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COMMON ROADS

SUMMERS

1881



Α **THESIS** FOR THE DEGREE OF C. E. BY **E**. **B**. **SUMMERS** 1881

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A Thesis on the Location, Construction and Drainage of Common Roads by E. B. Summers

It write upon and do justice to the subject of common soads it is recelsary that one should be familiar with every variety of them. The roads in some of the advanced and highly eivilized communities are of a most admirable character; while in the new and thing populated countries, they are found deficient in marly all___ the attributes of good roads. Cilly a few kinds that may be found in some of the most populous districts will be ture designated Roads are the pathways not only of industry, but of social and national intercourse, and the makers of them, by ___ enabling men to communicate with each other have been regarded as among The most effective pioneers of eiviligation. Mulever a line of consimunication is formed between mere it tends to bind Together society and bring out that healthy spiril of industry which is the life and soul of every great mation I country cannot be affectually opened up with out roads and in a new colony they are among the first improvingents to benefit the public

To write upon, and do justice to the subject of common roads, it is necessary that one should be familiar with every variety of them. The roads in some of the advanced and highly civilized communities are of a most admirable character; while in the new and thinly populated countries, they are found deficient in nearly all the attributes of good roads. Only a few kinds that may be in some of the most populous districts will be here designated. Roads are the pathways, not only of industry, but of social, and national intercourse, and the makers of them, by enabling men to communicate with each other, have been regarded as among the most effective pioneers of civilization. Wherever a line of communication is formed between men, it tends to bind together society and bring out that healthy spirit of industry, which is the life and soul of every great nation. A country cannot be effectually opened up with out roads, and in a new colony, they are among the first improvements to benefit the public.

Good roads, wherever they may be found, are a sure evidence of an industrous and energetic people As needs any as it may be to use very imperfect roads in order to accomplish a designed end in the infancy of a settlement, to fail to continually improve them is a disgraceful proof of indolence and want of enterprise in Those who continually travel whom them,-It is true that a guat many of The defects found in some of the American loads are the unavoid_ able results of the seantiness of eapital and of labor in a new country but with the people of some localities they arise from either an ignorance of the true principles of road making or by not having the advantages of putting these principles into use. The first work that should be performed before the construction of a read, is a close examination of the country through which it is to pass by making a rapid preliminary survey. It is intended as only an application to accuracy

Good roads, wherever they may be found, are a sure evidence of an industrous and energetic people. As necessary as it may be to use very imperfect roads in order to accomplish a designed end in the infancy of a settlement, to fail to continually improve them is a disgraceful proof of indolence and want of enterprise in those who continually travel upon them. It is true that a great many of the defects found in some of the American roads, are the unavoidable results of the scantiness of capital and of labor in a new country, but with the people of some localities, they arise from either an ignorance of the true principles of road-making or by not having the advantages of putting these principles into use. The first work that should be performed before the construction of a road, is a close examination of the country through which it is to pass by making a rapid preliminary survey. It is intended as only an approximation to accuracy.

and to serve to determine through what points routes should be instrumentally surveyed. The road maker in determining the most desirable route, will be greatly assisted by an examination of the map of the country He should visit and identify the various points selected on the map and sic whether his decisions Siave been correct. He must fease over the country in opposite directions, for it will often appear quite different, and convey very dissimilar appearances according to The point from which it is viewed Thus a hill may appear to have a very easy slope in deserviding, while the assessed might present a very tiresome contrast. These first explorations if properly carried out, will doubtless save much expense in the subsequent surveys which in their truck Thould be Thoroughly executed to secure the most remonical soute in construction. A road intended to connect two points should be as straight as practicable so that its length,

and to serve to determine through what points routes should be instrumentally surveyed. The road-maker in determining the most desirable route, will be greatly assisted by an examination of the map of the country. He should visit and identify the various points selected on the map, and see whether his decisions have been correct. He must pass over the country in opposite directions, for it will often appear quite different, and convey very dissimilar appearances according to the point from which it is viewed. Thus, a hill may appear to have a very easy slope in descending, while the ascent might present a very tiresome contrast. These first explorations, if properly carried out, will doubtless save much expense in the subsequent surveys, which in their turn should be thoroughly executed, to secure the most economical route in construction. A road intended to connect two points, should be as straight as practicable, so that its length,

