

THE TAHKO WATER ROUTE; JUANKOSKI AND KARJALANKOSKI CANALS AND LOCKS

by

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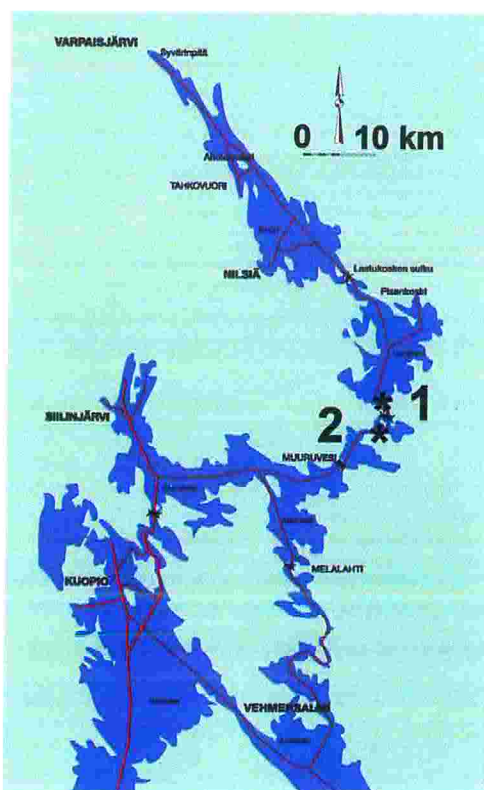


Fig. 1: The Tahko water route region:
1) Juankoski 2) Karjalankoski

1. AN INTRODUCTION TO THE TAHKO WATER ROUTE

In Finland, the land of a thousand lakes, it is no wonder that waterways have played a significant role throughout the history of the country. Of course, in the summer, for navigation, and also in winter, as frozen surfaces provide open circulation areas. Water routes have also been important to the development of towns, in many instances founded along them. The region surrounding of what is known today as the *Tahko Water Route* has been early on a border region, as well as an area of conflict. 1595 marked the year of the peace of *Tyavzino (Täyssinä)*; border markings of that period can still be seen today. Following this treaty, in 1617, the region became part of the Swedish kingdom, and as a result, more significant population settlements began to appear. Iron ore was discovered and became an important commodity for the Swedish kingdom. The available power from the river and an endless supply of wood for burning coal favoured the establishment of the *Strömsdals bruk* (later *Juantehdas*) ironworks foundry in 1746. The rapids were harnessed for energy and the waterway used for material transports.

As Finland became a Grand Duchy of Russia, from 1809 onwards, prosperity of the region was assured by eastward duty free exports of the highly needed iron ore. Between the rapids *Juankoski* and *Karjalankoski* (Figure 1), there was

only a small natural riverbed, which had no practical use to float materials. The iron was delivered to Russia by boat through the *Saimaa channel*, which connected the greater Saimaa Lake area to the Gulf of Finland. The *Saimaa channel* was completed in 1856, and is still in use today, but its location and dimensions have been changed after the Second World War.

Development followed in *Juankoski* in the form of new charcoal and blast furnaces, machine shops for the production of agricultural tools and other machinery. As the cost for iron ore became non-competitive and production decreased, demand for wood products went the opposite way. This insured some economical continuity for the region as logging and pulp production took pre-eminence. The *Syväri water route* took thereon the new role for timber floating up until the 1950's, when new roads were built.

Steamboats made their appearance early in the region, but rapids and factory dams between Vuotjärvi and Akonvesi lakes, still cut off boat traffic to Kuopio the regional capital. For this reason

the *Lastukoski* rapids were channelled by 1906. Because the *Juankoski* was not successfully channelled at that time, an alternative solution was devised. It consisted in transporting passengers and goods on a small railway line from 'ship to ship', between the *Karjalankoski* and *Juankoski* rapids. The railway line still partly exists.

2. NEW CANALS AND LOCKS

Canalizing the *Juankoski* had already been seriously considered by the authorities of the Grand Duchy of Finland because of difficult road conditions in the region. It was however only in the 1990's that actual plans for the new locks and canal sections were designed and that the project came to realisation in 2001-2002. The total length of the new fairway is 6.5 km. The *Juankoski* (Figure 2) and *Karjalankoski* (Figure 3, next page) canals and locks have been realised for leisure boating and now form a whole route which joins the *Syväri* route and other Vuoksi waterway systems. This new ensemble has been named the *Tahko Water Route*.



