Contractual Practices & Project Management: TELT Time Adjustment Mechanism

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ABSTRACT: The fair management of Construction Time and deadlines is a key aspect of Contract Management for long and deep tunnelling Projects. Addressing geological and geotechnical uncertainties of such underground works is challenging and the need for a time adjustment mechanism has proved to be a « must-have » over the last decades, to prevent or reduce claims and disputes. While the Swiss practice is probably at the foundation of this approach, the FIDIC Emerald Book (2019) has set an internationally recognized and comprehensive approach to this mechanism. TELT, the bi-national organisation in charge of one of the World longest railways tunnels which is currently under construction and is now moving forward all along his 57km-length, has a long track-record in the implementation of time adjustment, for over 15 years. The present article reviews the implementation and progressive development of Time Adjustment in different Contracts of the TELT's project. The completed case of Adjustment of Time Mechanism is presented for the Saint-Martin-La-Porte Exploratory Works. Two major new contracts are now ongoing, one of which is CO6/7, awarded in 2021 and spanning until 2027. This contract is EUR 1.4 billion worth and includes the implementation of 3 TBMs for a bored length of 25km, and several other excavated structures. One of the key focus of interest for the present article is the articulation of the Schedules of Baseline and the planning tools.

1 INTRODUCTION

For underground works, especially for long and deep tunnels, the design project is based on uncertain parameters and conditions. Indeed, it is impossible to completely know the geological and geotechnical conditions and parameters in advance. Given the difficulties in carrying out site investigations, particularly for deep tunnels, residual risks remain significant at the end of the design phase:

- Lower ground quality
- Water seepage
- Front instability
- Geological fault
- …

Underground construction is challenging, and contract management must take account of these issues. The time adjustment mechanism is a specific contractual device to share the consequences of geotechnical risks between the owner and the contractor. Indeed, the geological risks cannot be fully taken on by the contractor.

With this mechanism and depending on the geological conditions encountered, the time for completion of the tunnel boring and lining as well as the price, are adjusted. If the geological

conditions encountered are worse than expected, boring and tunnel lining times are extended. However, if the ground is better than expected the time for completion is reduced. This principle is described in the following figure:

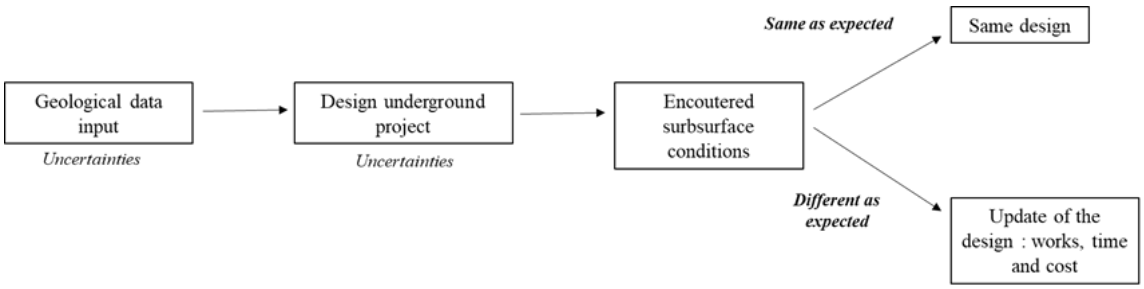

Figure 1 : Global principle of adjustment mechanism.

2 TIME ADJUSTMENT MECHANISM

2.1 *SIA standard*

Swiss engineering has developed a specific payment tool, especially used for long and deep tunnel projects called the time adjustment mechanism.

Historically, the idea that the cost of the construction site installation takes account of the ground conditions encountered first appeared in 1985, with the revision of the SIA198 - Underground Construction. This update stipulates that if a Variation is implemented during the project, prices will be modified. Besides, any change in quantities for temporary supports and water drainage shall be considered as a Variation.

For this reason, the bill of quantities, for excavation and temporary support, must consider the Construction time for valuation purposes to pay for the contractor's equipment, facilities, and supervision. This mechanism requires an accurate assessment of the critical path. Therefore, a change (extension) in the construction time due to unfavorable ground conditions does not affect negatively the contractor (SIA 118/198).

Finally, it is important to note that in the Swiss contractual framework, engineers provide all the necessary information and input data to the contractor, for the execution of the work (SIA 118). In this way, for underground projects, the principal and contractor, agree the type of temporary support to be performed.