Therefore the time and labor exhended in travelling whom it should be the least possible that is its direction departing from one extremity of it, should constant by levid lowards the other However, it may be the principal in view to connect two distant points and get there man be instances in which it would be greatly deviate from expedient to a straight linew the accompanying -Figure - Suppose for instance it is desired to Mal connect the two points A and B. our at first sight it would appear that a perfeelly straight line drawn from one point to the other wour be the best that could be chosen In a eareful examination however of the locality it is found that there is a third place & situated somewhat on one side of the straight line drawn from A to B and although the primary object in view is to connect only the two latter points it may nevertheless be considerable service if the whole

and, therefore, the time and labor expended in travelling upon it, should be the least possible, that is, its direction, departing from one extremity of it, should constantly tend towards the other. However, it may be the principal object in view to connect two distant points, and yet there may be instances in which it would be expedient to greatly deviate from a straight line.-

In the accompanying Figure. Suppose for instance, that it is desired to connect the two points A and B. Now at first sight, it would appear that a perfectly straight line drawn from one point to the other would be the best that could be chosen. On a careful examination, however, of the locality, it is found that there is a third place C, situated somewhat on one side of the straight line drawn from A to B, and although the primary object in view is to connect only the two latter points, it may nevertheless be of considerable service if the whole of

The three places were connected. Now this connection may be made in three different ways, any one _____ circumstances be the best. In the first place, it may be done. by a straight road from A to B together with two other straight roads; one from A to C, and the other from B to E, and this would be the most perfect way to effect the object in view, and the distance between any two of the... points would be reduced to the least possible However, this mode of connection ____ would be considerable expense, and would naturally require a greater length of road than according It a second plan which would be to form as before a straight road from A to B and another one from E to DB making sight angles with it at a point (P. The traffic between A and B, in this ease would proceed to the point of and if desired turn off to With this arrangement, the length of the road would be greatly

the three places were connected. Now this connection may be made in three different ways, any one of which might, under certain circumstances, be the best. In the first place, it may be done by a straight road from A to B, together with two other straight roads; one from A to C, and the other from B to C, and this would be the most perfect way to effect the object in view, and the distance between any two of the points would be reduced to the least possible.

However, this mode of connection would be considerable expense, and would naturally require a greater length of road than according to a second plan, which would be to form, as before, a straight road from A to B, and another one from C to AB, making right angles with it at a point D. The traffic between A and B, in this case would proceed to the point D, and if desired turn off to C. With this arrangement, the length of the road would be greatly

decreased and only a slight in_ erease would be occasioned in the distance between & and the other two points. The third and most usual method would be to construct only the two loads AC and O.B. in which ease the distance between A and B would be some what increased, while that between A and E or B, and E would be diminished and the total length of the road to be constructed would be lessened. In choosing the best direction for a roadway, the proper gradient it is of far greater importance than the mere maintaining of a direct line. If a road be not level a large potion of the power will be expended in raising ___ The load up the ascent. It is a principle fully demonstrated in Mechanics, that when a weight is drawn up an inclined plane, The resistance of the force of gravity, or the weight to be overcome, is such a part of the whole weight, as the height of the plane is of

decreased, and only a slight increase would be occasioned in the distance between C and the other two points. The third and most usual method would be to construct only the two roads AC and CB, in which case the distance between A and B would be somewhat increased, while that between A and C, or B, and C, would be diminished, and the total length of the road to be constructed would be lessened.

