there is no way to reinforce a layer that can hold up to this expansion. Setha hadn't anticipated this situation in his previous design, and was unable to do anything about it after discovering the problem, which is why he once called the tunnel "an engineer's disaster". This is not the first time that such a situation has been encountered in Algeria. A Japanese company in Algeria to build a highway, tunneling also encountered the same geological conditions, unfortunately, the tunnel eventually collapsed, and finally the highway chose to detour. In Setha can not give a solution, China Civil Engineering has also looked for German design companies, but the company proposed a solution to the experiments proved that, also can not solve this problem. China Railway Construction experts previously constructed tunnels in the experience can be played here, put forward the construction of the concept, and then arranged for domestic test institutions to analyze the characteristics of the composition of the marl again, and at the same time, the organization of domestic experts, consulting other well-known European design consulting firms put forward a new grouting as well as support programs. After the proposal of China Railway Construction came out, the supervisor and the owner did not accept it at the beginning, because on the one hand, due to the different theoretical systems between the two sides, the proposal put forward by China could not be verified in Sestana, and on the other hand, the owner was worried about the increase in cost and did not agree. The project was stopped for one and a half years, finally, China Railway Construction repaired 30 meters test section at its own expense according to its own plan, and found that the deformation problem had been controlled after inspection.



**Fig.3** Steel mesh lining in Ganseta tunnel construction



**Fig.4** Water inrush at Leche Hill base tunnel



**Fig.5** Construction of Yanjiang Expressway and Dusi Railway Tunnel

## 2. Project Overview

Newly built Kun duplex railroad on the Jixin Tunnel, the railroad line is the most difficult geological conditions, the construction of the most difficult high-risk tunnels, is located in Liangshan Yi Autonomous Prefecture, Sichuan Province, Ganluo, Yuexi counties in the territory of the hole length of 17.607 kilometers, is the second-longest tunnel of the whole line of the Chengdu-Kunming

Railway Duplicate Line, the tunnel through the mountains located in the eastern part of the Hengduanshan Mountains, Sichuan Basin to the Yunnan-Gui Plateau transition zone, is China's second geomorphic step to the first geomorphic step transition high mountain canyon area. Steps to the first geomorphic step transition of the high mountain valley area, along the line of high slopes and steep, gullies and ravines, in order to ensure that the construction progress, the tunnel section under the jurisdiction of four cross-holes, an inlet, a flat guide and an inclined shaft and so on a total of seven work areas to assist in the construction of multi-operation surface synchronized advancement. But the most difficult problem is still from the test of tunnel geology - Jixin Tunnel through a total of 17 different types of rock formations, the development of three fault zones in the region, karst, active fracture, mudslides, gas, high geostress and rock burst, sudden water gush of sand occurs frequently dolomite strata, especially the tunnel traversed by the 1620 meters of dolomite sandstone water-rich section of the tunnel, rare for domestic tunnel construction, is the longest line of the Chengdu-Kunming Railway, the most serious degree of sand fragmentation, the most difficult geological conditions of the tunnel, known as "in the water-saturated quicksand through the tunnel". Through the water-rich dolomite section is nearly 11 kilometers long, digging in the process of frequent changes in the surrounding rock, sudden water mud is a common occurrence, especially sandy intervals of self-stabilizing ability is extremely poor. During the construction process, the builders will participate in different types of tunnels over the years to optimize the combination of experience, adhere to the principle of "to the water, the amount of water and line, classified policy", to take grouting plugging, target drainage, water decompression and other different ways of water treatment measures, to achieve the "rock changes I change!", dynamically adjust the work method and support measures, through the encryption of geological forecast frequency, accurate detection of the degree of sanding, crushing direction and water-rich conditions and other initiatives, synchronized with the use of drilling and blasting + milling and digging, micro-three steps and other methods to reduce the perturbation to prevent the arch from breaking through the destabilization, effectively avoiding the sudden water surge of sand, to achieve the rapid advancement of tunnels to protect the quality and safety of the construction, and successfully dealt with the All dolomite water-rich sandy passages. It has successfully dealt with all the water-rich sandy dolomite sections, avoided the construction risk in a targeted way, ensured the quality of the process, and created a technical precedent for tunnel boring construction in the same type of geology.