Fig.: 2: Juankoski: built lock and part of the channel



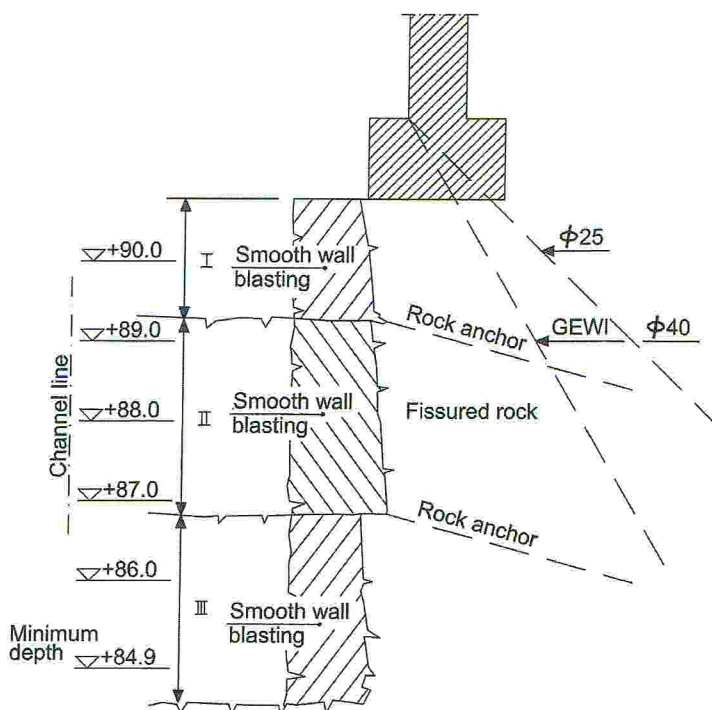
Fig. 3: Karjalankoski: built lock and part of the channel

The entire project includes two new locks and fairways, two new bridges, roads and waiting platforms. Apart of 3000 m³ of newly built concrete structures, the project also included earth displacements equivalent to 50,000 m³, as well as rock excavation works totalling 50,000 m³. Dredging work to open up the new fairways, on their own represented a volume of 12,000 m³.

The leading authority for the project, the Finnish Maritime Administration, was represented at the site by project manager Eng. Tarmo Nuutinen. The main planner of the work was Suunnittelukeskus Ltd., and the main contractor was Suomen Maastorakentajat Ltd. The *Juankoski* and *Karjalankoski* canals were dredged or blasted in the bedrock. The original mandate of KAREG Consulting Engineers was to be involved in all rock excavation and the strengthening of rock by anchoring and injection. As the construction progressed, the project manager decided it was necessary to take additional measures in regards to structural plan-

ning, and if necessary make changes on the spot. Because of difficult conditions at the two sites, the mandate of KAREG Consulting Engineers was extended to planning and modifying concrete, steel and timber structures during the whole construction time, therefore design work was mostly done at site office.

The construction sites of the *Juankoski* and *Karjalankoski* locks and canals each formed their own entity. A technically challenging part for the work at the *Juankoski* site was to blast a channel, which was realised underneath a road bridge kept open at all times. The actual blasting level was 7.5 m below the strip foundations of the bridge, thus necessitating some additional precautions. Because of fissured rock below the footings and loads of the bridge on the rock, the work had to proceed in phases. This was realised by blasting some rock and then strengthening, by anchoring and injecting (Figures 4 and 5 on the next page).



Before blasting

- Lugeon-tests and detailed injection work.
- Rock anchors $\phi 25$ and GEWI $\phi 40$ were erected (installed).

Blasting and rock anchoring

- The work was done in phases I, II and III.
- Every phase included main blasting and smooth wall blasting.

Fig. 4: Juankoski: blasting and rock strengthening underneath the bridge footing

At the Juankoski canal, it was observed in the area behind the upper waiting platform, which was built before the lock, that the rock had large fissures and fault lines falling at an angle of 50° , spanning from the starting point of the cliff, upwards until an excavated disused sewage trench on the top. Because of the sliding hazard, it was considered necessary to remove approximately 1000 m^3 of rock along this particular joint (Figure 6). The section of rock came off with the use of a small quantity of explosives, which confirmed the apprehension of the risks it represented. Fortunately it was afterwards noted that this removal also greatly improved the general view of the canal.

The Juankoski lock is a typical automatic self service lock, mostly in use for the passage of recreational boats. The rock was excavated and finished with concrete walls which are anchored to it. All anchors were designed to withstand hydrostatic pressures.