2.2 *The Emerald Book*

The Emerald Book (ITA&FIDIC, 2019) includes the time adjustment mechanism, with an important contractual document named the Geotechnical Baseline Report (GBR). The GBR "establishes a contractual understanding (interpretation) of the subsurface physical conditions, defined as baselines" (ASCE, GBR for Construction suggested guidelines, 2007).

Adding the interpretation of expected subsurface physical conditions and associated threshold values, the Geotechnical Baseline Report (GBR), defines the "design and construction methods of the Excavation and Lining Works" (Emerald Book, SC 1.1.51), including different types and application conditions of temporary supports. In terms of responsibilities, the contractor determines the appropriate temporary support, according to the subsurface conditions encountered (Emerald Book, SC 4.24).If the subsurface physical conditions encountered remain within the ranges defined in the GBR, the adjustment time mechanism is applied. Otherwise, the unexpected geotechnical conditions shall be considered as "Unforeseeable Physical Conditions" and subject to a claim for a time extension.

2.3 *In France*

Overall, the French contractual framework does not include the time adjustment mechanism. To consider this mechanism, in French contacts, particular conditions are necessary.

- Provide reliable input data about the geological and geotechnical conditions, which might be encountered. In France, the final design is usually performed by the contractor. In this way, the contractor identifies geological and geotechnical conditions and chooses the adequate supports, among those defined in the contract.
- Identify the critical path of the project, which can be very complex, especially when the construction work includes different parts (2 tubes in parallel, connecting galleries, caverns...).
- Define a bill of quantity, to consider immobilization, monthly, which differs from standards.

Finally, this mechanism is useful and used, when the time for completion and costs directly depend on the excavation method or temporary support executed on site; and finally on the geotechnical conditions encountered on the site. Indeed, a tunnel can be bored with conventional methods or grippers' TBM, for which the production rate and application possibilities are very different.

2.4 *TELT contracts*

Time Adjustment mechanismis used today in TELT contracts. Used for the first time for the excavation of the Villarodin-Bourget/Modane Adit (MOD2), it has been progressively improved in the work contracts for the excavation of the La Praz adit (PRA) and for the excavation of the Saint-Martin la Porte adit (SMP2), then for the excavation of the Saint-Martin La Porte gallery (SMP4) and finally for the excavation of the main tubes (CO6-7).

From the Villarodin-Bourget/Modane Adit (MOD) to the Saint-Martin la Porte gallery (SMP4), that is, exploratory work, the time adjustment mechanism had been used, only for one excavation front.

Since 2021, with the CO67 project, the mechanism is now a genuine tool for managing and monitoring construction time and deadlines. The CO67 project requires simultaneous excavation fronts, connecting galleries, cavers, etc. For example, the critical path, partial deadlines, work program updates have been added.

Finally, Times Adjustment Mechanism in CO6-7 is based on the following contractual documents: administrative conditions, Program of works (annex 13 CCA), Bill of Quantities, Risk Management Plan. The geotechnical model is shared with the Contractor, but as a non-contractual document.

3 TIME ADJUSTMENT CALCULATION

To calculate the "adjusted time", the contractor provides, at the bid stage, production rates associated with excavation conditions (including excavation and temporary support) which are contractually agreed. With the rates of progress, the initial theoretical completion time of the work can be assessed. Finally, depending on the geotechnical and excavation conditions encountered, the "adjusted time" of all work parts of the project can be calculated.

The first theoretical completion time and "adjusted time" are assessed, with the following document, named the Annex 13 in TELT's contract (CO6/7).

Annex 13B - Work 2				
Quantity estimated by the Employer				
Quantity estimated by the Contractor				
Final account				
Baseline Schedule : planned time, time adjustment, ...			**Employer (TELT)**	
Work part	WBS	Work 2	Order form	
Previous work part	WBS	Work 1	Previous work part	
Next work part	WBS	Work 3	Next work part	
Start date				
			Real start date of the work part	
Shift/worked day		3	Real completion date of the work part	
Work time/Shift		8	Worked day/month	28
Number of worked days (WD) per week		6	Production Shutdown for this work part	20

Figure 2 : First part of Annex 13B : principal information.

This first part of the document presents the principal information about the work part, start and completion date, work time, etc. There is a different Annex for each part of the work.

