Geometric Design Guide in Canada – The First 100 Years

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Abstract

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This paper will be a historical treatise on the evolution of highway design standards in Canada. The author will examine the various documents from the first letters associated with geometric design in the 1920's to the most recent versions of the TAC Geometric Design Guide.

The elements of design and their evolution will be examined to understand the changes in the technical content of the guide and to put the upcoming revision to the design guide into historical context. Where possible, an evaluation of changes in design approach and philosophy of design will be discussed.

Examples of design from various eras will be used to illustrate the changes in design across the decades. By understanding the process and evolution from past to present, the author will summarize the historical basis of geometric design in Canada.

Through the study and review of the early proceedings of the Canadian Good Roads Association annual meetings, it is possible to follow the patterns of evaluation and evolution of the various design elements that contribute to present day practice of Highway design.

In 1928, R.M. Smith brought to the attention of the convention attendees that ”In Ontario, the first construction of major importance was the Toronto to Hamilton highway, 37 miles in length, commenced in 1915 and completed in 1917. Since that time, in the Province of Ontario alone, we have completed 713 miles of 20-ft. concrete roadway, using approximately 4,000,000 barrels of cement and entailing an expenditure of over $16,000,000.” (1)

This was followed by discussion from Alex Fraser of Quebec, “One hundred million dollars is being spent every year in this country for the betterment of our roads and streets. Would it not be advisable to establish a central and permanent body, be it federal or special, entrusted with the duty of making appropriate researches and experiments, of compiling data of some interest and value and of distributing them to the provinces? This would likely result in the saving of large sums of money. It is my impression that such a body, composed of experts specially trained to carry out the duties entrusted to them, is an organization which we lack in the highway activities of our country.” (2)

Percy C. Black from Nova Scotia noted that “in 1910 there were 5,977 vehicles in Canada. In 1925 there were 648,554 and today there are approximately 900,000.” (3)

R.M. Smith, from Ontario, returned to the convention in 1930 reminding the attendees that “conditions will vary and good judgment must govern.” (4)

Also, “the engineer must have a vision: he must see the future development as a picture before him: he must have imagination. Unfortunately for him, however, it is sometimes very difficult or next to impossible to get officials or executives higher up to see the picture that he paints or to follow his image, and so he is obliged to adopt the second best, falling back on the old line that it is “a big improvement over the old conditions.” How often we satisfy ourselves with the next best thing, almost invariably regretting our lack of aggressiveness after the work is completed.” (4)

We see some of the first references to highway alignment “…In our early construction we permitted a 300ft radius curve at a right angled turn, today nothing less than 500ft would be allowed and preferably a 700ft to a 1000ft radius should be used.” (4)

Furthering the discussion on alignments and the responsibilities of the designer, “too often outside influences, are allowed to play a part in this highway alignment pressure is brought to bear to have the road go here there or elsewhere, sometimes only to serve selfish ends. Above all things, no influence should warp our judgment in this extremely important item of highway building.” (4)

Advice passed on to the attendees that , “alignment is the only definite and final thing about a highway. Bridges fail, grades settle or wash away, the surface deteriorates and requires replacement, but the alignment is always there. Engineers, give the matter your closest study. Err on the side of extravagance rather than weakness.” (5)

R.M. Smith entered into discussions on the effects of design vehicles on alignments , he shared that “we know, for instance, that truck traffic will not be great in sections remote from industrial centers. We must not lose sight of the fact, however, that touring traffic moves at a much greater rate of speed than the freight carrier, and consequently vertical curves are just as serious and dangerous as horizontal curves. While a 7 percent grade is considered the maximum, we rarely allow more than 5 per cent.” (5)

Even today the advice regarding drainage holds true, “another matter that occasionally is overlooked is the construction of the drainage structures along the road. How frequently we notice short culverts and narrow bridges, neither permitting of convenient widening. Bridges, especially the steel truss type, are possibly the worst offenders.” (5)

Thoughts to the future for the road cross-section, “we have also changed the design of our ditch from 1 ½ to 1 slope to 2 to 1 slope, this improvement removing to some extent the deep ditch hazard. Be generous in your grading work. Don’t skimp the width. Earth is moved very cheaply in the first instance.” (6)

Further refinement of the lane widths, “in Ontario the pavement is built 20 feet wide, divided into two 10 foot strips, 10 inches in depth at the side and 7 inches at the centre.” (6)

