THE TRANS-CANADA HIGHWAY – A Major Link in Canada's Transportation System

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ABSTRACT

The Trans-Canada Highway (TCH) is one of the major Canadian transportation accomplishments of the last 100 years. It runs from coast to coast in a mainly east west direction. The Highway consists of a variety of highway types - rural two lane sections, rural and urban multi-lane sections, major streets in downtowns, urban freeways and encompasses major ferry crossings to Vancouver Island and Newfoundland. The original Trans-Canada Highway when completed in 1971 ran some 7,821 kilometres from St John's Newfoundland to Nanaimo, British Columbia. It was the longest continuous highway in the world.

Today, travelling from coast to coast in Canada on a high standard highway is taken for granted but it wasn't always so. This paper looks at the history of trans-Canadian travel before the Trans-Canada Highway Act in 1949 and the impact of the Act.

The paper also looks at design standards and focuses on the construction achievements – muskeg, gumbo and rock, the Rodgers Pass, Louis Hippolyte Lafontaine Tunnel and the paving of the entire highway.

There have been many additions to the TCH since the original project. The paper examines these additions and also speculates on the future of the Highway

INTRODUCTION

Today we take for granted the Trans-Canada Highway, the TCH, the T-CAN, or Highway Number One, the name depending in which part of Canada you live. But just over 50 years ago, it was under construction and in many parts of the country it was a gravel road.

It runs from coast to coast in a mainly east west direction. The Highway consists of a variety of highway types - rural two lane sections, rural and urban multi-lane sections, major streets in downtowns (e.g. St John's, Calgary) , urban freeways (e.g. the Boulevard Metropolitan in Montreal) and encompasses major ferry crossings to Vancouver Island and Newfoundland. The original Trans-Canada Highway when completed in 1971 ran some 7,821 kilometres from St John's Newfoundland to Nanaimo, British Columbia. It was the longest continuous highway in the world.

Since 1971, there have been numerous additions to the system, but this paper deals mainly with the original Trans-Canada Highway. Much of the information is taken from the "Final Report of the Trans-Canada Highway Act *(1)*. This paper also served as the basis of the TAC e-book chapter on the TCH. *(2)*

HISTORY

Today, travelling from coast to coast in Canada on a high standard highway is taken for granted but it wasn't always so.

The idea of connecting one end of the country to the other was promoted in 1912 by a group of British Columbian automobile enthusiasts – The Canadian Highway Association, and they offered a gold medal to anyone who completed the coast to coast trip on Canadian roads.

The first crossing by automobile was in 1912 when Thomas Wilby travelled from Halifax to Victoria in two months although large portions of the trip were with the automobile strapped onto a railcar or on a deck of a steamer and as such did not qualify for the medal.

In 1925, a photographer, Ed Flickenger, as project to mark the 21st anniversary of the founding of Ford Canada, drove a new Model T from Halifax to Vancouver. From Sept 8th to Oct 17th he traveled 4,794 miles without leaving Canada. At times, he had to cross rivers and valleys that were not yet bridged for traffic , over roads so narrow that brushes and trees scraped the edge of the car, axle deep gumbo on the prairies and wagon roads in the Rockies. On fourteen occasions the right-of-way was cleared for him. Despite all these accomplishments, it did not qualify him for the honor of being the first person to travel on rubber from coast to coast. For some 835 miles where there were no roads, Flickenger substituted flanged wheels and used the transcontinental railway. But still, this was a major accomplishment which stood for many years.

The first complete crossing by automobile was in 1946. Brigadier R. A. Macfarlane drove a new Chevrolet from Louisburg, Nova Scotia to Victoria, British Columbia in 9 days, only a few months after the last link connecting the highway systems of eastern and western Canada had been completed in northern Ontario.