Work	Unit	Production rate (Example)	Contrat (Estimation)		Adjusted time (real, on site)	
			Quantity	Time (day)	Quantity	Time (day)
Tunnel cross section						
Excavation section 1	ml	4m/WD	200	50	100	25
Excavation section 2	ml	2m/dWD	100	50	200	100
Total				100		125
Specific Works						
Excavation of niches	U	6 WD/U	2	12		
Crossing	U	7 WD/U	1	7		
Other Works, according to the Contractor needs						
Total						
Other Works						
Core drilling (lenght = 50 meters)	m	60m/WD	50	0,8		
Core drilling (lenght = 100 meters)	m	40m/WD	200	5,0		
Geological overbreak m^3		50mc/WD	70	1,4		
Total						
Water seepages	Annoyance factor (additionnal Working Days (WD))					
For the 25m area from the front, 5l/s < D < 20l/s	hours	0,2	50	250,0		
For the 25m area from the front, 20l/s < D < 35l/s	hours	0,6	70	116,7		
For the 25m area from the front, D > 50l/s	hours	0,8	30	37,5		
Total						
Other interruptions						
Exceptional execution	hours		10	0,42		
...						
Total						

Figure 3 : Second part of Annex 13B : different types of work.

This second table list all the work phases and different types of works, interruptions, water seepages… with each production rate, quantities, and additional time for hindrances.

Work	Contrat (Estimation)		Adjusted time (real, on site)	
	Quantity	Time (day)	Quantity	Time (day)
Total previous works				
Production shutdowns (Summer breaks, winter breaks,...)				
End of works				
Oher works, for the contractor needs				
Theoretical duration				
Adjusted time				

Theoretical end (Example)	01/03/2025
Adjusted end (Time adjustment mecanism) (Example)	01/03/2026
Recorded completion date (Example)	01/01/2026
Advance/Late according to Adjusted time	-59

Figure 4 : Final part of Annex 13B: different dates.

This final part summarizes the differences and highlights the adjusted end date and quantifies the advance or delay according to the adjusted time.

The main objective of these annexes is to assess, during the works, the adjusted excavation and temporary support time, according to the encountered geological conditions. Indeed, the tender quantities for the different works (excavation, temporary support, core drilling, water seepage...) had been estimated on the basis of the "theoretical" geological and geotechnical conditions. Underground works uncertainties will change all these quantities and the completion time. The time adjustment mechanism is used to monitor the works on site, as closely as possible according to the real conditions. Finally, the advance or delay is defined as the difference between the adjusted time and the actual completion date. Indeed, the adjusted time gives the theoretical time available to complete the work.

4 WORK PROGRAM MANAGEMENT

4.1 *Time adjustment management*

Each month, the time adjustment is calculated from the spreadsheet (Annex 13, presented above). For each work item (or part of a work item), the actual time is compared to the theoretical time (or previous adjusted time). The advance or delay for each work part is thus calculated from this annex 13.

The adjusted completion time of the global project is the sum, according to the work program, of the "adjusted time" for each work part. Thus, if the critical path is modified during execution of the work, the global work program can change. For the excavation of the main tubes (TELT project), this time adjustment management is carried out according to the following flowchart:

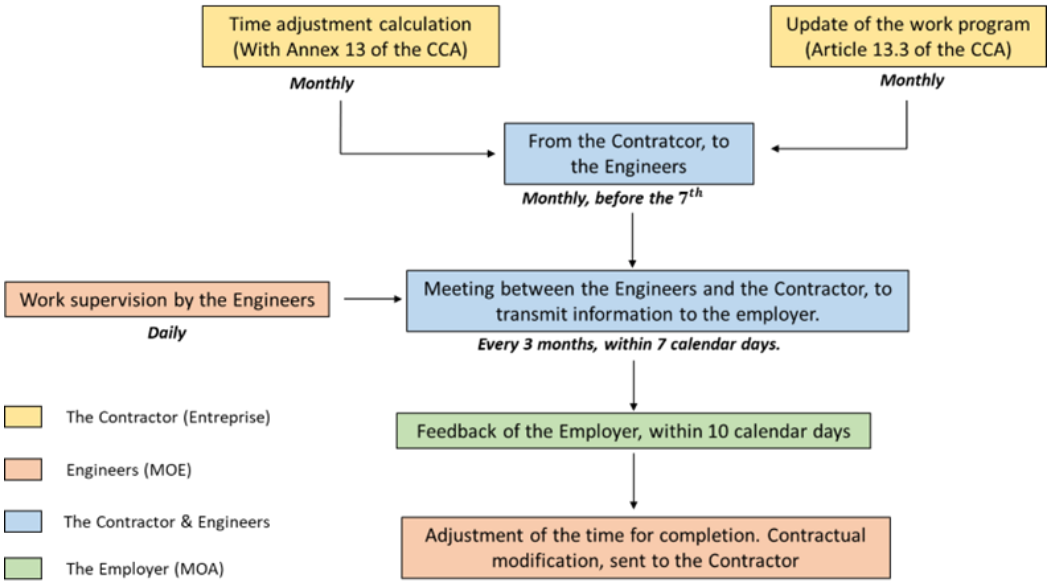

Figure 5 : Management of time adjustment mechanism.

4.2 *Link between time adjustment and work program*

The adjusted completion date is unknown until the work part is fully completed. However, every 3 months, the time adjustment is calculated and compared to the baseline schedule and real execution time.

In addition, the theoretical progress for the rest of the work part and the different completion dates (time adjustment and real contractor progress) are assessed. The advance or delay is finally defined as the difference between the time adjustment progress and the contractor real progress.

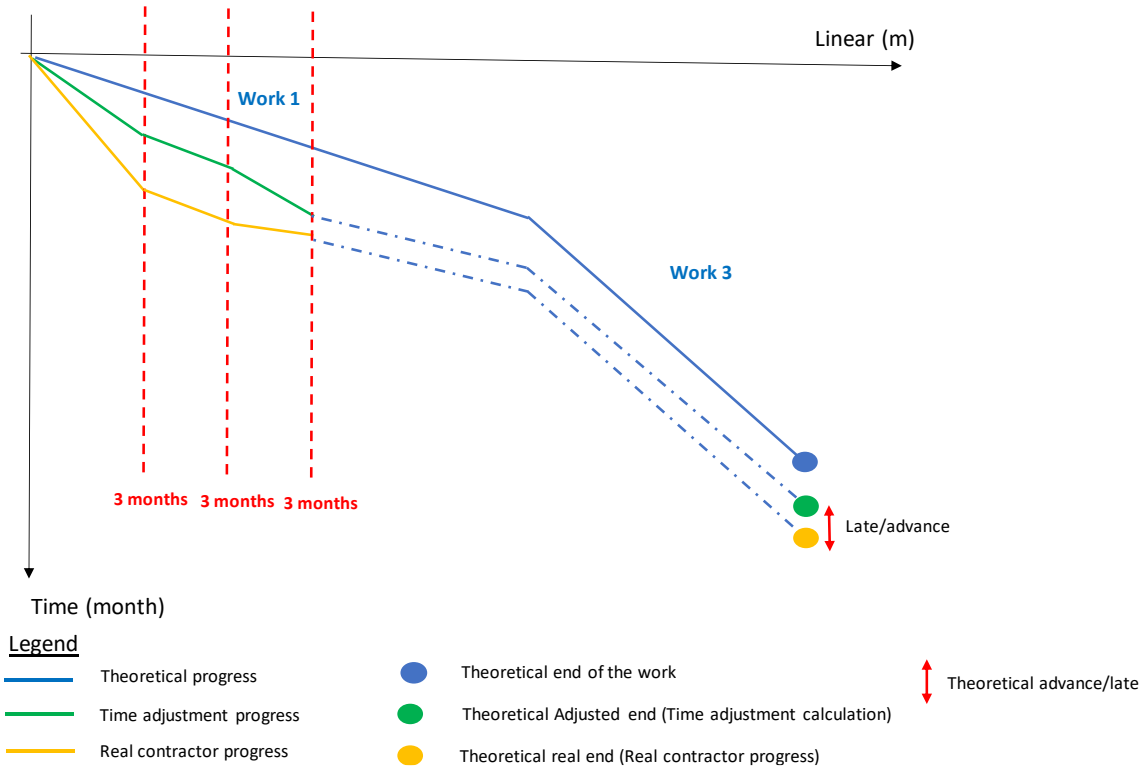

Figure 6 : Link between time adjustment mechanism and work program.

4.3 *Critical path*

Each month, the contractor updates the planned completion date of each work part, with the Annex 13. These updates can modify the work program and finally the global critical path of the project.