**Fig.6** Water and sand inrush in tunnel

### 3. Construction of the Main Process Management and Difficult Points

The so-called tunnel surge, simply put, is the tunnel in the construction process, destroying the structure of the aquifer inside the hole caused by a sharp change in the equilibrium state of the surrounding rock, so that the original rich groundwater, dark river and other water bodies instantly released, causing varying degrees of damage to the surrounding rock. The water influx in Jixin Tunnel was unprecedented, the daily water influx in the inclined shaft location plus the main tunnel reached 60,000 cubic meters, which is equivalent to a truck with a load of 20 tons pulling 3,000 carloads of water from the tunnel every day, an average of 125 carloads of water per hour; water seeps out from the palm face in a steady stream, some of which are multiple strands and streams, such as a torrential downpour, and some of which are like direct jets of a water faucet. In the face of this situation, tunnel construction drilling and firing, initial support, upward arch pouring concrete and other operations can not be implemented, because once the water softens, the arch foot soaking softly easy to cause the collapse. The large amount of water surge makes part of the surrounding rock deformation and collapse, and the rock becomes mud in water, without any self-stabilizing strength. Jixin Tunnel belongs to the sedimentary rock, tuff, dolomite and other loose pile layer tunnel, of which dolomite accounted for 64.7%, the pile layer is not only loose and large gaps, the mountain is excavated around the water through the rock infiltration, along with the tunnel construction footage continues to move forward, the more the gushing area with the flow of water; initially the most primitive method of pumping into the field, the deployment of high-powered pumping machines, the installation of large-diameter drainage pipeline, only with the pumps in the In the initial stage, the most primitive way to pump water was to deploy high-power pumps and install large-diameter drainage pipes, with as many as 6-8 pumps in the palm face and about 10 pumps in the rest of the inclined shafts. Moreover, with the lack of oxygen inside the tunnel, the equipment power could only be utilized at about 60%, and the damage rate was extremely high, which made the large amount of repairs and replacement of equipment uneconomical in terms of cost and consumed a lot of the construction time. In the middle stage, the construction team puts forward the equipment improvement plan, after contacting the manufacturer to make the negative pressure pumping and drainage device of the long tunnel, through the scientific way to make clever use of the atmospheric pressure, fixing the pump 50 meters away from the palm surface, relying on the atmospheric pressure to realize the drainage, the advantage lies in the reduction of the time of moving and replacing the equipment to ensure the drainage speed, and at the same time, reduce the labor intensity of the workers. However, the problem of huge amount of sudden surge, just rely on drainage is far from enough, but also have to have the necessary water plugging program, in order to achieve both the symptoms and the root cause of the problem. Traditional plugging methods after several attempts, can not play any effect, declared a failure; this time the construction team and university research institutes to contact, the use of the management of the surge of the "panacea" - viscosity time-varying grouting materials (viscosity changes over time), by adding additives to the cement slurry, adjusting the hydration reaction of cement, and then control the cement slurry coagulation. By adding additives to the cement slurry, the hydration reaction of the cement can be adjusted, and the setting time of the cement slurry can be controlled, thus improving the water plugging effect of the rock formation. Viscosity time-varying grouting material is less affected by water, not easy to disperse, and can normally solidify underwater, effectively forming a solid body.

The article "Research on hydration process and rheological properties of SJP grouting slurry" elaborates the principle of viscosity time-varying grouting material, which mainly focuses on the complex environmental conditions such as steeply inclined depth cracks in the slope joints are staggered, unevenly distributed, loose overhead, and high head pressure, etc., which as a matter of engineering construction is a major geological problem related to the feasibility of the project; the existence of ordinary cement slurry is "unable to irrigate", "running along the seam", easily dispersed, and quick to lose. Ordinary cement slurry has the problems of "not being able to fill", "running along the seam", easy to disperse, and fast loss. And cement slurry initial setting time is long fluidity is not

controllable, cement water glass slurry pump can not be easily adjusted, solidification of low strength in the late stage; cement - polymer grouting material performance is inconsistent, such as water reducer, polypropylene amine flocculant can effectively change the mobility, but there is a high strength in the early stages of the problem, low strength in the late stages, poor stability. The above shortcomings reflect the long hardening time, slow growth of consolidation strength, a special construction environment often lead to greater slurry loss, poor grout quality, difficult to meet the project requirements. As a slurry material composition and proportion: cement-based slurry, mixed with synthetic cellulose solvent, calcium and silica early strength agent, amide stabilizers, the ratio of 100:60:0.8:2~2.5:0.5. Hydration mode firstly to the cement slurry mixed with cellulose solvent, to break the state of the cement particles are isolated, so that it quickly participate in the reaction to the semi-transparent dialysis mode in the cement particles between the reaction to generate a large number of dense collodion, and by the cement particles to the cement particles, the cement particles are separated, and then the cement particles are mixed with the cellulose solvent. In the hydration mode, cellulose solvent is added into the cement paste to break the isolation of cement particles and make them participate in the reaction rapidly, and then a large amount of dense cement is generated between the cement particles by semi-permeable dialysis.

