HISTORY OF THE ROADS IN COLOMBIA

MsC. Eng. Ana Sofía Figueroa Infante
Research Group INDETEC, La Salle University, Colombia
afigueroa@lasalle.edu.co
PhD. Eng. Fredy Reyes Lizcano
Research Group CECATA , Javeriana University, Colombia
Fredy.reyes@javeriana.edu.co

DRAFT PAPER

"There were the curumes, the Ituangos, great fishermen, the pencos and the carautas who inherited crowns of feathers and the ceremonial barges, the sown ground and the body of noble men, the Nenchí nutabes who made stone paths…"

William Ospina (Ursúa, 2005)

ABSTRACT

This work details the evolution process of Colombian routes from the discovery of America going through the period of Colonization to the present time. Furthermore this paper includes the development of the national road network according to the analyses presented by the B.I.D. (Inter-American Development Bank) and the strategies the central government is implementing to mitigate the present situation of the Colombian system of highways.

NEW LANDS

When the seafaring Rodrigo Triana stepped foot on Cartagena and saw the first mound of land from the ship (La Pinta), he never imagined the magical and the countless events that he would encounter. La Pinta then arrived at Guanhani Island, a place inhabited by naked people who were astonished by the mirrors, pieces of glass and all other trinkets swapped by the crew for fruits, exotic animals and very soon for the gold which they used to put on their copper – coloured and shining skin. The first thought of the conquerors was to make good use of the noble, flexible and totally serviceable labour force as they thought that the guests were sent by the Almighty. Their means of communication was completely by the sea. They communicated among the Caribbean Islands from the rows of their oars pushed from side to side to stout and brown coloured men. The Spanish found path ways to travel in the beginning as these were left by the indigenous people who carried loads on their back due to the lack of beasts (donkeys) etc. The transfer of goods by the paths resulted in long walks that took months to arrive at their destination.

In 1536 the first explorers headed for Santafé de Bogotá, where the main Colombian Indigenous people were known as the *Chibchas*. Gonzalo Jimenez de Quesada and his entourage. Riding on horses brought from Spain through the banks of the Magdalena, they overcame all weather conditions, illnesses and the rural forest until they arrived at the indigenous town of Santafé de Bogotá in Colombia. One of the main characteristics of that population was their devotion to religion. This is why the road development of the indigenous people of Savanna was adorned by shrines throughout the towns. They even

used to decorate some paths with gold and Emeralds as a sign of importance and divinity to the place. In terms of the people, many roads even – though in bad condition, allowed the movement of beasts and people. Later when, Gonzalo Fernandez de Oviedo, discovered ahead of the town in front of la Tora he quotes " a source of mineral fuel that's a well, and it boils and runs outside the earth penetrating into the mountain, just by the base of the ranges and in great amounts and very thick as liquor", he realized that this could be used for the development of roads. He also noticed that the Indians rubbed it on their bodies, which relieved them from being tired and for tarring the brigantines. This discovery of the petroleum led to the improvement of the roads which was available for the Nuevo Reino de Granada.

During the period of Spanish colonization, which includes three centuries, there was no technological development in the *Nueva Granada*. Their main interest was to accumulate wealth and the best way for achieving that was through mining. While the old world was taking a huge step in development, like the invention of a vapour carriage on French roads by Tressaquet and Thomas Telford in 1775 and that of John Mark Adam in England in 1805, Luis Villegas and Avendaño took charge of the Spanish crown for mining in the Nueva Granada. They extracted emeralds in *Muzo* which increased their riches and the dispute for power among the conquistadors. The few technological developments in the town were due to the military engineering.

One of these was the Dique Canal; built from 1649 – 1651 by field Master Pedro Zapata. The first geometry outline was used in the Nueva Granada project for roads and the first stoned road was built in 1570 in Santafé de Honda as a way for carriages from Santafé de Bogotá to Facatativa. This was due to Viceroy Venero de Leyva's interest and intervention. Later on stoned paths were built to carry conquistadors' viceroys or food from one place to the other.

One of the main barriers for the development of the country was due to the great difficulty to move loads. An Indian could only carry up to 100 kg (person, food etc) and had to travel through rural and dangerous grounds. Transport was usually carried out in a combined form, by foot and by animals packed with loads, as they had to overcome the great precipices and the steep and muddy areas.

