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WHAT HAS BEEN ACCOMPLISHED UNDER FEDERAL AID?

American Association of State Highway Officials 6th Annual Meeting

To many here has come today the great opportunity to contrast the present highway situation with that existing at the time of the annual meeting of this Association at Chicago in 1915 - just five years ago. At that time the proposed Federal Aid measure was presented by the Executive Committee and received the final approval of the Association. Many of the States were facing a reactionary wave against modern highway improvement threatening the authority, even the very existence of the organizations themselves. A few months later the Federal Aid Act had become a law, and even while in one State petitions were being circulated calling on the General Assembly to refuse cooperation with the Federal Government, the future of road building in this country was definitely established.

Sharply contrasted with the road improvement program represented by the officials in that convention, is the immense program going forward under the direction of the officials in this convention. Here are gathered more of the men who are responsible for the development of highway policies than will come together again until this body meets after another twelve months. Highway history is in the making. Our progress in the future is dependent upon a correct analysis of the underlying principles developed by our experience so far, and an intelligent forward-looking policy based upon this study.

Although since 1916 the State and Federal highway departments and road building agencies have been continually handicapped, disorganized and rebuilt, still great progress has been made. The year just ending has been filled with many discouragements and restrictions, and yet surprisingly large and excellent results have been produced. Certainly not all the results which have accrued have been the direct product of Federal Aid, but it has seemed desirable to extend the topic to include the broad developments of the last five years, of which the Federal Aid measure has been one of the major factors. Further, it has seemed desirable to treat the progress already made as an index of the possible rate at which highway improvements may be carried on in the future, rather than to be content with a summary of the more or less lifeless figures which go to make up the totals. This opportunity cannot be satisfied with a bare recital of statistical facts.

Any standard of measurement that will actually indicate what has been accomplished under Federal Aid, or more properly during the period that Federal Aid has been effective, is not the standard of dollars made available or expended for highway purposes, or the mileage of highways which has been built. Any conception which seeks to measure progress by these factors is wrong. Any State highway department which fails to sense a different problem than these is missing the main reason for its existence.

During the six-year period since 1914 an astonishing development of the motor vehicle has given us potentially the means for a

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great increase in our transportation facilities, but the availability of the motor vehicle for this purpose is contingent upon serviceable highways, not of any particular type or character of material, but highways over which, with the maximum public and private economy, motor vehicles in sufficient numbers to supply the highway transportation necessities of the nation may operate. This, in general, means continuous service, but not continuous service under maximum or peak loads. The extent to which such service is being and will be supplied is the true standard of measurement which should be applied to the past results and the future proposed programs. The motor vehicle in combination with the improved highway has added such a powerful influence to our civilization that we do not yet sense its potentialities. The increase in transportation facilities for the local and short haul afforded by this combination is destined to bring great changes in the conduct of the activities which go to make up the life of the whole nation, and will have a far reaching effect upon its development along every line. The results which have been so far accomplished in a relative sense are unimportant. Rather it is the way which they point toward the realization of great mileages of adequate highways, and by this test the outstanding development of this period is the sum total of modern highway legislation produced.

Legislation is the only vehicle through which the public can set in motion activities for its own use and advancement, and no great constructive policy can go forward without adequate authority from the public itself. Here the influence of the Federal Aid Act has been potent, and in the great amount of new legislation which has been set up as the law governing highway activities is the greatest result which has come largely as a direct consequence of the Federal Aid Act. It is conceivable that much legislation would have come in time, but the same amount of advanced legislation would not have resulted within a decade without this measure to stimulate and guide. Not only is the amount large, but there is a uniformity of principle which will mean larger results than had there been no standard, in the principles in which the State Legislatures have shown confidence, and with which new legislation has conformed. In this five-year period there have been new laws providing State participation, State revenues, State highway systems, and State supervision. Entirely new highway departments were established in five States, and in about twenty others the highway departments were reorganized and greatly strengthened to carry on the program set in motion by the Federal Aid appropriation. Thus in over half of the States new highway departments were added or those existing were greatly strengthened, and in practically nearly all the others some new legislation was enacted increasing the authority and available funds of the departments. Ten States by a State-wide vote have provided either for constitutional amendments or for State bond issues removing prohibitions and enabling these States to engage in highway improvement. By the passage of the Federal Aid Act the Federal Government, after a lapse of nearly eighty years, again assumed responsibility for highway construction, provided funds ample to carry on a large highway improvement program, and provided for general supervision through a Federal Department that is a constant force for bringing up standards of engineering and construction in the work undertaken.