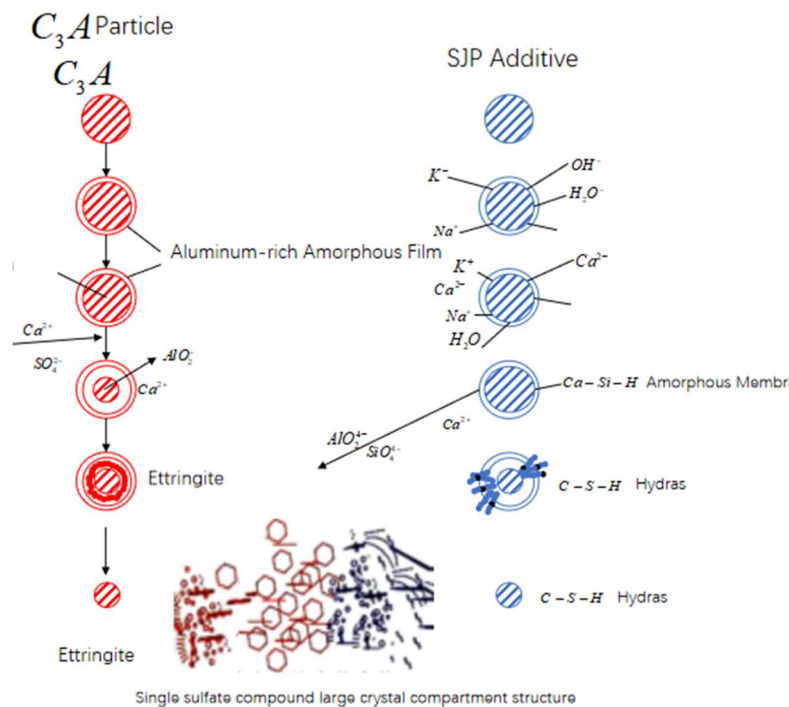


Fig.7 SJP cement based grout material conceptual model

Research method first slurry proportioning, water-cement ratio of the same conditions, maintaining a single element variable control, one by one, the three types of auxiliary additives were dosed; and then prepare a number of groups of samples for the determination of the heat of hydration test, the direct method of determining the hydration temperature curves of pure cement slurry, SJP slurry, the corresponding heat of hydration and exothermic rate of hydration, in accordance with hydration kinetics formula, the degree of hydration analysis. Finally, the rheological properties of the slurry were investigated, the viscometer was used to test the viscosity, and then the plastic strength of the slurry was measured as a measure of groutability. Use the test needle Vickers meter to measure the condensation time, and then test the compressive strength of the specimen, from the multi-dimensional, multi-indicator, all aspects of the relevant data results; and then according to the hydration process of the material for hydration kinetic analysis. Grouting in the tunnel, to be formed after the first radial grouting, from the side wall to the arch and then the bottom plate of the order, the

division of dense and large water-surge fissure curtain grouting, from the outside to the inner ring encrypted borehole arrangement. Take the appropriate hole depth and hole diameter, not empty grouting, chamber grouting needs to be filled full.

Viscosity time-varying grouting material for extra-long large-section lithological rupture high water-rich tunnel construction, has a good solidification and water-blocking effect, effectively increase the self-stabilizing strength of the lithology, improve the integrity, reduce the construction risk, improve the construction efficiency.