Budgetary constraints played a role in the 1920’s and 30’s as R.M. Smith reminds that, “the highway policy of any Province is governed largely by the funds available, but the wise and careful expenditure even of limited funds cannot help but produce results.” (6)

Following the paper presentation during discussion, Col. J.L. Boulanger of Quebec indentified that “under the French Regime, one of the first cares of the administration was to link up the various early settlements by means of communication. These were at first only trails, roads of the most primitive type serving chiefly for pedestrians, French settlers and Indian trappers.” (7)

He also shared that, “the King’s Highway, thirty feet wide between ditches, had, by virtue of the 1777 statute, to be maintained and repaired by the owner of the land it crossed. Defaulting ratepayers were liable to a fine of ten shillings for each offense.“ (8)

The nature of early Canadian roads was described by indentifying that “a good part of our highway system was laid out and built more than two centuries ago under statutes which fixed at one and the same time the alignment and the width of such roads. For that very reason, we have not only to deal with construction work, which would be relatively easy, but-and this is the difficult part of the problem-to rebuild, widen and correct the location of roads dating back sometimes over 200 years.” (8)

As a reference for the amount of work being completed, “at the beginning of 1930, the Province of Quebec had 12,500 miles of improved roads.” (9)

The efforts that Quebec were pursuing included, “elimination of sharp turns, improvement of curves, straightenings, widenings, and super elevation of the outside curves-such, in brief, are the improvement s to which we have subjected our highways in the last few years, so as to adapt them to the almost unlimited exigencies of automobile traffic.” (10)

One project was identified as including a “boulevard, of a little more than 9 miles, has a right-of-way of 150 feet wide and a width of 70 feet at subgrade, on which two 20 foot strips of concrete pavement will be laid on a gravel foundation, leaving a free space of 20 feet between the two roadways. This free central space is reserved to provide for a future widening of the concrete pavement or for the construction of a tram line. Outside these concrete roadways, of the one way type, there have been built gravel shoulders of five feet.” (10)

As a reference for the value of construction in 1930, “another item on our construction program provides for the permanent paving of about 900 miles of highway at an estimated cost of 17 million dollars.” (10)

Finally, it was noted that , “the Department of Highways has drawn up a standard specification for highways, providing for a 66 foot right-of-way, 500 degree curves, 5 percent grades, a 20 foot pavement and 3 foot shoulders, ‘V’-shaped ditches and ample space for poles or trees.” (11)

In 1937, R.M. Smith discusses various elements of divided highways, “dual highways, boulevard, super-highways and many other names have been applied to roadways where traffic lanes are separated. The Province of Ontario is only now commencing the construction of this type of road, but even the limited length we have completed has indicated the justification for the construction of the divided highway.” (12)

He indicated that “gradients and alignment go hand in hand with traffic densities and traffic types. Grades and alignments that would have created a scandal in Ontario a few years ago, because of their extravagance, are now common construction; as a matter of fact, as we have continued to improve, even greater demands continue to be made. In the development of the dual type, grades and alignment will receive the same study and consideration that would apply in best railway practice. The day has come when highways cannot be classified as roads or streets; they must be accepted as the foundation for a great transportation system.” (13)

R.M. Smith discussed the context of , “dual or divided highways are of world-wide importance at the present time. Germany is attracting very definite attention. Already it has over 1,000 miles completed, with a further programme of 4,000 miles under way. It may be said that car density in this country makes this type of road necessary. Germany had last year a total registration of 945,000 motor cars. Canada had 1,035,198. The most remarkable thing about Germany’s motor car registration is that in 1934 it only had 661,800. There is no doubt but that highway development and motor car registration have paralleled each other.” (14)

He suggested that “divided four-lane highways will promote themselves. As they are completed traffic accidents will be lessened, we believe, by 60 per cent. Convenience of movement and efficiency in the handling of traffic can hardly be estimated.” (14)

In Ontario, “the question of boulevard width has meant considerable study. The ideal width between traffic lanes in now accepted as 30 feet. This permits of the longest vehicle coming to rest at intersections between traffic lanes without likelihood of causing a collision.” (15)

Also, the Province’s “first attempt at the dual type of construction we have acquired a right-of-way of 150 feet. Thirty feet of the centre has been set aside for boulevard, and 20 feet on either side for traffic ways. Earth shoulders beyond this add another 10 feet on each side (widened where sidewalks are required to 20 feet), and drainage, lighting, power and telephone lines, trees and fencing taking up the balance of the room. Incidentally, we are encouraging the placing of all public service wires in conduits.” (15)