Indeed, a significant decrease in the production rate of a work part, due to poor subsurface conditions, will modify the completion date and, therefore, also the work program and/or the critical path of the project. The following graphs illustrates the evolution of the critical path, due to a critical event, and the impact of these changes on the work program.

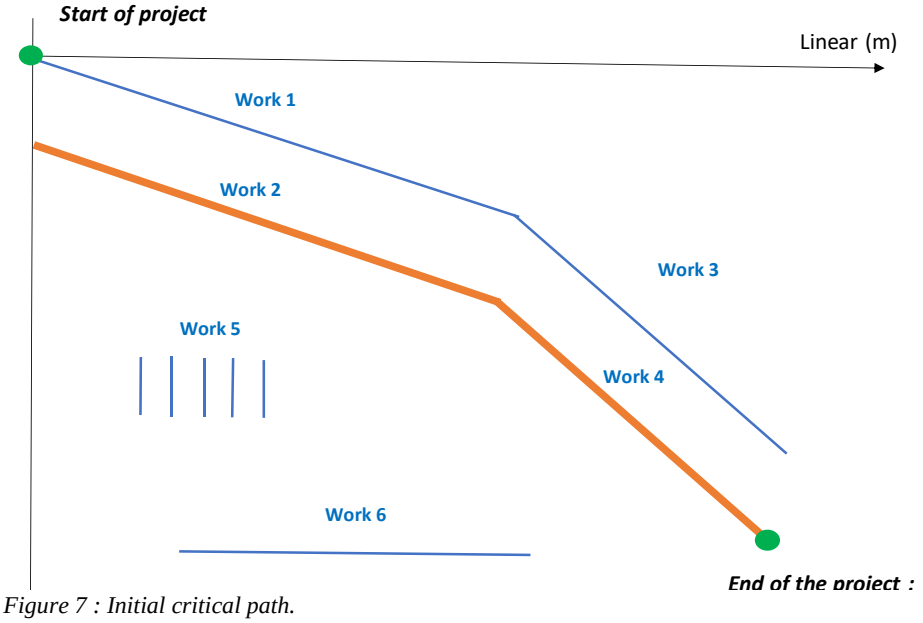

Figure 7 : Initial critical path.