Fig. 5: Juankoski: end of blasting process below bridge

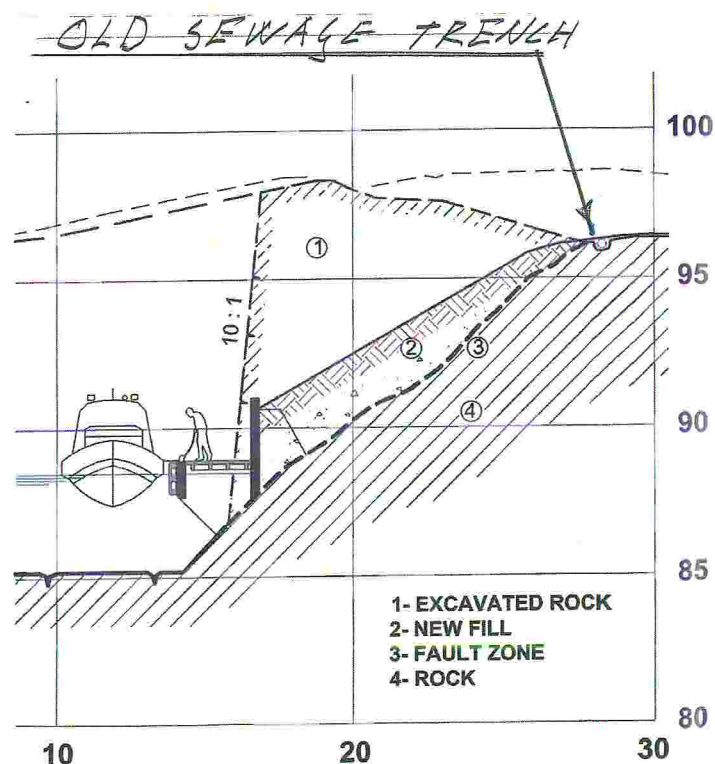


Fig. 6: Juankoski: section of fault zone

In the case of the *Karjalankoski* lock, the originally planned structural design of the lock walls had to be modified because of the poor state of the rock. The upper part of the otherwise straight rock face had, after blasting, a dip varying from 30° to 60°. This is also why the reinforced concrete walls for the lock were replaced by wooden walls made of vertical planks. These were built over horizontal timber beams supported by concrete contreforts anchored to the rock. The concrete contreforts were placed at every 3 m. This solution with contreforts matched the original structure and its wooden surface is friendlier to boats. It provided significant savings in materials, and at the same time, accelerated the building process.

On one of the sides of both locks, platforms were built. These are floating platforms, which run the whole length of the lock and to which boats should be attached during sluicing time. This new solution for a Finnish channel has proven highly effective and safe and was well received by its users (Figure 7). The lock activation is done by an automatic self-service system, however if necessary sluicing can be made by the lock-keeper.

3. COMPLETION

After an intensive work schedule, the *Karjalankoski* and *Juankoski* canals and locks were completed in the summer of 2002. In spite of numer-

ous changes during the course of the work, this EU supported project was completed on time, and within the allocated budget of 6.65M €. Final verifications and acceptance were made on September 16th, 2002, which was registered as the official completion date for the work.

Canal and lock specifications

Lock type: automatic self-service locks

Design Vessel: length 30.0 m, width 7.0 m, draft 1.8 m

Lock dimensions: length 40 m, width 8.0 m

Lock chamber height 11.8 m

Min. water depth of lock during sluicing 2.4 m

The filling of the locks occurs by controlled water flow through a concrete filling culvert (3.5 m x 1.8 m) built at the bottom of the locks.