In order of next importance to the legislation provided for highway improvement is the development of the organizations necessary to carry on the work. The placing of large new responsibilities upon the State highway departments and the Federal Bureau of Public Roads has been followed not only by a growth of the central organizations of these departments, but by a systematic expansion of these departments covering the whole United States and extending down through each State until men responsible to these organizations are in immediate charge of all road work carried on through the cooperative funds. Activities of both the State and the Federal departments have been de-centralized to facilitate procedure and to place the responsibility upon the men in actual conduct of the work so far as our experience had dictated advisable. The construction work proper has attracted many of the companies and individuals formerly engaged in other lines of construction activities, has brought into the highway building field a large number of men who are experienced in handling large work, and has made available a large amount of capital as well as equipment to carry on the work. It is quite true that these new contractors have come into the field at a very difficult time, and the experience of many has been discouraging, yet the past season has proven to many of these that the highway contracting field can and will be in the future a profitable field in which to be engaged. Many manufacturing companies have extended their lines of equipment and are engaged in the development of new devices which will prove effective in quantity production. During the past few years much attention has been given to the development of labor saving devices because of conditions existing. Producers of road materials have established new plants, enlarged existing plants, and prepared themselves to furnish a larger output of material for this purpose. An effort has been made by a very considerable number of these producers to standardize their product and to produce sizes and quality of material which the highway engineers are demanding. In addition to the contractors' organizations and equipment which have been made available, every State has profited largely from the distribution of war surplus materials and equipment, and there is now available sufficient equipment in each one to carry on road building operations of a major character.

Summing up this period, the greatest results are undoubtedly shown by the amount of constructive legislation and the development of the engineering, construction, manufacturing and producing organizations, and the making available of a large amount of State-owned equipment for both construction and maintenance purposes.

All of this progress has been time-consuming, and has been carried through at a most difficult period, but there has been produced a situation out of which, during the next few years, will come a larger production of roads than has yet been considered possible. There is not an indication which fails to confirm this viewpoint as to the future, yet during this same period the actual operations under the Federal Aid Act have been large. From the engineering and administrative standpoint the following table indicates the progress by years of the project statements approved by the Secretary of Agriculture.

Project Statements Approved by Fiscal Years.

Fiscal Year	Number	Federal Aid	Estimated States' Share	Total Estimated Cost.
1917	23	\$ 846,152	\$ 999,282	\$ 1,845,434
1918	557	15,478,090	25,575,111	41,053,201
1919	736	38,664,397	52,831,401	91,495,798
1920	1670	109,830,366	142,699,817	252,530,183
To Oct. 31, 1920	501	24,198,610	40,599,480	64,798,090
Totals	3487	189,017,615	262,705,091	451,722,706

Because of the fact that the project agreements are not executed until after the engineering work has been completed, the projects financed and ready for taking bids, the following statement of project agreements executed is more indicative of the producing ability of the highway organizations.

Project Agreements Executed by Fiscal Years.

Fiscal Year	Number	Federal Aid	Estimated States' Share	Total Estimated Cost.
1917	6	\$ 224,717	\$322,375	\$547,092
1918	218	5,658,458	8,581,481	14,239,939
1919	454	18,048,442	23,583,290	41,631,732
1920	1286	85,906,556	111,665,070	197,571,626
To Oct. 31, 1920	393	23,745,415	33,324,573	57,069,988
Totals	2357	133,583,588	177,476,789	311,060,377

The extent of the development of the State and Federal highway organizations is well shown by contrasting the engineering output as indicated by the project agreements executed between the fiscal years 1917 and 1920. In 1917 six project agreements were executed, in 1920 1286, more than 200 times as many. Project agreements in 1917 called for a total expenditure of \$547,092, of which \$224,717 was Federal Aid. In 1920 the total estimated cost of projects was nearly \$200,000,000, of which \$86,000,000 was Federal Aid, an increase of nearly 400 times the amount requested in 1917.

The construction record also is good. Prior to the fiscal year 1920 only 59 projects, comprising 293 miles and involving Federal Aid in the amount of \$1,284,806 had been completed.

The fiscal year 1920 added to the list of completed projects 233 more, or nearly 4 times as many as had been completed up to the beginning of the year. These 233 projects involved 1384 miles and \$7,635,547 of Federal Aid, so that the record of entirely completed projects at the end of the year was as follows:

Number of projects completed	292
Mileage of completed projects	1,677
Federal Aid allotted to complete projects	\$8,920,353.
Estimated total cost of completed projects	20,878,484.

The above refers only to entirely completed projects. In addition to these there were at the end of the fiscal year (June 30, 1920) 1835 more projects under construction, involving 14,940 miles, and Federal Aid to the amount of \$103,925,094, the estimated total cost of these projects being \$241,977,217.