Further he indicated that “divided highways have been accepted as absolutely essential on all heavily travelled roads in the United States. Already some 4,000 miles are under construction, In some instances, where states have completed four lanes without a boulevard, they are actually lifting half the pavement and moving it to one side to permit of boulevard development.” (15)

Finally he added that “ease of movement over safe and sane highways will add not only to the growth of the tourist traffic, but will benefit industry as well. Canada has a splendid example on other countries which have gone ahead on an amazing scale in the last few years almost entirely because of a progressive highway policy.” (15)

E.C. Lawton from New York in discussing trends in highway design mentioned that “Highway design, construction and maintenance work were carried on mostly by rule-of-thumb methods and almost every citizens considered himself a highway expert without peer. Improved highways were then considered a convenience in the luxury group. A layer of stone was placed on an earth subgrade and on a profile grade determined from balancing cuts and fills. The principal test of good design was whether or not the cuts balanced the fills and made proper economic use of earth work.” (16)

He went on to mention that, “as time passed, failures in the construction and maintenance of pavements and bridges became so numerous that engineers naturally entered the highway field. Now, a engineer wields science and industry and typifies progress. In due time he began to analyze highway problems and apply engineering principles to their solution.” (17)

Further, “the application of engineering science to improved highway construction proceeded rather leisurely until about ten years ago, when developments in motor transportation began to take place by leaps and bounds. Speed and weight of vehicles were greatly increased overnight, so to speak, and today motor vehicles over three or four years old may be out-moded and almost obsolete.” (17)

His words echo across the years as he says that “Highway engineers are hard pressed to meet these needs, partly due to inertia and past conceptions of the craftsman experts and partly due to lack of funds. These two handicaps can only be overcome by education, and this is one of the problems of modern highway administrators. Strange and paradoxical and unfortunate as it may seem, this education of the public is making headway at the expense of, and I might say needless slaughter of, thousands of our citizens. The highway accident rate in the United States for 1936 was 37,800 fatalities and nearly 100,000 injuries. The question might well be asked: Is such a slaughter necessary in order to make so-called progress in highway transportation? Our answer must be most emphatically “No”, and I will endeavor in this paper to outline what the modern highway engineer is now permitted to do, and what should be permitted to do, in the realms of “ the three E’s” – Engineering, Education and Enforcement – to reduce highway mortality.” (17)

He admonishes the attendees to consider, “each time you select a profile grade or a horizontal curve in a given locality, you are, or you should be, confronted with the problem of making a decision upon the fundamental question: Is the benefit to be derived commensurate with the cost? To answer this question, you must be informed and have a clear conception of the purpose for which improved highways are being constructed, namely, safe, rapid and economical highway transportation.” (17)

E.C. Lawton indicated that “it is rather difficult, of course, to impart what I will call a proper balance of mind and matter. Mind is your intelligence, and matter is the material which goes to build a completed and improved highways. I think it is obvious that the most able highway engineer is one who, by proper analysis, will place correct emphasis upon those matters or parts of matters that should come first in determining what really constitutes the fundamentals of the highway industry, viz., providing safe, rapid and economical transportation.” (18)

He defined “the term highway design as devoted primarily to the selection of a proper combination of tangents and horizontal curves and profile tangents with vertical curves in such a manner as will afford maximum sight distance or visibility and provide minimum grades consistent with economy in any given region. Somewhat less directly this term also involves width of pavement, banking of curves, width of lanes of pavement, width of centre island construction, etc., all of which may be embraced in the term “typical section.” (19)

Similar to current design practice, “the element of safety largely determines a choice of these variables. Safety involves accidents. Speeds, directly or indirectly, are the cause of accidents. Cruising speeds have increased more than twofold, and this in itself has required almost revolutionary changes in standards of highway design. In New York State many more miles of highway are rendered obsolete by speeds of vehicles than are worn out by numbers or weights of vehicles.” (19)

He goes on to mention that “Highways can be properly designed and are being designed for known or assumed speeds under normal operation conditions. For some years past, highway engineers have been constantly increasing design speeds.” (19)

Discussion regarding sight distance, “on primary routes a minimum sight distance of 1,000 feet shall be obtained on three-lane pavements, or the three lanes shall be widened to four lanes over summits where it is not economically feasible to make heavy cuts or deep fills, which increase the cost of construction and the damage to property. If four lanes are constructed, a minimum sight distance of 400 feet is to be obtained. These limits are intended as a minimum, with the understanding that a greater sight distance will be secured wherever practicable.” (20)