Cargo carrier with a loaded mule, buried in the mire of the paths of the time. 1910.

The most important way was Honda - Santafé de Bogotá but most of the products that arrived to the savannah became notably more expensive due to the cost of transportation.

Similarly, to take out the products of the interior towards Honda was almost impossible.

DISTANCE AND COST OF LOCAL TRANSPORTATION (1850-1880)

ROUTE	DISTANCE Km	DURATION Days	FREIGHT $/Ton
Bogotá-Barranquilla	**1088**	**15**	**120**
Medellín-Barranquila	**950**	**15**	**94**
Bucaramanga-Barranquilla	**714**	**10***	**90**
Bogotá-Medellín (por Sonsón)	**520**	**8**	**104**
Cali-Buenaventura	**142**	**14**	**50***

The author's *approximation

Source: Technical Engineering and history. Volume IV. Gabriel Poveda Ramos. Colciencias. Pag. 172

In 1890 there were 7500 leagues of roads (1 league = 5 km) that is 37.500 in Colombia.

DISTANCE DURATION (BY HORSE)

ROUTE	1826 (days)	1890 (days)
Túquerres-Pasto	**1**	**1**
Pasto-Popayán	**9**	**7**
Popayán-Neiva	**7**	**7**
Neiva-Bogotá	**9**	**9**
Bogotá-Tunja	**5**	**3**
Tunja-Pamplona	**8**	**8**
Pamplona-Cúcuta	**3**	**2**

Source: Alberto Pardo P, Geografia Economica Humana de Colombia.

The hope for transportation at the most important areas was focused towards travel by rail and after a couple of failures in its construction, finally in 1848 the government of Mosquera approved for the construction of the railway to John Stephens, Henry Chacey and William Aspinwall, who hired North American engineers George Totten and John Trautwine. In 1851, the first 7 miles were completed joining the bay of Limon, in the Atlantic, with the village of Gatún in the Chagres river, in Panama. Owing to its economic and social success, the railroad was extended and, in 1855, it was possible to go from one ocean to the other in a journey of 80 km. The construction of this project took six years. Between 1869 and 1871 the German engineers built the railroad from Barranquilla to Puerto Salgar.

THE FIRST RAILWAYS BUILT IN COLOMBIA

NAME RAILROAD	UNION OF	LENGTH Km	YEAR
Panamá	Colon-Panama	80	1840-1851
Bolívar	Barranquilla-Pto Colombia	22	1869-1871
Cúcuta	Pto Villamizar-La Jarra	14	1878-1880
Antioquia	Pto Berrío-Malena	78 66	1874-1880* 1894-1899*
Pacífico	En construcción		

* The project was interrupted between 1880 – 1894 owing to financial problems and civil wars. The first section was completed by the Cuban Engineer, Francisco Javier Cisneros and the second by Colombian Engineers: Rafael Torres Mariño, Tomas Arturo Acevedo, Jorge Paez, Pablo E Perez and Juan de Dios Vazquez.

The savannah railway system began in 1882, by Colombian engineers: Manuel H. Peña, Cecilio Echevarria, Juoaquin Barriga, Rafael Vargas, Francisco Mariño, Honorato Espinosa under the government of Rafael Nuñez. The construction was completed in 1885, after interruption due to the civil war.

Itinerary of the railroad of Amagá, Antioquia. 1920.

Simultaneously and amid the tough topographic condition some ways were built with a strategic out line and with a bad superficial drainage system.

Photograph 1 a. Siecha Pathway 100 years, 1906 – 2006; paved with stones to ease moving of people and loads.
b. Steps to facilitate moving in steep areas.
c. Intersection of a plain zone of pathway with a branch to the steep zone of the mount.

Photo 2. A hundred year old bridge of bamboo and wood. Siecha pathway, department of Cundinamarca Colombia.

Stone paving on the roads of the capital began with a maximum width of three meters. The system of pluvial sewer system and sanitarium was based on an open central pipe. Channels were located in the streets with a slope in each lane to head the waters towards the center.

Remain silent of the observatory in Bogotá. System of evacuation of waters. 1842.

Towards 1905, convex paving stones were introduced and the sewer buried underneath.

First automobile that arrived in Colombia from France.