This crossing plus the post-war boom and the rapid growth in the number of automobiles led to the Trans-Canada Highway Act which was passed in 1949 and the dream of crossing Canada by automobile was at last changing from a dream to reality.*(1)*

THE TRANS-CANADA HIGHWAY ACT

"An Act to Encourage and to Assist in the Construction of a Trans-Canada Highway" or the "Trans-Canada Highway Act" as it is more commonly known was enacted on December 10, 1949. The original act was to be in effect for seven years and provided $150 million in federal contributions to be paid to the provinces with a limit of 50 percent of the cost of construction. Subsequent amendments extended the act to December 31, 1970 and increased the federal payments to $825 million.

The act provided for the federal government to share the costs equally with the provinces except that those portions in the National Parks would be the full responsibility of the Federal Government. This was significant as some of the most difficult terrain was to be found in the western National Parks. A subsequent amendment in 1956 took "cognisance" of the great variation in construction costs by providing an additional 40 percent to each province thereby increasing the federal participation to 90 percent.

Agreements were signed on April 25th, 1950 with British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Prince Edward Island. Agreements were signed with New Brunswick on May 27th, 1950, Newfoundland on June 27th, 1950 and Nova Scotia on May 15, 1952 and Quebec on Oct 27th 1960.

At first the administration of the Act was the responsibility of the Department of Resources and Development but this was transferred to Department of Public Works (DPW) in September 1953.

Final payments to the provinces totaled $825 million. In addition to this amount the federal government spent $76.6 million for the sections of the highway in the National Parks. The total cost for the highway when the costs incurred by the provinces were included totaled some $1.4 billion dollars in 1971 dollars.

CONSTRUCTION ACHIEVEMENTS

The construction of the Trans-Canada Highway was carried out by the provinces except for those sections in the National Parks which were carried out by the Department of Public Works (DPW). However all design, tender calls, contract awards and construction were subject to review by federal authorities. Arrangements were made for federal inspection of the work as it proceeded.

A summary of the construction standards is found in Table 1.

The Final Report on the Trans-Canada Act *(1)* identified three major challenges as the following:

1. Muskeg, Gumbo and Rock

One of the sections that posed the most difficulty was the 165 mile (265 km) section along the shores of Lake Superior between Wawa and Sault Ste Marie. Sixty percent of this section was in a completely new location and required some 25 bridges. Sometimes muskegs were up to 50 feet (15 m) deep and thousands of tons of blast rock had to be transported in to make a solid base. This section was opened in September, 1960.

Similar conditions were also found in other areas of Northern Ontario and Newfoundland.

The sticky heavy "gumbo" clays across the prairies were treacherous when wet and were another major obstacle. However, in 1957, Saskatchewan became the first province to complete its section of the Trans-Canada Highway - some 654 kilometres.

Major rockwork was required through the Fraser and Kicking Horse Canyons. For example a nine mile (14.5 km) stretch between Golden and Field required more than two million tons of rock and another two million tons of earth to be moved.

2. Rogers Pass

The 27 mile (45 km) section through Glacier National Park was a major challenge. A railway through Rogers Pass was built by the Canadian Pacific Railway in 1882 but was abandoned in 1916 when a tunnel was constructed to avoid the heavy snowfall and avalanches. The Trans-Canada Highway followed the same general location as the abandoned railway over the pass.

The area gets an average of 8.5 metres of snow each season and in 1953/54 it got almost 16.7 metres of snow. To add to the difficulty, the highway route was lined by snow laden peaks that produced numerous avalanches.

The option of closing the highway on a routine basis to allow clearing of avalanches or until the danger period was over was not an option as the Trans-Canada Highway was to be an all weather all season highway. Even with "modern" snow-clearing equipment and no avalanche control devices, it

was estimated that the road would be closed to traffic for 75 days between November and May in a normal winter.