As these projects were reported at the end of the year as being 30 per cent complete in the aggregate, it follows that the work done on these uncompleted projects up to the end of the year would call for approximately 30 per cent of the Federal Aid allotted to them, or \$31,174,732. This, added to the Federal Aid expended on completed projects (\$8,920,353) gives a total equivalent expenditure of Federal Aid up to the end of the fiscal year of \$40,095,085. At the end of the fiscal year 1919, the amount allotted for completed work was only \$4,658,749, so that the Federal Aid allotted to work completed during the year was \$35,436,336.

But until the first of July, 1920, we had not yet caught our stride in construction work. In the face of the most serious shortage of rail transportation, between June 30 and October 31, 329 additional projects were completed, or 37 more than had been completed in the four years preceding, making the total completed projects on October 31, 621.

The Federal Aid and mileage, of course, were correspondingly increased, and in order to show the amount of the increase the several items are listed below for the two dates.

	June 30, 1920:	October 31, 1920
Number of projects completed	: 292:	621
Mileage of completed projects	: 1677:	3191
Federal Aid allotted to completed projects	: \$8,920,353 :	\$20,900,014
Estimated total cost of completed projects	: 20,878,484 :	46,740,472

Notwithstanding the great increase in these items for completed projects, the corresponding items for the projects under construction on October 31 were not decreased, but largely increased. On that date there were 17,369 miles under construction, to which had been allotted \$121,322,198 of Federal Aid. These projects were reported as 43 per cent complete in the aggregate; hence the equivalent Federal Aid expenditure upon them was \$51,844,586. This amount added to Federal Aid expended on completed projects gives a total of \$72,744,600 as the equivalent of the Federal Aid expended for completed work up to October 31.

Thus the work completed on October 31, 1920, has consumed, practically speaking, the whole amount of Federal Aid appropriated up to February 28, 1919.

It will be noted that during the previous four-months period construction was completed requiring approximately \$32,000,000 from Federal Aid funds, or \$8,000,000 per month. The acceleration of the rate of construction will be large when highway building is operating under more favorable circumstances. It is now apparent, however, that conditions will vary widely between the States. As closely as can be approximated at this time it appears that if freed from influences which have so hindered construction during the past season, particularly the lack of rail transportation, the rate of expenditure will be greatly increased, and by the end of the calendar year 1921 eight States will have expended the full amount of their Federal Aid apportionments, twenty more States

will have expended or placed under contract all of their funds, five will have placed their funds under contract by the middle of the following year, fifteen will have placed all of their work under contract by the end of the year 1922. The number of States in each of the above classes may vary somewhat, but the figures here given are based on the best evidence obtainable.

This situation should be clearly understood because between 30 and 40 of the State legislatures which meet biennially will be in session this winter, at which time questions affecting the future road building programs should be settled. More than one year should be allowed to get the funds in the State treasuries after the legislation is enacted, and the highway organizations should know the amount of available funds for several years in advance to enable them to carry out the preliminary engineering and administrative work necessary for the inauguration of road building projects.

While we are seriously suffering from a lack of improved roads, and our production of new roads up to the present year since 1916 has been small, it has been fortunate for the future stability of the road building program that because of the limitations imposed there has been sufficient time to get the necessary engineering work done much more thoroughly than would have been possible had we gone hastily into a heavy construction program. So it would seem that conditions have worked out well in spite of the discouragements. We have come to see the immense task ahead and the organizations which have succeeded in driving through actual construction in spite of the handicaps cannot fail to produce road mileage at an accelerated rate.

But the big important work, considering the general situation, is ahead, and as we go into the heavy construction program in all of the States we must face the immense physical task of transforming the funds which are provided into adequately built roads. There are certain phases in which our present legislation is weak. These weak points have already shown up and should be eliminated in future legislation. It has become very apparent that those States which have provided State funds with which to meet the Federal Aid apportionments have less difficulty in exercising proper engineering control of the design and construction than those States in which the funds are largely provided by the counties or districts. In a number of States it has been necessary to remove constitutional limitations before State funds could be appropriated for this purpose. There is no reason why local funds should not be used with State and Federal funds, but these should be made to augment the other funds.

Referring again to the standard of measurement by which results must be gauged, that is, the extent to which transportation is facilitated by highway improvement, the results of our observation as to the deterioration of roads and the intensive studies which have been carried on during the past year have demonstrated as never before the absolute necessity of adequate maintenance. In about 30 States the Federal Aid projects are maintained under the direct supervision of the State highway departments or the highway departments have funds to maintain the projects if the local authorities fail. In about 18 States the maintenance is under supervision of the local authorities. Probably the majority of those represented here will not question that a principle of any future Federal Aid provided should be that the States as States

should have control of the maintenance of the roads built under the cooperative funds. More than 40 of the States have established a system of main roads. These systems vary from a restricted mileage up to more than 10 per cent of the total mileage within the State. The aggregate mileage of the main systems is approximately 8 per cent of the total mileage of rural roads within the United States. Further classification of many of these systems is necessary in order that the construction of those roads of the greatest importance should be expedited. In order that there may be a systematic improvement of the highways this classification should be carried forward, and the sequence of the improvement of the roads should within reason be justified by the relative uses which they serve. Only by properly laying out highway systems can the task of road improvement within any reasonable period be completed to an extent necessary to give the public adequate highway service.