In 1899, Carlos Coriolano Amador, originally from Medellin, imported the first automobile from France and with it were the driver and the fitter. By the beginning of the 20th century, the transportation system consisted of “Trams of blood” pulled by mules, bicycles and a few imported cars for hiring by the wealthiest families. However, they could hardly run in the city due to the rough condition of the roads.

to. Tram of blood, b. Carriage of century beginning, Barranquilla c. Neighborhood Colon, Medellín.1910. Source: Museum of urban development.

Two important things occurred with respect to the Colombian road engineering. The first interstate highway was built, which is the central highway, 283 kilometers long and for the first time asphalt was used to cover a street in Bogotá. Due to the majestic structure of the streets, the mayor asked for them to be polished and the dissolving material rather destroyed them.

In the same year Mr. Gonzalo Mejia from Antioquia came up with a water craft base on Louis Blériot French model and passengers were sent from la Dorada to Barranquilla in two days making a great difference when compared to the ship that made the same distance in 8 days.

In 1922 there were 3437 unconfirmed roads and that figure tripled in 1936. In 1921, the first air cable for passengers (sky ride) between Mariquita and Manizales was built to unite regions in mountainous areas. The urban service of buses was introduced by the late twenties.

Jorge Eliecer Gaitan tried to tar the roads again in 1932, however as this was during the warmest part of the day the pedestrian's were struck to the ground as the temperature went higher. The mule carriage was replaced by the cable car in this same year and there were exotic means of transportation in the city: mule, cars, cable cars, carriages, bicycles and a few other vehicles which grew in number every day. The road development in Colombia became important by the mid forties and the early fifties. The main roads constructed in 50's were in the hands of foreign firms like Morrinson Knudsen, Utah – Olap (with Colombian presence), Raymond Co, Cristiani – Nielsen, and Winston Mantilla etc. These engineers trained the Colombians who took part in many different projects in terms of heavy duty operation, mechanics, work personnel management and many other linked specialties, in such a way that a simple group of Colombian constructors developed and there after became very important companies.

During this time the vital constructions that the foreign companies carried out in the country were completed in an improvised way and with the help of a person that knew the land and was able to make a layout between two points.

The only designs that were carried out in a very superficial way were the sub-base, the granulated, the double surface treatment, macadam of penetration or asphalt concrete (hot blending), rigid pavement on some occasions and mix pavement for roads. Different kinds of pavements were made in Colombia in the 50's: Dual surface treatment and blended road asphalt. The Ibague - La Linea – Armenia road was made with macadam of penetration. During that period other pavements were made in asphalt concrete, using solid asphalt which showed some penetration problem. Toward the 50's solid asphalts like 60 – 70 and 85 – 100 were produced and are in existence today. The asphalt was transported in 55 gallon buckets with all the implied problems. Due to the bad conditions of this procedure, all kinds of polluting elements were found in an asphalt blend. The water formed a foamy mixture which was practically impossible to use in the asphalt heaters. This tells us about the process efficiency, the asphalt quality and the mixture it produced. It's worth mentioning that the buckets and the drums were open to fresh air for long periods of time, a condition that eased water accumulation (thicker than the asphalt) to form. As a solution to this problem, the buckets were raised with hoisting machines, chains and were punctured on the sides to release the water before subjecting the asphalt to heating at the plants. If the water was not well drained, it was then necessary to destroy the buckets completely to avoid the manual collection of asphalt blocks to be put into the plant heater, for the preparation of the mixture. One would

then ask the question: What would be the hourly and daily performance of production be with this type of feeding system? The answer to this question would result in a pavement project that would be delayed considerably as only a few kilometres would be built per year.

During the sixties and seventies, important changes were seen in the pavement technology. For the first time in the country, road construction based on plans was introduced. Until 1962, roads were built by direct location, using topographic sheets as construction plans were not used, or side plant, transversal section were the styles of volume sheets and embankment by kilometer. The development on this aspect of pavements was achieved with foreign assessment by the TAMS Company which implemented this technology in the country effective up to date with remarkable advancement through electronic systematization. This deed brought about the making of road proposals and future projects. In 1966 the M.O.P. published the new Specifications of Construction that replaced the existing Specifications for the Construction of Highways and Streets of 1955. Another important achievement was the obligation to use mashed and a thick collection of granulated asphalt pavements with hot mixtures held at plants as this resisted much more the repetition of high load than those with round collection. Based on this process, the alluvial deposit and store block materials were adopted.