He identified horizontal curve radii, “on primary routes a radius of 2,500 feet, with a minimum of 1,500 feet , is standard, and on secondary routes that of 1,500 feet with a minimum of 1,000 feet.” (20)

With respect to vertical design, E.C. Lawton mentioned that, “it is our endeavor in New York State to make the maximum grade 5 per cent on primary routes and 7 percent on secondary routes, but a sincere effort is made to obtain the least possible grade consistent with a reasonable expenditure of funds.” (20)

The discussion around sight distance appear to include design ranges, " where speed or motion is involved there must be provided a certain range of clear view or sight distance if collisions or accidents are to be avoided. Assuming average conditions on the highway and prudent operation of cars, it can be easily demonstrated that the sight distance requirement varies from 600 to 1,600 feet and upward, dependent, of course, upon the speed of the three vehicles involved in passing." (21)

Advice was provided that "the final choice of a design should be entrusted only to a highway expert. A little knowledge is a dangerous thing, and the novice should not be given responsibility in a matter which so vitally affects the lives of great numbers of people." (21)

He reminds the attendees that, "there seems to be a modern tendency to hold that faulty highway design, rather than faulty operation of vehicles, is the principal cause of accidents." (21)

As closing remarks he mentioned that "in conclusion, I might summarize what I have tried to describe by saying that engineers are alert to the highway needs of a nation and are patiently waiting for the time to arrive when sufficient funds can be made available to do the work." (22)

As a portion of the following discussions, H.W. Giffin of New Jersey, mentioned that, "in selecting curves for any one section of road, consistency in sharpness should be observed. This is because the element of hazard in curvature is mostly one of surprise. Where hazard is expected its effect is compensated in anticipation." (23)

Of interest he mentioned that, "on heavily travelled routes the problem of securing an adequate non-skid surface is complicated by the fact that during a prolonged dry spell oil drippings from vehicles form a film which is very slippery when first becoming wet. This is, however, temporary, as continued rain washes it off." (24)

H.W. Giffin discussed that "all of these things, illustration the physical trend of highway design, are but a few parts of a slow development over the years. Because the development in design is so gradual, it is inevitable that older roads, not having many of the design features now considered as standard, be regarded as somewhat obsolete. It is sometimes forgotten, however, that the service rendered by these older roads, although not equal to that of the new roads, is still of much value. The service they give is not lessened except by comparison. The new roads of today will be the old ones of tomorrow, and, as standards of design and service are raised, they too will perhaps be regarded as unsatisfactory and obsolete." (25)

He warns that , “to escape the waste of obsolescence many have wondered if the trend of highway design cannot be foreseen and if the standards of tomorrow cannot be anticipated in the roads of today. There has been much speculation about the highways of the future, and there is the natural desire to plan now for a long time in the future. Peering into the future is always fascinating – but also hazardous and tricky.” (26)

Speaking to the nature of society, he mentioned that “we can plot the trend line of population for use as a rough guide for future needs. We know that practically all of our population desire to own and use automobiles. We feel sure that production per capita is likely to increase, bringing a wider distribution of goods, including automobiles. The shortening of the work day is giving more leisure for travel. We can probably expect more vehicles per family and fewer occupants in each vehicle.” (26)

He predicted that, “the significance of all these trends and facts is that we can see more roads and better roads, easier driving, and higher speeds. The construction of highways will probably not slacken for a few years, because today we are still so far short of our needs. These are some of the things we can see in the near future.” (27)

Further he said, “as to the present, the upward trend toward improved features of highway design is strong. Much thought and money are going into them. But the trend must, at some time, level out to a table. Where this may be is not clear. If we could foresee its position we could build to it without the fear of looking back in the future to see a wasteful obsolescence. We must realize that the time is coming when the construction of new roads will practically cease.” (27)

He asks the attendees of the convention, “Have we not reached the stage where many drivers cannot develop the capacity to use intelligently the facilities which are now provided? Human nature has its limitations, and the criterion is providing improvements for its use is not the limits of the highest type, nor even of the majority, but the limits of the lowest type allowed the free use of the highways. Until we restrict drivers of limited capacity – a drastic and, today, seemingly impossible step – are we justified in providing facilities for higher speeds?” (28)

Interestingly, he comments , “as each hazard is removed, caution is relaxed and the effect of other hazards is increased. The removal of all road hazards possible by design does not touch the real core of the problem – bad driving.” (28)