There are other important features which the experience already acquired has pointed out. There should in many States be better standards adopted for the basic improvements such as widths of graded roadway, alignment, grade crossing elimination and building of permanent drainage structures. The comprehensive studies of the relation of soils to road design, particularly the studies which have coordinated surface failures with certain types of soils have proven beyond doubt the great prominence which should be given soil studies in road designing. In general, more ample surface widths should be provided, and greater attention given to the construction of shoulders. All of these are features which make for permanency of design and the first cost, while greater, will be more than compensated by lesser expenditures for maintenance and reconstruction as our traffic grows heavier. Sufficient attention is not yet being given to the control of materials. The results which really count are the finished product. The materials used must be controlled through laboratory and field tests more adequately. To accomplish these results it seems highly desirable that there be a larger contact between the Federal and State forces. Up to the present time the Bureau of Public Roads has not succeeded in carrying out the amount of inspection originally planned because of difficulty in maintaining a sufficient organization. It seems probable that a larger number of engineers will be available during the coming year, and so far as possible the Bureau proposes to render greater assistance to the States in carrying on a large construction program.

This whole road movement has been conceived with the idea of providing adequate roadways for the movement of the highway traffic of the nation. We have not reached a stabilized character of traffic particularly with reference to the limiting weights of the larger vehicles, and we should not plan the higher types of construction without allowing a considerable safety factor. Our scientific knowledge of the duty imposed upon highways has been largely increased during the past year, and in the face of facts secured it is evident that our highways in the vicinity of the larger centers of population must be more amply designed and more carefully constructed. No matter how true this is, we must not lose sight of the big fact that there are large areas where transportation over the highways is of the greatest importance to our producing population and where roads of the less costly type, particularly well built gravel roads, will amply serve the purposes if properly maintained. The building of highways is the means to an end, that of carrying most economically the traffic developed in com-

munities served. This principle is being carried out in the projects which have been agreed upon between the Federal and State highway departments as evidenced by the mileage of the various types of road improvement for which the plans and specifications had been approved up to June 30, 1920. Grouping these types by class we have:

Type	Class 1.			
	Mileage	Per cent of mileage	Total Cost	Percent of total cost
Earth	3,701	21.5	\$21,763,989	7.7
Sand-clay	1,721	10.0	9,854,570	3.5
Shell	27	0.2	296,801	0.1
Gravel	5,583	32.5	47,151,795	16.8
Gravel (surface treated)	355	2.1	4,136,533	1.5
Total	11,387	66.3	83,203,688	29.6

Class 2.				
Water-bound macadam	342	2.0	5,258,779	1.9
Water-bound macadam(surface-treated)	97	0.6	1,433,499	0.5
Bituminous macadam	714	4.1	16,669,782	5.9
Total	1153	6.7	23,362,060	8.3

Class 3.				
Rock asphalt	51	0.3	1,978,293	0.7
Bituminous concrete	496	2.9	15,064,756	5.3
Concrete	3,308	19.2	120,629,308	42.9
Brick	351	2.0	15,725,494	5.6
Sheet asphalt	48	0.3	1,572,472	0.6
Total	4,254	24.7	154,970,323	55.1

Class 4.				
Undetermined	392	2.3	19,796,607	7.0

It is unimportant whether all engineers would agree to this classification in regard to all the types. The relative percentages would be little changed between the classes. One big important fact stands out, that all types of roads must be used, and if the traffic demands are to be supplied large mileages of the lower cost roads must be built. The time factor alone will permit no other course, but there are the other conditions of funds available, continued public support, and economical handling of the public's business which cannot be met otherwise. The other important fact is that the big percentage of the funds, particularly where the population served is relatively dense, is going into the more durable types of construction.

In closing, as conditions have tended more toward the normal, and limitations have been removed upon the activities of both the State and Federal departments, the spirit of cooperation has steadily improved and it is needless to say that as the organization of the Bureau looks

forward to the biggest year for construction of highways in the history of the United States, it is with the most friendly attitude toward the State organizations and with a desire to produce large results which will reflect credit upon both organizations and with the sincere hope that at the end of another year the efforts made will have produced greater results than has been possible heretofore.