**Fig.8** Site of water gushing in Jixin Tunnel

Also in the newly built Chengkun Duplicate Railway, another very long tunnel - small phase ridge tunnel to cross 10 faults and 2 folds, the maximum depth of 1350 meters, the total length of nearly 22km, is the new Chengkun Railway longest tunnel. As we all know, mountain tunnel construction is different from the city subway tunnel construction, shield machine and TBM can be used in urban tunnel construction, but the mountainous areas do not have the corresponding conditions, tunnel construction more blasting construction. As the Chengkun double line on the "neck project", the surrounding rock changes are difficult to predict. For tunnel construction blasting is the use of emulsion explosives, open flame is not point, to ensure the safety of the blasting loading process, usually a one-time blasting needs about 400kg of explosives, its power is equivalent to the power of a cruise missile's battle section. Each blast tunnel can advance 3.3 meters, according to the plan to open this tunnel, at least 6,600 times more than the need for blasting; traditional construction method is to use the wind gun to cut through the rock, shot holes used to charge explosives, in order to avoid dusty wind gun in the drilling eye at the same time, but also need to spray water outward, and fall down to the mix of soil and stone residue, each gun hole has a fixed angle and depth (generally 4-5 meters deep), each gun hole is a fixed angle and depth (generally 4-5 meters deep), and the tunnel can be opened by blasting. The middle of the excavation surface of the shell hole using continuous loading, the perimeter of the shell hole to take the interval loading, the bottom of the shell hole is filled with a roll of emulsion explosives, and then every 60cm and then filled with half a roll of emulsion explosives; section on the shell hole after calculation and experience to assist, the innermost is called hollowing out the eye, the middle of the exterior is called auxiliary eye, the most external is the peripheral eye, the order of the blasting is from the inside to the outside; blasting the tunnel after dusty and turbid air, the construction workers can not immediately enter the excavation face, and the air is not good. Construction workers can not immediately enter the excavation surface to continue operations, for this long tunnel ventilation distance is long, the smoke and dust after blasting is difficult to quickly spread out, blasting cycle time invariably increase the duration of construction, with the increase in the strength of the surrounding rock in the tunnel, drilling time and explosives, blasting equivalent, blasting effect is far less than expected, a significant increase in construction costs.

Domestic blasting technology, for the tunnel boring conventional surface blasting method there are two biggest problems:

- (1) The energy of the explosives was not fully utilized.
- (2) Serious pollution of the environment; and the domestic researchers of the innovative polymerization of water pressure surface blasting technology, which effectively solves the above problems.

What is the polymerization of water pressure surface blasting technology, that is, at the end of each hole filled with water bags (the size of the form of such as emulsion explosives), the middle is emulsion explosives, and finally the hole is sealed with gun clay. In contrast, the general blasting method in the bottom of the gunhole not only need to charge, and to strengthen the charge; and polymerization of hydraulic surface blasting technology not only does not strengthen, and even at the bottom of the gunhole does not charge, water bags instead; polymerization of hydraulic blasting in the tunnel along the contour of the perimeter of the gunhole, not only before and after the two ends of the installation of the water bags, but also filled with emulsion explosives polymerization of the tube (cross-section of the two sides with a notch, the explosion) In the position of the half-wall tube to produce high-temperature, high-pressure polymer jet, as if a sharp knife like cutting along the contour) instead of similar sausage-shaped emulsion explosives. Construction site in a blasting excavation surface, evenly divided into two halves, one half of the traditional conventional surface blasting, the other half of the polymerization of hydraulic blasting, polymerization of water pressure of the arrangement of the hole spacing than the conventional surface blasting enlarged by a factor of two distance.