In choosing the best direction for a roadway, the proper gradient should not be over looked, since it is of far greater importance than the mere maintaining of a direct line. If a road be not level a large potion of the power will be expended in raising the load up the ascent. It is a principle fully demonstrated in Mechanics, that when a weight is drawn up an inclined plane, the resistance of the force of gravity, or the weight to be overcome, is such a part of the whole weight, as the height of the plane is of

its length. If then a road rises one foot in every twenty its length, a horse drawing h it a load of one ton is come helled to actually lift up one twentieth of the whole weight, that is, one hundred pounds, through the whole height the ascent, besides overcoming the friction of the entire load. Now a horse will excel for a short time twice the average tractive full which he can exert continuously throughout a day's work, Therefore so long as the resistance on the gradient is not more than double the resistance on the level The horse will be able to take up the full load which he is eapable of drawing. If the resistance to traction is Taken at one-thirtieth of the load on the wheels then the maximum gradient should not. exceed one in thirty; because on that slope the gradient resistance is equal to the resistance on the level, and the total

its length. If then a road rises one foot in every twenty of its length, a horse drawing up it a load of one ton is compelled to actually life up onetwentieth of the whole weight, that is, one hundred pounds, through the whole height of the ascent, besides overcoming the friction of the entire load. Now a horse will exert for a short time twice the average tractive pull which he can exert continuously throughout a day's work, Therefore, so long as the resistance on the gradient is not more than double the resistance on the level, the horse will be able to take up the full load which he is capable of drawing. If the resistance to traction is taken at one-thirtieth of the load on the wheels, then the maximum gradient should not exceed one in thirty; because on that slope the gradient resistance is equal to the resistance on the level, and the total

resistance exactly doubled. Again in regard to descending slope should not be so great that the gravity acting down The slope should exceed the resistance to the traction In that ease the vehicles would tend to accelerate in velocity under the action of gravity and brakes would become necessary to control the descent thus earising a waste of work in priction. This consideration again fixes the maximum gradient at one in thirty For a short distance steeper gradients may be adopted with economy but their number should be as few as possible. When inclinations are reduced to the limit of one in thirty there is little loss of power compared with a perfect level in either direction of the travel; for the increased labor of ascending is compensated in a great degree by the increased of descending while on

resistance exactly doubled. Again, in regard to descending, it may be assumed that the slope should not be so great that the gravity acting down the slope should exceed the resistance to the traction. In that case, the vehicles would tend to accelerate in velocity under the action of gravity, and brakes would become necessary to control the descent, thus, causing a waste of work in friction. This consideration again fixes the maximum gradient at one in thirty. For a short distance steeper gradients may be adopted with economy, but their number should be as few as possible. When inclinations are reduced to the limit of one in thirty, there is little loss of power, compared with a perfect level, in either direction of the travel: for the increased labor of ascending is compensated in a great degree by the increased ease of descending, while on

a steeper slope this advantage is multified by the necessity of the horses holding back to resist the excess of the force of _ gravity. It requires great enginsering skill to construct a road through some sections of country, and at the same time avoid loo great inclinations. It is said that the road between. London and Barnet the total number of perfendicular feet that a horse must now aseend is upwards of 1300, although Barnet is only 500 ft, higher than London, and in going from Barnet to London, a horse must ascend sooft, although London is, 500 ft lower than Barnet. It is also said that another instance of this defect in road engineering is observable in the line of the old load across the Island of Anglesea, on which a horse was obliged to ascend and decend 1283 perpendies_ ular feet more than was found necessary by Selford when he laid out the present new line as, shown by the Table on following page

a steeper slope this advantage is nullified by the necessity of the horses holding back to resist the excess of the force of gravity. It requires great engineering skill to construct a road through some sections of country, and at the same time avoid too great inclinations. It is said that the road between London and Barnet, the total number of perpendicular feet that a horse must now ascend, is upwards of 1300, although Barnet is only 500 ft. higher than London, and in going from Barnet to London, a horse must ascend 800 ft., although London is 500 ft. lower than Barnet. It is also said, that another instance of this defect in road engineering is observable in the line of the old road across the Island of Anglesea, on which a horse was obliged to ascend and descend 1283 perpendicular feet more than was found necessary by Telford when he laid out the present new line, as shown by the Table on following page.

Not chimmit Jolal rise Long above Migh Water and Ful miles yards Ild road 3540 339 New road 193 2257 21 1596 ifference 146 12\$3 59

Breadth and Grass-section of Roads, he proper width for a road depends. of course upon its, importance, and he amount of travel whom it, Its minimum is about one red, or 16/2 feel sufficient to enable two vehieles to pass each other with ease. For ordinary lown roads a good is from 20 to 25 hoe roadways in pohulous towns and their neighborhood no general rule can be given eases in which the raffie is greatest adway is about Lhaths on each side from 10 to 15 feet in width widths preseribed for those hublic roads in B interfered with by railwans are al Jurnpike roads lie carriage roads (not turnpike).