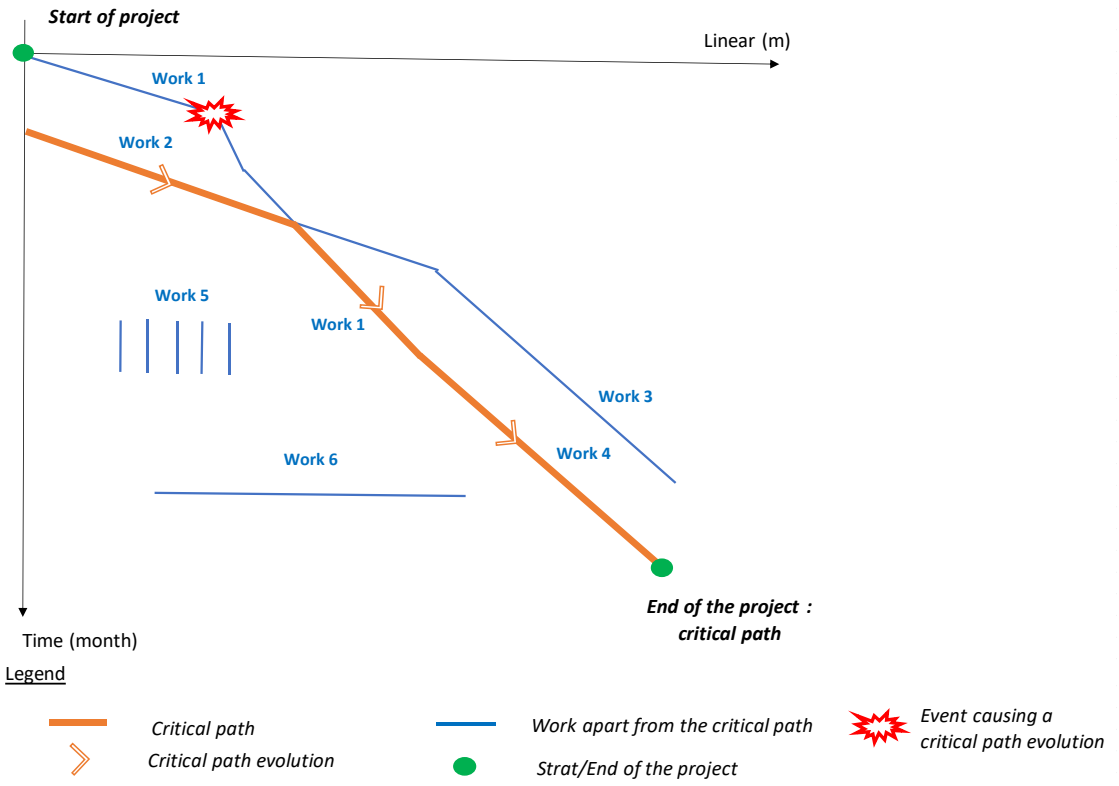

Figure 8 : Evolution of the critical path due to a critical event.

4.4 *Milestones*

As explained before, the time adjustment mechanism evaluates the "adjusted time" accorded to complete a part of the project. Depending on the subsurface conditions encountered the completion dates are adjusted and, therefore, the contractual milestones as well. The global project is divided into different partial deadlines and milestones. Each partial deadline is the maximum time for completion of a certain activity (or set of activities) which the contractor is obliged to meet. Finally, most of the milestones and partial deadlines defined in TELT contracts are subject to the time adjustment mechanism.

5 IMPACT ON PAYMENTS

5.1 *Rates*

An adjustment of payments on the basis of the time adjustment calculation is applicable only if different types of rates are defined in the Bill of Quantities, as following :

- Unit-rate items (amounts depending on quantities) ;
- fixed-rate items ;
- time-dependent items: the extended availability ("c" prices in TELT contracts)

5.1.1 *Quantities related amounts*

The unit rates are valid whatever the completed quantities. These unit rates concern the following :

- Logistics and production staff (salary included in the unit rates).
- Materials : concrete, steel,…
- Consumables and machine operation : energy and maintenance.
- Sub-contractor : services provided by a third party (subcontractor).

5.1.2 *Fixed rate items*

The costs of mobilization and removal of the installations and equipment are fixed. The possibility of transferring them to the owner is also provided for. In TELT contracts, 3 different fixed prices are available:

- Price a : Preparation, transport, assembly/installation, commissioning, and possible dismantling of existing equipment.
- Price d : Dismantling, removal and transport.
- Price e : Transfer to the owner.

5.1.3 *Time related items*

Generally, in TELT contracts, prices depending on the time adjustment mechanism concern:

- Workforce : only management staff. The production staff is paid with unit rates.
- Equipment and installations on the construction site : extended (or reduced) availability of offices, water treatment installation,…

For example, management staff is remunerated by a specific unit rate, named "c" price, to compensate the additional period of the project. Besides, the employees charged with security and site communication depend on the time adjustment mechanism. Finally, the installations on the construction site are also paid for at a specific rate "c" (ventilation, lighting, offices…). These time related items take account of the initial completion time and the additional time required (the "adjusted time") for the project.

5.2 *Bonuses and delay damages*

Bonuses and penalties are calculated based on the difference between the actual contractor's completion time and the "adjusted time" granted. In case of a delay, on partial deadlines or on milestones (as defined in part 4.4), the contractor is liable for delay damages for each full week of delay. In the case of an advance on the milestones, the contractor is awarded bonuses for each full week of advance. As a reminder, the notification of adjusted deadlines and milestones, every three months, with the time adjustment mechanism, is the basis to calculate bonuses and delay damages.

6 CONCLUSION

The time adjustment mechanism allows to adjust the completion time and payment according to the encountered subsurface conditions.

This mechanism was developed in Switzerland, in the SIA Standard (in 1985), to provide for additional payment for the extended availability of the site installations. Recently, with the Emarald book FIDIC has implemented this principle in its contracts. In France, this mechanism appeared in the TELT project and had been developed over the years. In the CO67 TELT's contract, the adjustment mechanism is calculated for each part of work and updated on a monthly basis together with the work program. Besides, the critical path, the time for completion and the major part of payments are linked to the encountered subsurface conditions.

7 REFERENCES

- Swiss Society of Engineers and Architects (SIA). (2013) Standard 118.
- Fédération Internationale des Ingénieurs-Conseils (FIDIC). (2019) Emerald Book.
- Randall J.Essex, American Society of Civil Engineers (ASCE). (2007), GBR for Construction suggested guidelines.