Fairway widths:	lake area	30-60 m
	river area	20-35 m
	canals	12-18 m

Sluicing level

Karjalankoski 6.5 m

Juankoski 6.0 m

Bridge underpass height 8.0 m

New fairway length 6.5 km

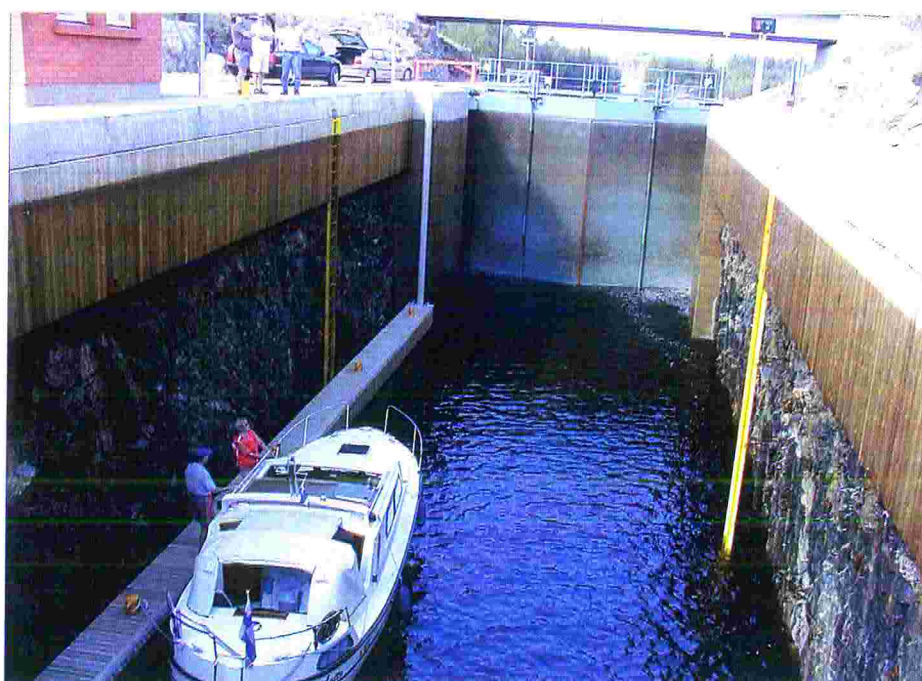


Fig. 7: *Karjalankoski*: the wooden wall and floating platform

4. CONCLUSION

All the parties involved have successfully met the challenges of this project. The *Tahko Water Route*

runs from *Kuopio* to the *Tahko Holiday resort*, which represents about 90 km (48 nautical miles). It is part of the greater *Saimaa Lake District*, and joins the *Gulf of Finland* through the *Saimaa Canal*.

SUMMARY

The *Tahko Water Route* was completed in 2002, although canalizing the *Great Lake District of Saimaa* has a long history which can be traced to the time of Swedish rule in Finland. Industrial development has been the determining factor for the creation of canals in the region, first with the discovery of iron ore, and then with logging. During the time of the *Grand Duchy of Finland*, industrialization accelerated and canalization projects followed suit, however, it wasn't before the 1990's that a feasible project for canalizing the *Juankoski*

and *Karjalankoski* was proposed. The project involved surmounting several technical challenges while maintaining it on schedule and within the initially allocated budget. This was realized by a process of constant revisions of plans at site during the whole course of the work, according to local conditions, as well as good management of all involved parties. The *Juankoski* and *Karjalankoski* canals and locks are now in service for pleasure boating and provide links to *Kuopio* and the *Gulf of Finland* through the *Saimaa canal*.

RÉSUMÉ

La voie nautique de *Tahko* a été achevée en 2002, bien que la canalisation du *Grand District du Lac de Saimaa* ait une longue histoire qui remonte au règne suédois en Finlande. Le développement industriel a été le facteur déterminant pour la création de canaux dans la région, d'abord avec la découverte de minerai de fer, puis avec l'exploitation forestière. Durant l'époque du *Grand Duché de Finlande*, l'industrialisation s'accéléra et les projets de canalisation suivirent. Toutefois, ce n'est que dans les années 1990 qu'a été proposé un projet réaliste de canalisation du *Juankoski* et du *Kar-*

jankoski. Pour ce projet, on surmonta plusieurs obstacles techniques, tout en tenant le calendrier et le budget prévisionnels. Ceci a pu être réalisé grâce à un processus d'adaptation constante des plans aux conditions locales, durant toute la durée des travaux, et au management performant de l'ensemble des parties prenantes. Les canaux et écluses de *Juankoski* et *Karjalankoski* sont maintenant en service pour la navigation de plaisance et font le lien avec *Kuopio* et le Golfe de Finlande à travers le canal de *Saimaa*.

ZUSAMMENFASSUNG

Die *Tahko-Wasserstraße* wurde 2002 fertig gestellt, obwohl die Kanalisierung des *Great Lake District of Saimaa* eine lange Geschichte hat, die bis in die Zeit der schwedischen *Regentschaft in Finnland* zurückverfolgt werden kann. Die industrielle Entwicklung war der entscheidende Faktor für den Bau von Kanälen in dieser Region, zuerst durch die Entdeckung von Eisenerz und dann durch die Forstwirtschaft. Zu Zeiten des *Großherzogtums Finnland* beschleunigte sich die Industrialisierung und Kanalisierungsprojekte folgten entsprechend; es wurde jedoch erst in den 1990er-Jahren ein durchführbares Projekt zur Kanalisierung des *Juankoski* und des *Karja-*

lankoski vorgeschlagen. Das Projekt beinhaltete das Überwinden verschiedener technischer Herausforderungen unter Einhaltung des Zeitplans und des anfänglich zugewiesenen Budgets. Dies wurde erzielt, indem die Projektplanung während der gesamten Bearbeitungszeit ständig vor Ort an die Gegebenheiten angepasst wurde, sowohl hinsichtlich der örtlichen Bedingungen als auch bezüglich des Managements aller beteiligten Gruppen. Der *Juankoski*- und *Karjalankoski*-Kanal sowie die Schleusen sind jetzt für die Freizeitschifffahrt in Betrieb und stellen über den *Saimaa-Kanal* Verbindungen nach *Kuopio* und zum Golf von Finnland her.



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