At this time the pavement equipment, the rollers, the loaders for complementary work had important changes. Since then the Asphalt rollers had undergone important improvements especially in the area of longitudinal levelling. The transporting of asphalt in baskets was changed for motorized tanks with a heating system (first in plants, then on vehicles), whereby the plant heating was carried out by thermal oil controlled by a boiler. It’s a technique used today. In this decade and with the aid of construction plans, drainage was introduced as an important aspect on pavement engineering. The contracts that were dealt with in the years before the 60’s, 70’s observed that there was little interest for this aspect of paving, so the total percentage of the project assigned cost on this activity increased remarkably and the job was removed – off drainage conditions, such as the end hose in collecting buckets didn’t have any great improvement. Despite the fact that, at this time of Colombian pavement history, some costs for some works, especially drainage and sub drainage, the contention structure and sliding treatment etc, no checks were completed and the road net work continued with some deficiencies which was seen in their longevity in the decade of 1970 – 1980. Considerable work was completed on the national road pavement network. Approximately 1807 kilometers was incorporated into the pavement plan.

This Plan was divided in 13 Groups that tried to cover all the regions of the country and the highways with more traffic and with an acceptable infrastructure that didn't imply big earth movements neither long variant.

An acceptable out line and a reasonable degree of stability is provided in the following boxes:

TOTAL PAVEMENT PROGRAM: 1.807 KM.

GRUPO 1			
1	A:	Pedregal - Túquerres	30K m.
1	B:	Ipiales - Guachacal	23K m.
			Total : 53 Km.

GRUPO 2			
2	A:	Garzón - Altamira	29K m.
2	B:	Altamira - Pitalito	47K m.
2	C:	Altamira - Guadalupe	10K m.
2	D:	Florencia - Montañitas	35K m.
2	E:	Montañitas- Puerto Rico	68K m.
2	F:	Florencia - Belén	44K m.
			Total : 230 Km.

GRUPO 5			
	A:	La Unión – Guamal	32K m.
5	B:	Guamal – San Martín	22K m.
5	C:	Restrepo - Cumaral	10K m.
			Total : 64 Km.

GRUPO 6			
6	A:	Mosquera – La Mesa	54K m.
6	B:	K23 – Ubaté	28K m.
6	C:	Ubaté - Chiquinquirá	53K m.
			Total : 135 Km.

GRUPO 7			
8	A:	Primavera - Amagá	10K m.
8	B:	Boquerón – Antioquia	40K m.
8	C:	La Ceja – La Unión	14K m.
8	D:	Hatillo – Barbosa	10K m.
8	E:	San José – Pto. Berrio	59K m.
			Total : 133 Km.

GRUPO 3			
3	A:	Crucero Pance– Pto. Tejada	17K m.
3	B:	Yumbo – San Marcos	10K m.
3	C:	Mediacanoa – Yotoco	5 Km.
3	D:	Crucero – Darién	18K m.
3	E:	Palmira – Tiendanueva	11K m.
3	F:	Crucero- Ginebra	7 Km.
			Total : 68 Km.

GRUPO 4			
4	A:	La Unión – El Toro	11K m.
4	B:	Cartago – Anserma nuevo	11K m.
4	C:	Armenia – Montenegro	10K m.
4	D:	ClubCampestre- |Alambrado	16K m.
4	E:	La Uribe – Tres Puertas	25K m.
4	F:	Manizales – Aranzazu	30K m.
4	G:	La Virginia – Nápoles	19K m.
			Total : 122Km.

GRUPO 8			
9	A:	Capitanejo – Málaga	35K m.
9	B:	La Lejía - Pamplona	10K m.
9	C:	Zulia – Astilleros	27K m.
9	D:	Astilleros - Sardinata	33K m.
			Total : 105 Km.

GRUPO 9			
10	A:	Límites – San Alberto	35K m.
10	B:	San Alberto – La Mata	90K m.
10	C:	La Mata – San Roque	87K m.
10	D:	San Roque– La Estación	98K m.
			Total : 310 Km.

GRUPO 10			
11	A:	Aguachica – Platanal	22K m.
11	B:	Platanal – Río de Oro	29K m.
11	C:	San Roque – Becerril	59K m.
11	D:	Becerril – Codazzi	32K m.
11	E:	Mariangola-Bosconia	43K m.
Total : 185 Km.			