Finally, he concludes that , “looking backward is easy. The course we have made is plain; the path we tread now is a little uncertain; the near future is somewhat vague; and the distant future is obscure. But if we can solve the problems as they are presented we can let those in the distance wait until we can get closer to them and see their outlines more distinctly.” (29)

In 1938, Alphonse Paradis from Quebec, discussed that, “the location of modern highways has become a problem of much importance in highway transport. It has developed logically in relation to motor vehicle development.” (30)

As further advice for the attendees, he mentioned that, “roads must be built for the interest of road users and must be located to take them where they need to go. Forcing traffic out of its natural way under the pretext of relieving congestion is not sound practice. By-passing large cities with first class highways at heavy cost is a luxury.”(30)

Arthur Dixon from British Columbia shared through that, “the evolution from the horse-and-buggy days is familiar to us all; the old settlers’ trail has gradually improved, and later, upon the insistent protests, demands and petitions which were thrust upon our governments, special arrangements were made to provide at least gravel surface. Early car owners were truly satisfied as long as the roadbed was dry and solid.’ (31)

He goes on to say that, “today the highway engineer is chiefly concerned with relocating and modernizing existing highways in order to allow traffic to move faster and more safely. Therefore modern highway location and speed are in my opinion inseparably linked and any discussion of the former must involve mention of the later.” (31)

He adds, that, “the facts in each case should be considered and the decision based on the old adage, ”the greatest good for the greatest number.” The few must inevitably suffer, but adjustments are soon made to the new conditions.” (32)

Further, “there are some extremists who would have us design for safe constant maximum speeds as high as 100 miles, and who hold that such speeds will be commonplace in the future. Others are more reasonable, and believe that speeds are being reduced and that 50 or 60 miles per hour is the maximum for safety under the best conditions.” (32)

Arthur Dixon indicated that, “the four-lane divided highway is the most practicable solution to the problem of safely increasing the flow of traffic.’ (33)

He discusses the use of spiral curves by indicating that, “while the adoption of spiral or transition curves has become general on this continent for main highways, there are many who consider these to be an unnecessary refinement for the average highway. The motor vehicle, is more flexible, and if additional width is provided at curves the good driver automatically provides his own transition from tangent to curve without crossing the centre line.” (33)

He notes that, “pedestrians and school children are our special problem. In England, I understand they now provide at least one smooth path. If we are going to save life, this is the only solution were pedestrian traffic is heavy.” (33)

H.S. Carpenter of Saskatchewan mentioned that, “a condition which is sometimes overlooked on location and construction work carried on in the summer is the selection of a location where the finished highway will be least affected by drifting snow in the winter months.” (34)

He then discussed a project where, there were many right-angled turns on this stretch of highway. These turns were made within the limits of 66 or 99-foot road allowance. Alarmed by the number of accidents at these sharp corners, we undertook to replace them with easy curves. These were welcomed by the travelling public, many of whom referred to them as ‘speed curves” and proceeded to negotiate them accordingly.” (35)

David Noonan of New York adds that they “intend to build a ten-lane highway which will include a 20 foot mall in the centre, two 30 feet pavements on each side, and a separate truck highway. That road will cost, according to our estimates, about $150,000 a mile.” (36)

Finally, Alphonse Paradis from Quebec added that he, “cannot imagine a highway starting at Halifax and bypassing the cities in New Brunswick, Quebec, Montreal, Toronto, Hamilton and running I don’t know where. The most important highways in this country should run into the large centres.” (37)

In 1940 James S. Bixby of New York brought to the attention of the convention attendees that “at 7 A.M., August 6th, 1940, the mechanized 1st Battalion, 18th Field Artillery of the Pennsylvania National Guard, started from Indian Gap for the Pittsburg-Harrisburg Highway, thirty miles away. The prescribed speed was 35 miles per hour but due to sharp curvature and high crown in the pavement, 30 miles was found the maximum practical. Or it was considered practical until a howitzer hit a reverse curve at Fishing Creek, wandered across the road, hit an abutment on a bridge and upset the equipment.” (38)

Further he added that, ”on May 6th, 1940, Brig. General Strong, Asst. chief of Staff, US Army, said in citing the need for highly mobile forces capable of acting instantly in the event of an emergency, that the problem was one of streamlining the military units and providing highways adequate to transport and service them, and he pointed out highway engineers should include in their design emergency airplane landing strip along the highways and wide shoulders for the accommodation of civilian vehicles in case military transport pre-empted the highway.” (39)