The Avalanche Research Group was created in 1953 by DPW to locate potential avalanche zones, recommend practical defence mechanisms and to develop an avalanche forecasting system. It was no simple task. A great part of the work was at high altitudes had to be done on skis. This was dangerous work given the ever-present risk of avalanches. On more than one occasion, the parties of scientists and engineers had to be dug out by rescuers with no serious results. The work was worthwhile. The original estimate of 1525 metres of snow sheds was reduced to 825 metres based on these studies.

Among the innovations suggested by this group, some of the most effective solutions still in use today were snow sheds (Figure 1 and 2) which are concrete structures constructed in known avalanche paths where the avalanche passes over the structure. Other innovations still in use are permanent gun emplacements (Figure 3) where Canadian Army personnel fire artillery shells into known avalanche trigger zones to create smaller avalanches thereby preventing more massive avalanches when the snow builds up.

Other mechanisms were used to break up or divert avalanches before they reached the highway. These included diversion dams made from earth to change the direction of the avalanche and/or reduce the length of the snowsheds. Benches were also dug into the mountainside to catch the snow slides and hold them. Also used were cone shaped hills that acted as breaking obstacles.

With the use of these technologies, although not completely eliminating road closures due to avalanches, closures are minimal most winters and are of short duration.

3. Louis Hippolyte Lafontaine Tunnel

One of the more complex engineering feats was the design and construction of the 5860 metre bridge - tunnel crossing of the St Lawrence River at the east end of Montreal. Pre-stressed sections of the tunnel were constructed in a dry dock, floated into position and sunk in a prepared trench on the river bed. Each of the seven pre-stressed sections weighed 32,000 tons, were 110 metres long ,37 metres wide and 8 metres high.(Figure 4). They were constructed in a casting basin near the site. The Ile Charron casting basin resembled one large floating assembly line. (Figure 5) When each section arrived, it was placed at the end of the dock where the "assembly line" began. Assembly teams placed the concrete roadway deck and steel reinforcement bars inside each section. The concrete and steel were placed carefully so as not to capsize the section that was being floated. When each section was finished, it was floated out by barge to the trench in the St. Lawrence River, and the next section was pushed up the "assembly line." *(5)*

The tubes provide three lanes in each direction and are 28 metres below the low water mark of the river.

This tunnel complex still provides a major access to the island of Montreal and carries 130,000 vehicles daily. It is the longest underwater tunnel in Canada. The cost of the tunnel complex was $85 million in 1971 dollars.

Although not listed as a challenge, implicit in the Final Report was:

4. Pavement of the Trans-Canada Highway

In 1956, the goal was to have the 10 provinces connected by a "paved" road by 1967 – Canada's centennial year. In 1955 much of the roadway designated as the Trans-Canada Highway was gravel. In 1962, at the time of the official opening of the highway approximately one half the highway was still a gravel surface, but by 1967 most of the highway was paved.

OFFICIAL OPENING

This great accomplishment was celebrated twice - first by a provincial event on July 30th, 1962 and then by the federal government on September 3rd. B.C. premier W.A.C. Bennett skipped the second event; he wanted more federal construction money and had officially opened the road through the pass himself a month earlier at a nearby spot, calling it B.C. Highway No. 1 and never once mentioning Canada.

The federal official opening took place at Rogers Pass with a backdrop of the snow covered peaks of Glacier National Park. (Figure 6) The significance of the opening was not that the highway was physically completed, but that a formidable gap had been closed and the site of the ceremony was not far from another historic opening ceremony at Craigelachie B.C. where in 1885 Sir Donald Smith drove the last spike in the CPR trans-continental railway. Neither ceremony implied that the work was done but then both meant that the routes were open for use and both took place in a portion of the route where the greatest obstacles to construction were found *(1)*.

The official opening was boycotted by the premiers of British Columbia, New Brunswick and Newfoundland mainly over funding provided by the Federal Government. Moreover, there was constant bickering between the provinces and the Federal Government over everything from lane widths, guardrail location, maximum grades and pavement thicknesses to, of course, funding.