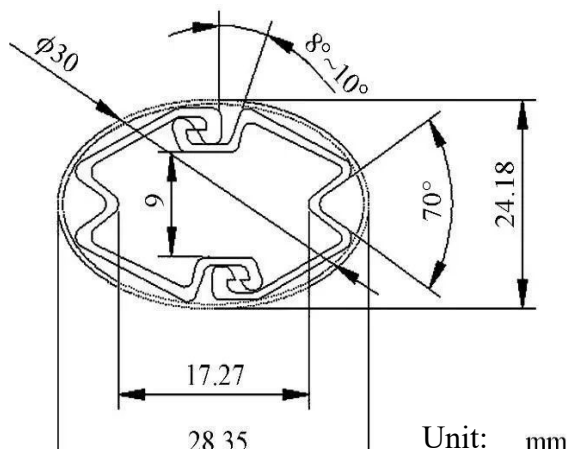


Fig.9 Shaped tube pattern diagram

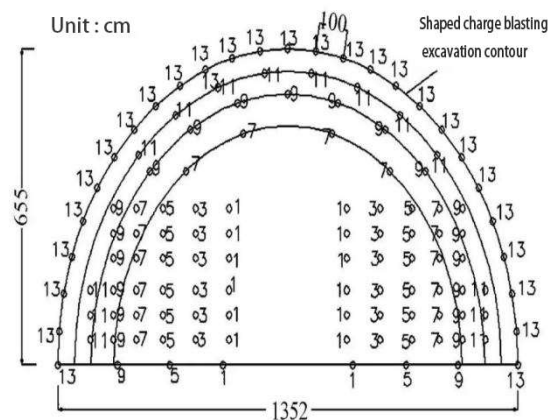


Fig.10 Shaped charge blasting hole layout

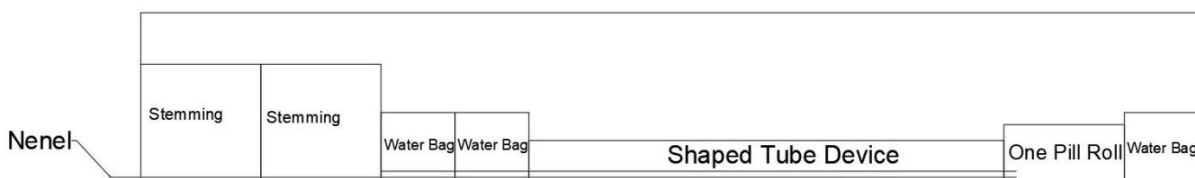


Fig.11 Charge filling with water pressure smooth blasting explosive



**Fig.12** Smooth blasting effect of condenser water pressure

Final comparison results, conventional blasting explosives an explosion generated by the blast wave, transmitted to the air in the gunnel, through the air and then transmitted to the surrounding rock, now the air into water, the blast wave transmitted to the water, water, incompressible energy is not lost, and then transmitted to the rock, that is, instead of dynamite water bags and produced a water wedge effect, after blasting the water generated by water bags of water mist will palm surface soot reduction of 40%, and the smoothness of the surrounding rock contour surface Degree better than the traditional surface blasting (because the distance between the gunnel increased, the diameter of the polytunnel device is much smaller than the diameter of the gunnel, so that the surrounding rock disturbance is small, and in the direction of the polytunnel to give full play to the role of the direction of the high temperature and high pressure polytunnel jets generated). Thus, on the whole, effectively control the construction of the relevant thorny issues, maximize the construction progress smoothly, to save materials, protect the environment, cost savings, enhance the construction cycle.

**Table 1.** Comparison of conventional and hydraulic blasting economy

order number	project	Conventional surface blasting	Poly energy, water pressure and smooth surface blasting	Festival super	Section over percentage
1	Circulating footage (m)	3.3	3.61	15	4.3%
2	Amount per unit (kg/m <sup>3</sup> )	1.07	0.91	-0.16	-14.95%
3	Half-eye mark retention rate of (%)	86	95	9	9%
4	Number of peripheral eyes (s)	48	24	-24	-50%
5	Cost of peripheral eye blasting (CNY)	1046.34	698.11	-348.23	-33.3%
6	Upstep blasting cost (CNY)	4528.27	4058.6	-489.67	-10.77%
7	Cost of primary concrete (CNY)	3790.64	3559.36	-231.28	-6.1%

**Table 2.** Comparison of conventional and hydraulic blasting data

order number	project	Conventional surface blasting	Poly energy, water pressure and smooth surface blasting
1	Peripheral control diameter (/mm)	42	42
2	Spacing of peripheral holes (/cm)	50	100
3	Drug Volume Diameter (/mm)	32	32
4	blast hole depth (m)	3.5	3.5
5	Explosive consumption (/kg)	29.4	24.84
6	Inulator consumption (/mm)	42	23
7	Max overmax (/mm)	250	165

#### 4. Conclusion

Now the Chengdu-Kunming double line railroad has been completed and opened to traffic, closer to Chengdu to Liangshan, Panzhihua, Yunnan distance, convenient for the people along the line of travel, but also to the local economic vitality; currently under construction in the Yangtze River Highway, Xixiang high-speed and Sichuan-Tibet Railway, is still traveling in the southwest of the mountain depths, as little as 10km or more than 40km tunnels throughout the above routes, and its encountered a variety of geologic issues related to The two methods mentioned in this paper also provide some solutions for the future construction of tunnels, which can provide valuable experience for the subsequent construction of transportation projects in similar areas.

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