Height of Summit above High Water		Total rise and Fall	Length	
			miles	yards
Old road	339	3540	24	428
New road	193	2247	21	1596
Difference	146	1283	2	592

Breadth and Cross-section of Roads. The proper width for a road depends, of course upon its importance, and the amount of travel upon it. Its minimum is about one rod, or 16 $\frac{1}{2}$ feet, sufficient to enable two vehicles to pass each other with ease. For ordinary town roads a good width is from 20 to 25 feet. For the widths of roadways in populous towns and their neighborhood, no general rule can be given. In some of those cases in which the traffic is greatest, the width of carriageway is about 50 feet with foot-paths on each side, from 10 to 15 feet in width. The widths prescribed for those parts of public roads in Britain which are interfered with by

In forming the travelled part of the road or road bed, as it is called the first and most important points in a flat country is to raise it above the level of the land through which it passes, so that the water may be permitted to drain from it. This is one of most essential requisites for. road in good condition Daving established the needsa ation the shape of the road bed at right angles to its length must decided whom The road should be higher in ils sides so as han at to allow the water of rains to un off into the side ditches the upper surface of the road at it is soon worn con on level ground recome a hool or a water course if it be on an inelination Both these evils are frequent occurrence on our country proper knowledge easily road making cour shahe given The usual to a road in order 10 make

In forming the traveled part of the road, or road-bed, as it is called, the first and most important point in a flat country is to raise it above the level of the land through which it passes, so that the water may be permitted to drain from it. This is one of the most essential requisites for keeping a road in good condition. Having established the necessary elevation, the slope of the road-bed at right angles to its length must be decided upon. The road should be higher in the centre than at its sides, so as to allow the water of rains to run off into the side ditches. If the upper surface of the road is left flat, it is soon worn concave, and if it be on level ground, its center will become a pool, or a water course, if it be on an inclination. Both these evils are of frequent occurrence on our country roads, but with the proper knowledge of road-making could be easily prevented. The usual shape given to a road in order to make it

crown has been a conver eurve al proaching a segment of a cire or a flat semi ellipse. This form was secommended by Ma Selford. but Mr. Walker prefers two straight lines connected by a short curve the erown ar Since the euroed profile is subject to many evils. My Malkers plan is_ thought by road makers to be the one most preferable dearee of inclination of the will depend on the surface road being greatest where lough and lessening ils improvement in smooth narrow road will hermer being distance to half over arealest si neonvenience which and anverse storie would cause to earninger 11 Unnia proper inclination for with a broken stone s Holyhead rou 1 in/30 was adopted by de a rough road the inch mereased to 1 in

crown, has been a convex curve approaching a segment of a circle, or a flat semi-ellipse. This form was recommended by Mr. Telford; but Mr. Walker prefers two straight lines, connected by a short curve at the crown.

Since the curved profile is subject to many evils; Mr. Walker's plan is thought by road-makers, to be the one most preferable.

The degree of inclination of the sides will depend on the surface of the road; being greatest where the road is rough, and lessening with its improvement in smoothness. A narrow road will permit its being less, as the water will have less distance to pass over. Its greatest slope is limited by the inconvenience which an excessive transverse slope would cause to carriages. It is thought that the proper inclination for a road with a broken stone surface. is 1 in 24. The Holyhead road, 1 in 30 was adopted by Telford. On a rough road the inclination may be increased to 1 in 20; and

diminished on a road paved with square blocks to 1 in 40, or 1 in 50. transverse slope should exceed the longitudinal in order wall incruina lov hreverik the down the length of the road direction of water summing from the sendre of the road is the a rectangle the sides diagonal high are proportional rest of the longitudinal and transverse sloke ramage of Roads to attempt the improve rousions are made to dishense of ighte to applewhon it. The proper construct dileher to convey the water hon of in road-making pari obten be transformed v a good one by side dilehes iciently inclined to carry off the water which surface so as to form mua and is hermitted to enter

diminished on a road paved with square blocks, to 1 in 40, or 1 in 50. The transverse slope should exceed that of the longitudinal in order to prevent the water running too far down the length of the road. The direction of water running from the centre of the road, is the diagonal of a rectangle, the sides of which are proportional to the steepness of the longitudinal and transverse slopes.