ADDITIONS SINCE THE END OF THE TRANS-CANADA HIGHWAY ACT

The original Trans-Canada Highway is depicted in Figure 7. Since 1971, there have been a number of additional alternative routes included in the Trans-Canada Highway to the highway. Among the notable additions is a section in Ontario from Ottawa passing through Pembroke and Sudbury to Sault Ste Marie, an alternative route through northern Ontario going through Kapuskasing and Hearst, and the Yellowhead Highway going from Winnipeg to the Queen Charlotte Islands in British Columbia. A comparison of Figure 7 and Figure 8 indicates that these additional sections represent major additions to the modern "Trans-Canada Highway System". When these alternative routes are considered approximately 12,800 km are classified as "Trans-Canada Highway".

There have been improvements to the highway as speeds and traffic has increased however much of the original Trans-Canada follows the original location and is a testimony to the work of the original engineers. Other major additions have included Highway 417 in Ontario and the Confederation Bridge between New Brunswick and Prince Edward Island.

THE FUTURE OF THE TRANS CANADA HIGHWAY

With the completion of 36 kilometres of four lanes between Edmunston N.B and Riviere du Loup in Quebec, the Trans-Canada will effectively be 4-laned between New Glasgow, Nova Scotia to just west of Ottawa and from Winnipeg to Yoho National Park at the Alberta-British Columbia border.

The future will undoubtedly see the continuation of the addition of four-lanes to the highway. A project during the Jean Chrétien era to four-lane the highway from coast to coast was not successful since there are many sections of the highway where traffic volumes are lower than other highways and the provinces had other priorities. For example, the Trans-Canada Highway does not go through Toronto or the Golden Horseshoe of southern Ontario and many north - south routes in the Prairie Provinces also had higher priorities.

A fixed link between Vancouver Island and the mainland has also been studied. At present there are no immediate plans for such a crossing but it may be a feature in the distant future as the crossing at present is difficult to justify economically.

Improvements are being made to the Trans-Canada on a continuous basis as part of every highway department program. For example, in 2014, the Manitoba government is planning to invest $213 million on the portion of the Trans-Canada between Winnipeg and the Saskatchewan border. Improvements include fully paved shoulders, rumble strips, resurfacing, intersection improvements and new bridges *(6)*.

The Trans-Canada Highway will continue to promote tourism and economic development along its corridor. This by-product of the Highway has been one of its strongest features and will continue to grow in the future.

REFERENCES

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6. *Manitoba to Fully Upgrade Trans-Canada Highway*. Globalnews.ca/news/1141533/manitoba-to-fully-upgrade-trans-canada-highway, accessed March 11, 2014

TABLE 1 The Trans-Canada Highway Standards

	Desirable	Minimum
Right-of-Way	100 feet	66 feet in densely populated areas
Pavement	24 feet wide maximum Bituminous Hot Mix with Graded Aggregate three inches thick	22 feet minimum
Shoulders	10 feet	5 feet where terrain and/or economy make it necessary
Obstructions	Distance between edge of pavement and obstruction shall be one foot less than width of shoulders	
Base, Sub-base and Drainage	Shall be constructed in such a manner that combined they will produce a roadway having a load bearing capacity for a repeating 18,000 pound axle load	
Curvature	Three degrees	Six degrees
Gradient	6 percent	7 or 8 percent for short distances
Sight Distance	600 feet Height of object 6 inches Eye height 4.5 feet	
Bridges	Loading H20-S16 Overhead Clearance 14.5 feet Width for less that 30 foot length of bridge – full pavement and shoulder width Width for 30-100 foot length 27 and 1.5 foot curb width on each side Width for over 100 foot length 24 feet and 1.5 curbs on each side.	