GRUPO 12			
13	A:	San Andrés Isla	22K m.
Total : 22 Km.			

GRUPO 11			
12	A:	Puerta deHierro–Magangué	46K m.
12	B:	Toluviejo – San Onofre	40K m.
12	C:	San Onofre – Sincerín	59K m.
12	D:	Cereté – Tolú	70K m.
12	E:	Ponedera – Pto. Giraldo	20K m.
12	F:	Pto. Giraldo – Calamar	36K m.
12	G:	Montería – Planeta Rica	16K m.
Total : 287 Km.			

This pavement plan contributed highly to reduce the backwardness in terms of the length of paved roads,however not much on geometric design standards. The pavement plan had the economic support of the World Bank.

Another aspect that contributed to the technological bettering, though very slowly and needed great effort, was the building of the first emulsion plant, by a French company TACSA, in late 1970, in Mosquera (Cundinamarca), currently a property of shell .

As has always been the case of technologic innovation on Colombian pavement, it was rejected by some government authorities, constructors and some consultants. In other words, when Europe, U.S.A, Brazil, Argentina and other countries in America were already using remarkable volumes of emulsion for paving secondary roads, Colombia was just building a little plant, which worked for twenty years so as to be accepted nationwide and still with low production. Ten years later 4 or 5 portable plants were built and imported which have in one way or the other helped on the application of new technologies.

The Ministry of Public Works and The National Road Fund took into account the 1966 specifications of construction that required revision and the addition of several items of construction as they hired a Colombian consulting company to carry out this task which came into effect from February 1970. This new specifications were common in almost all construction contracts until December of 1996, which is more than 25 years

Owing to the above standards and general specifications of construction in 1979 for recovery plan of the National paved road network. This edition lasted for about a year and was called the “yellow” book.

The two editions lasted for a short period of time for several reasons. One was the specific destination for the outcome of the pavement plan as there was a return back to the

specifications of February 1970. An important advancement with respect to the pavement quality was the bases fixed under the pad of the asphalt pavement rut.

Most important of all a great number of foundations ceased such as: “stabilized foundation for added soil” – “foundation for hydraulic Macadam” –“bases for mashing and slag” –“bases for sand-clay”- “bases for gravel and linking soil” – “bases for marine fields”- “soft rock bases” which were all part of the construction specification (1954 – 1966) simply because they did not serve as a support for the vehicle load and to these kinds of foundations. The decision was to use this treatment for the feeder roads and the pathways.

From 1970 only the granular bases of crushed gravel and crushed rock, and the stabilized bases, generally with products bituminous cement or with chemical preservatives, and the bases stabilized with ash and lime were used.

These changes and the new specifications improved the quality of the asphaltic pavements notably; however it took 42 years (1954-1996) to achieve this improvement. These base’s aspects, is one of the main causes of poor road conditions and the short life of our pavements. Furthermore the designing methods used until the mid 80-90 decade, the empiric methods were used, with the following philosophy: if the road had large traffic volumes, it was designed with the asphalt institute method, and if it was low traffic volumes then it was designed with elementary methods like the Mop-75 where, basing on the CBR of Sub friction and traffic (N) of the road, the granulated sub base thickness was designed, because the thickness of asphalt concrete was 4.5 cm o 5 cm according to the traffic or a double surface treatment if $N < 0.5 \times 106$, the granulated base thickness was always 15 cm . The MPT-15 method was also used for some 0 -16 years when the AA514 method, versions 1988- 1993 was implied. It is worth mentioning that some time from 1980 – 1990, the year 2000 Road Plan, under the ministerial government of Rodolfo Segovia, in 1985, was partially built or a great part was partly designed. If the plan had been accepted previously, 4754 km of road would have been built with at least 4 lanes, and a central separating line, which would have meant a great improvement on the National pavement network. The Road Plan 2000 had a cost of 2000 million dollars in 1985.

In summary this report now moves towards the 1990-2000 decade and discusses the main grading on the asphalt pavement in Colombia and it’s incidence on the National Road net work.