Ditches for the Drainage of Roads. It is useless to attempt the improvement of a road unless suitable provisions are made to dispense of the water that is liable to accumulate upon it. The proper construction of ditches to convey the water from a road, is one of the most important elements in road-making. A bad road can often be transformed into a good one by side ditches, sufficiently inclined to carry off all the water which falls upon it. Even if the water does not stand on the surface so as to form mud. and is permitted to enter by filtration

Tration from the higher land it will render the road incapable of bearing heavy loads and by capillary altraction will be absorbed into the upper stratum. wit over which the road is to built is naturally of a marship character it should be thoroughly drained before an altempt is to construct the roadway do this there should be on each he road a wide and del open main drain to convey the water to the natural water courses Covered eroll drains or culvests should be made at frequent inter-Moin bottom show h way from the centre road so as to permit the water flow into the main drains mature anaitificia road covering may be required bed may sometimes be formed by removing the upper stratum a depith of several feel and su hlying its place with grave any soil of a firm charace at been found neces

from the higher land, it will render the road incapable of bearing heavy loads, and by capillary attraction, will be absorbed into the upper stratum. If the soil over which the road is to be built is naturally of a marshy character, it should be thoroughly drained before an attempt is made to construct the roadway. Tod do this, there should be on each side of the road, a wide and deep open main-drain, to convey the water to the natural water courses. Covered cross drains, or culverts, should be made at frequent intervals. Their bottom should slope each way from the centre of the road, so as to permit the water to flow into the main drains. When the subsoil is of a spongy, elastic nature, an artificial bed for the road covering may be required. This bed may sometimes be formed by removing the upper stratum to a depth of several feet, and supplying its place with gravel, or any soil of a firm character. It has been found necessary in

some eases to form a bed of brush wood from g to it inches in thick ness to receive the soil on which the load-covering is to rest. Hor structures on a weak wet soil this, method has been long practised, and experience has fully tested its excellence. Broken Stone Roads the true principles of the construetion of roads covered we broken stone roas Me Adam and Selford roads the most important. difference in the two is that advocates the necessity of a paved foundation benea one covering and conroads accordingly; leddam denies that as being any advantage whatever The materials employed for a brokes stone road should be hard lough and durable The best materials are granite and greenstone ard compact limestone may

some cases, to form a bed of brushwood, from 7 to 18 inches in thickness, to receive the soil on which the road-covering is to rest. For structures on a weak, wet soil, this method has been long practised, and experience has fully tested its excellence.

Broken Stone Roads. John Loudon McAdam is said to have been the first to discover the true principles of the construction of roads covered with broken stone. Of broken stone roads, the McAdam; and Telford roads are the most important. The difference in the two is that Telford advocates the necessity of a paved foundation beneath the broken stone covering, and constructs his roads accordingly; while McAdam denies that as being any advantage whatever. The materials employed for a broken stone road should be hard, tough, and durable. The best materials are granite and greenstone. Hard compact limestone may

also be used and gravel composed but all flints should How into angular fragments countries where ound difficult to obtain and very hard to lower courses road may be formed of The staa from it materia maker an excellent sur app, material road eovering has been mer the road in three Cayors berna hu Mai a heavy process a firm and compact ed of angular fragments of she ormed Decording to Meddam the areally being often inches figrent and his practice was apply the broken stone Canana down covering a. consisting

also be used, and gravel composed of flints; but all flints should be broken into angular fragments. In some countries where it is found difficult to obtain hard stone, (and very hard to break if found) the lower courses of the road may be formed of a soft material. The slag from iron furnaces makes an excellent surface material. After the road covering has been properly prepared, it should be spread over the road in three successive layers being left to be partly consolidated by travel, or by the use of a heavy roller, before another is laid. By this process, a firm and compact bed of angular fragments of stone is formed. According to McAdam, 10 inches is the greatest thickness of covering required for any road, from 5 to 7 inches being often sufficient; and his practice was to apply the broken stone to the earth road-bed. Telford, before laying down the surface covering, a foundation is laid consisting of pieces of