FIGURE 1 Avalanche Snow Shed (photo courtesy of Parks Canada)

FIGURE 2 Avalanche over Snowshed (Photo Courtesy of Parks Canada

FIGURE 3 Howitzer Emplacement for Avalanche Control (Photo Courtesy of Parks Canada)

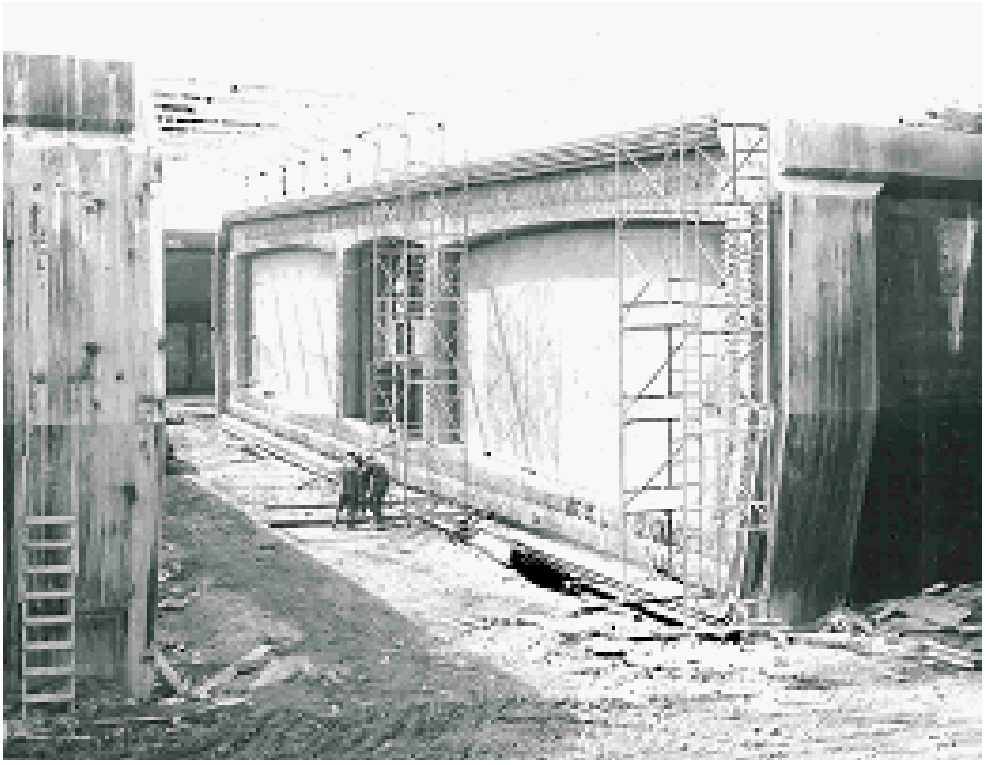

FIGURE 4 Pre-stressed Segments Lafontaine Tunnel *(5)*

FIGURE 5 Casting Basin for Pre-stressed segments Lafontaine Tunnel (*5*)