Finally as a note with regards to progress he mentioned that, “travelling over the highway from Montreal to Quebec for the first time since May 1938, I was astonished at the improvement. I estimated that the road is 1 ½ hrs., faster. We made the trip in about four hours and if this seems fast, I only suggest that many cars with Quebec licenses went by us, like throwing your hat by a stump.” (39)

R.M. Smith of Ontario addressed the future by suggesting that, "the subject 'Highways of tomorrow" might easily enough be expanded to a point where our imagination could be accused of having run away with our judgment, twenty years ago an engineer unwise enough to have predicted road systems such as are in effect in a number of countries at this time would have left himself open to considerable criticism; and no doubt the speaker may leave a questioning audience." (40)

He mentioned that, "dealing with the North American continent alone, we find that Canada and United States have a motor car registration equal to more than twice that of all the other countries in the world put together; roughly 31,000,000 cars with just over 13,000,000 scattered throughout the rest of the world." (40)

In his words, "the highways of tomorrow will be fitted into the landscape; they will be constructed to flowing lines under proper engineering supervision. Widths of rights-of-way will not be meager but sufficient to allow for lat, shallow ditches and a space for roadside improvement. Subgrade waters will be taken care of by storm sewers and tiling." (41)

As a reference to traffic growth he noted the, "traffic over the Queen Elizabeth Way varied from 16,508 in 1937 to 38,819 in 1940." (41)

R.M. Smith shared that "in the building of the Queen Elizabeth Way the original cross-section provided for 10-foot boulevard with two 10-foot lanes on either side. This has already proven unsatisfactory and at the present time our specifications require an 11-foot driving lane with 12-foot passing lane and a 30-foot boulevard separating directional lines of traffic. Cyclists have been banned from using the highway and pedestrian traffic is definitely discouraged." (42)

He predicted that, "Highways of the future, regardless of their type, will be brought to higher standards than in the past. Roads designed for 25 and 35 miles per hour are rapidly being realigned to permit of much greater speeds and so the desirability of obtaining higher standards continues until one reaches the super highway."(42)

Finally R.M. Smith suggested, "the future and what it will bring justifies the interest of the wisest prophet. Engineers are human, have vision and far-sightedness and I am inclined to leave our road problems in their hands, feeling that as we pass on the responsibilities they will be met with judgment and decision." (42)

Arthur Bergeron of Quebec mentioned that, " twenty-five years ago, at the time of the first Good Roads Convention, nobody could visualize the evolution of motor traffic nor the far-reaching revolution which the motor vehicle as to bring about in the transportation field as well as in the economic and social life of nations. (43)

He went on to say that, “no country, however advanced in highway construction, considers its road system up to present requirements. In the United States, there is a wide claim for more modern highways. Canada, despite brilliant exceptions, is at the first stages of highway construction. According to what we hear and read, Germany, with a definite idea of what roads should be and should do, has succeeded in building only isolated sections.” (43)

His recommendation for engineers was that, “the future of the highway must be approached with a great deal of circumspection , and even humility, as we do not know what tomorrow will bring. Two years ago, strategic and military highways were far from our minds. They are now front-page news. The elaboration of a road programme depends as much on common sense and sound judgment as on the most brilliant theorizing.” (44)

Arthur Bergeron made note referring to “good visibility is important in horizontal and vertical curves, so as to insure safety. Pavements twenty to twenty-two feet wide will be provided on those highways, with occasional thirty-three-foot sections. Subgrades and pavements will be built for heavy loads.” (45)

In reference to additional elements of design he mentioned that, “landscaping has become a part in the construction of super and provincial highways. In most cases, highway beautification could be secured at very small cost. More often than not, the sides of a new road look like devastation. War could scarcely make a worse job.” (46)

Finally looking to his future he said, “We do not know what tomorrow has in store. But we do know that well drained, well graded and well paved highways will carry year in and year out the traffic for which they were designed. Such a system would promote normal traffic and transportation. According to what we know, it would also promote strategic and military purposes. I believe nothing more can be expected from a highway system and human vision.” (46)

John Laidlaw from Toronto suggested “to the engineers who are laying out roads for tomorrow that they give more attention to the scenic possibilities than they have done.” (47)

Conclusions

These comments from the proceedings of the various conferences of The Canadian Good Roads Association demonstrate the evolution of standards including revisions through experience and experimentation. It is from these early discussions that we, as modern practitioners, standing on the shoulders of the past can build the state of the practice on a solid foundation for the future.

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