any ordinary store measuring on 6 to finelas in cach dimen-Scon These stones are arranged so as to form a compact layer about finches deep in the contre the road and from 4 to 5 1 ulus Un sides part of the required converily this foundation the Hone is spread as already described. To repair a broken Store road The surface must the new materials the more readily um 111.04 the old ones thus loosening and levelling he neverlary materia applied in uniform thick nel ale Shring or early summer season for repairing broken stone roads; for the weather is very wet or very dry the materia from becoming con revented and therefore causing either dully road heavy road repaired al Und Sealow in a good condition wolk hung we

any ordinary stone, measuring from 6 to 8 inches in each dimension. These stones are arranged so as to form a compact layer about 8 inches deep in the centre of the road, and from 4 to 5 inches deep at the sides, thus forming a part of the required convexity. On this foundation, the small stone is spread as already described. To repair a broken stone road, the surface must be loosened so that the new materials may the more readily unite to the old ones. After thus loosening and levelling the surface, the necessary material is applied in uniform thickness. The late spring or early summer is the best season for repairing

is the best season for repairing broken stone roads; for if the weather is very wet or very dry the material is prevented from becoming compact, and therefore causing either a heavy or a dusty road. A road repaired at this season is left in a good condition to resist the work of the ensuing winter.

aved Roads haved roads is princeconfined to large tou and cities where there is a comstant an heavy traffic Load should offer anod ittle resistance The stone should be of such a quality as to give a firm. hold to horses street pavements in cities should be easy to remove and replace morder to grue access to gas and water pipes haration mardh making of a paved 1 construction of a foundation whow which the stones are to Alaced. The principal founda Sand of broken Moundation lun exegurating. he road to a leanna the lar bollow stoping lach way from the centre then filling the even valion by applying 3 lanca used seeing that

Paved Roads The use of paved roads is, principally confined to large towns and cities, where there is a constant and heavy traffic. A good paved road should offer little resistance to wheels. The stone should be of such a quality as to give a firm foothold to horses. Street pavements in cities should be easy to remove and replace, in order to give access to gas and water pipes. The first preparation towards the making of a paved road, is the construction of a foundation upon which the stones are to be placed. The principal foundations are those of sand, of broken stone, and of pebbles. Foundations of any of the named materials are constructed by excavating the bed of the road to a depth of about 8 inches, leaving the earth bottom sloping each way from the centre, then filling the excavation by applying 3 equal layers of the material to be used, seeing that each layer is

well consolidated before the next Repahs: the mos pient of all the foundations excavation about 12 maked lowes ravement, and hard and on which a havement may then los slone havesuemle founds anverned hurhose of the the case unfrequencly oad or nearly Mrown dimensions show Samo hask road:

well consolidated before the next is applied.

Rehaps: the mostPerhaps the mostfall the foundationsefficient of all the foundationsfall the foundationsfor paved roads are those made offall the constructionfor paved roads are those made ofBelow, the constructionConcrete or Beton, the constructiononsists in making anof which consists in making anabout 19 inches lowerof which consists in making anbettom of the proposedexcavation about 12 inches lowerbettom of the proposedpavement, and filled with thatthe concrete or betomwhich soon becomes a hard andsolid mass, on which a pavementmay then be laid.

The best materials for stone pavements are syenite and granite, pavements are syenite and granite, the hardest that can be found. The size of the stones to be used in paving, will be governed by the intended purpose of the road. Any single stone should be large enough to sustain the entire weight of any load that may pass over the road; for it is not unfrequently the case that the whole load (or nearly) is thrown on one wheel. Stones of different dimensions should not be used on the same part of the road;

for it mixed the small ones will sink lower than the large ones Thus forming depressions that will be increased by every passing wheel Cubes of eight inches are sufficiently large for nearly all haved roads recommends that the blocks stone taker towards their lower ends while Ranking phoses that saying that special care be taken that they do not taken downward There is an advantage in having the stones taker slightly towards their top, for if the wedge shaped spaces thus formed are properly filled with gravel chips Stone cement to the road gives a more secure fooling for horses than a close-jointed pavement Plank Roads. The formation of a plank road in the mast general approved system is effected by digging twe parallel ditches about 14 feet apart and throwing the earth taken out between them so as to make an earthen surface of one half

for if mixed, the small ones will sink lower than the large ones, thus forming depressions that will be increased by every passing wheel. Cubes of eight inches are sufficiently large for nearly all paved roads.