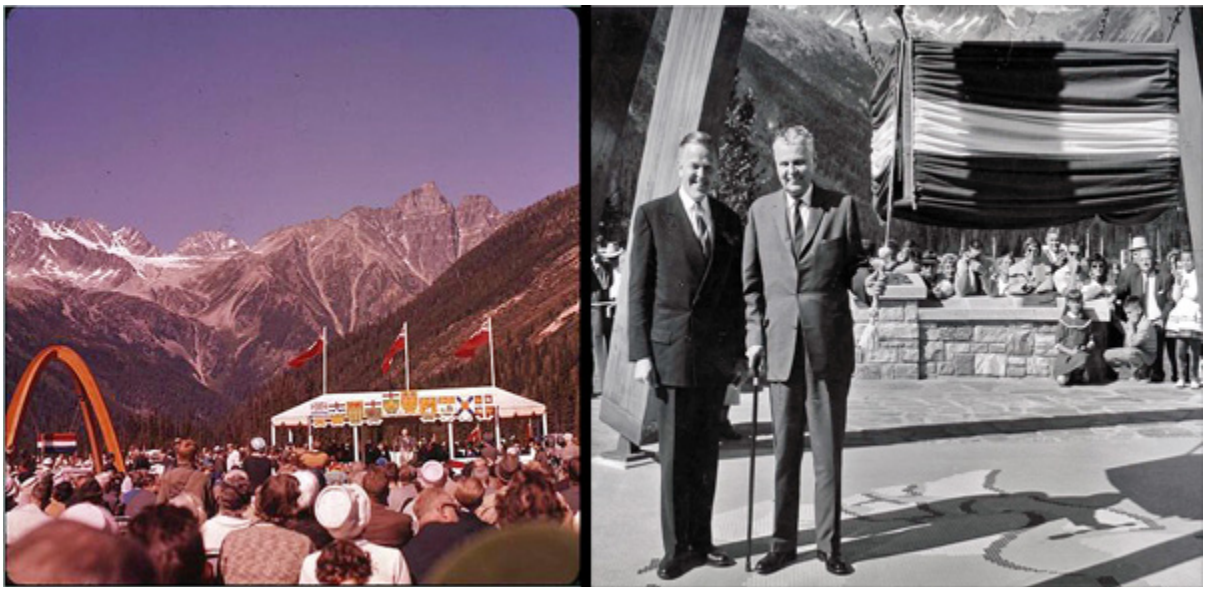

FIGURE 6 September 3rd, 1962, Prime Minister John Diefenbaker and representatives from all ten provinces attend the opening ceremonies at Rogers Pass in Glacier National Park *(3).*

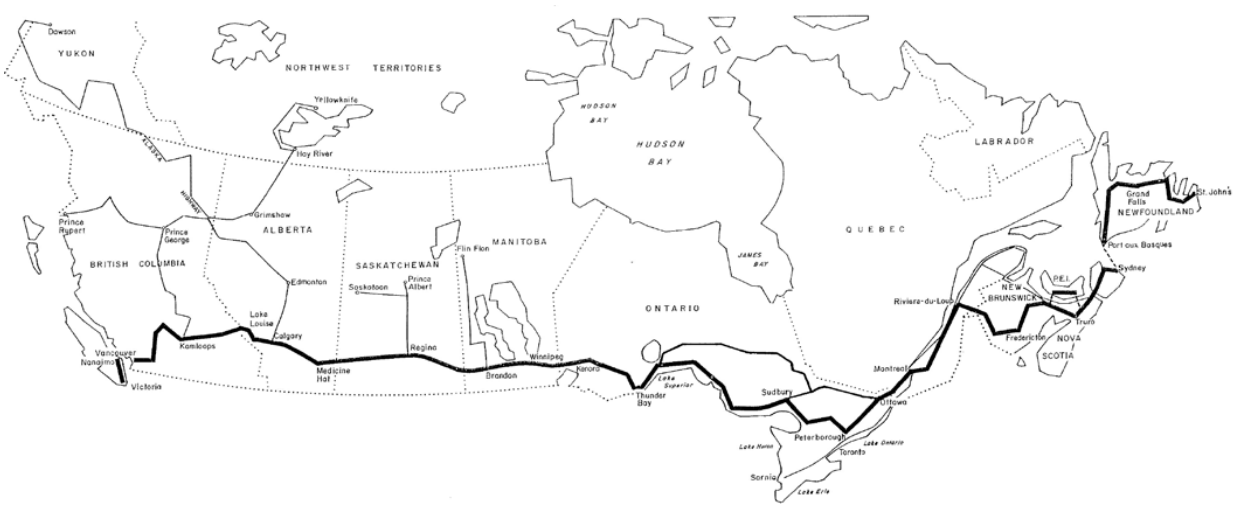

FIGURE 7 Original Trans-Canada Highway ***(2)***

FIGURE 8 The Trans-Canada Highway 2013 ***(4)***

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