During the late years of the 20th century and what’s already gone for the 21st, the Boquerón tunnel has been built (2.5 km long) and Buena Vista (almost finished) of 4.5 km on the new road from Bogotá-Villavicencio. The Western tunnel (San Geronimo) on the Medellin–Santafé de Antioquia road, 4.5 km long and the license with the 8.5 km long line is currently with two ventilation windows of 500 and 400 high respectively.

The current government of Columbia has presented one of the most ambitions road planning programs ever.

Under the eyes of the Ministry of Transportation and participation of the National Planning Department, Camacol, the construction industry and the economic and industrial groups have proposed for the pavement of 2500 km of roads all around the country. The financing model is

based on bonds and market shares to get the resources for the priority roads. The back up of these bonds represents the future effectiveness the goes to the transportation sector in the near future.

According to CONPES document the priority projects will be as follow:

- Projects supported in the performance of productive process or illegal cultivation substitution program.
- Projects consisting of the regional and municipality plans in accordance with what was set up under the National development plan.
- A project that promotes agreement process between the National government and communities.
- Projects that generate high regional impact in accordance with the programs aim due to it's physical characteristics and location.
- Projects containing direct aim and link to the main network and the town capitals.
- Projects motivating inter-modal transportation.
- Projects in process.
- Corresponding to priority projects at the public hearing.
- Projects allowing regional integration especially that of the rural areas with low entrance.
- Projects where agreements are subscribed with the territorial entities to ensure that there is sustainability of the covered roads, once the program ends (i.e. after eight years).

It is expected that, the investment of the 2500 plan on road development, allows the country to be more competent in terms of the free trade treaty.

NEW SYSTEM OF TRANSPORTATIONS

Today Bogotá is a city with approximately 7.000.000 inhabitants and one of the major issues is transportation and its link with the quality of road infrastructure in the city the last three years. Transmilenium, which although, not being the best, could be the start of a better transportation system for the future? Transmilenium has been a revolution for the city in terms of its arrangement and beauty. Other capital cities have commenced building this massive transportation line. The system to date only covers about a 20% of the total necessity, a really very low figure knowing that over half of the inhabitants travel by bus. The project hopefully will provide better roads and service in all of the city's corners.

The city is currently running on road repair and building, especially to ease the feeder buses of Transmilenium.

a. Panoramic view of the city centre of Bogotá. b.Bus system TRANSMILENIO, capacity 160 people c. Panoramic view of the east of Bogotá.

At this time inhabitants of the city are carried out via local routes on buses and feeders of TRANSMILENIO.

CONCLUSIONS

- Allowing a serious reflection on the road evolution in Colombia to conceptualise the trouble of infrastructure of national roads.
- To describe the typical problems of structural deficiencies by reason of the ignorance of pavement materials.
- To present the improvement steps taken by the government for improving road structure.
- To leave open the possibility to enlarge a study on the improvements that should be taken regarding the quality of pavements in Colombia.
- To present to the international community the road development achieved by our country and to compare all aspects coinciding with the Latin-American culture

REFERENCES

- MELO. Jorge, VALENCIA, Reportaje de la Historia de Colombia. Editorial Planeta, 1989.
- Nueva historia de Colombia, Álvaro Tirado Mejía, Editorial Planeta 1989.
- Ingeniería e Historia de las Técnicas, tomos IV y V. Gabriel Poveda Ramos, COLCIENCIAS.
- La Reingeniería del Desarrollo Nacional- Anotaciones para la formulación y ejecución del plan Nacional de Desarrollo 1994-1998.
- El Desarrollo integrado Naciona1- El Desarrollo Económico, Social y humano en Colombia, SCI 1996.
- Datos de Estudios del plan Maestro de Transporte de Colombia, Ministerio de transporte Consorcio Hidrotec, Harrís, Renaardert, Agosto de 1992.
- Fredy Reyes, Diseño Racional de Pavimentos, Universidad Javeriana, 2003.
- Diario Económico-El Espectador Mayo 31 de 1998.
- Documento Conpes 2940, Julio 30 de 1997.
- Heberto Jiménez. La infraestructura vial en Colombia Segundas Jornadas de Pavimentos y Mantenimiento Vial, 21/24 de abril de 1998.
- DNP pavimentación de 10 15 km nuevos de juho/90 a Dic 1993.aro Mendoza. . Pavimentos flexibles, XIII Congreso Colombiano de pavimentos, Universidad de los Andes, Junio de 2002.