W. M. Gillespie C. E. recommends that the blocks of stone taper towards their lower ends, while Rankin opposes that by saying that special care be taken that they do not taper downward. There is an advantage in having the stones taper slightly towards their top; for if the wedgeshaped spaces thus formed are properly filled with gravel, chips of stone, cement &c. the road gives a more secure footing for horses than a close-jointed pavement.

Plank Roads The formation of a plank road in the most general approved system is effected by digging two parallel ditches about 16 feet part, and throwing the earth taken out between them so as to make an earthen surface of one half

have between and sloping nearest ditch with a inches On the other mering 11 made alound two Conailudina rom pentho be from 14 to down with hland which and? ripA lankel

of the space between, and sloping towards the nearest ditch with a fall of 6 inches. On the other half, the plank covering is made, by imbedding in the ground two parallel lines of longitudinal wooden sleepers, 4 $\frac{1}{2}$ feet apart from centre to centre. These sleepers should be from 14 to 20 feet long, 12 inches broad, and 4 inches thick; they should be laid with flat side down with short connecting sleepers of the same scantling under their joints. After the earth is well consolidated between and beside the sleepers, and is level with their upper sides, the planks, which are 8 feet long and 3 inches thick, are laid across. The ends of the planks next to the earthen division of the roadway should not be laid evenly, but should have alternate projections, in order that carriages may be easily drawn on to the planking from the soft part of the road, by giving a hold for the wheels. If this provision is not made

the wheels will scrape along the the planks causing jeuty to enter upon the road with a loaded wagon. Since the planked pail of the broad enough for once is intended that wagon on wo wagons meet and hall will make way by moving to heavier earthen hart of the load a new and well constructed filante road a horse can draw times as much as an ordinary Meldam or good common load Is admirable as plank roads are when new their short duration expense in heeping theme in repair, has caused them I be abandoned except in certain localities where an abundance is found or on ac some peculiar erreum Jelford or Merdam even a good road is more profilable the long run makes a much

the wheels will scrape along the ends of the planks, causing much difficulty to enter upon the plank road with a loaded wagon. Since the planked part of the road is broad enough for one wagon only, it is intended that when two wagons meet and pass, the lighter will make way for the heavier by moving to the earthen part of the road. On a new and well constructed plank road, a horse can draw about three times as much as he can on an ordinary McAdam or good common road. As admirable as plank roads are when new, their short duration and the expense in keeping them in repair, has caused them to be abandoned, except in certain localities where an abundance of timber is found, or on account of some peculiar circumstance. A Telford or McAdam road, or even a good gravel road, is more profitable, and in the long run makes a much better road.

oman Roads omand with many arst brought road making. Roman Loads: nerfect modern construclions ah hear to be only inhe and incomplete initations The Romans regarded heir roads. ial means for the their empire and eculiar and observable oman roads raced for miles at her leas construe havements with concre oundations resting on sub-par direction and halalle furous and removed from the foundation was made

Roman Roads The ancient Romans, with many other arts, first brought into England the art of road-making. Compared with the Roman roads, the most perfect modern constructions appear to be only imperfect and incomplete imitations. The Romans regarded their roads as the essential means for the maintenance of their empire, and of their social prosperity. The most peculiar and observable feature in the Roman roads. is their remarkable straightness. These roads after the laps of nearly two thousand years, may be traced for miles, as perfect as when first constructed. They consist essentially of dressedstone pavements, with concrete foundations resting on sub-pavements. Their direction and length were marked out by two parallel furrows, and the loose earth removed from the space between. The foundation of the road was made by first spreading over the earth a bed

ancitar, upon which was laid a course of large flat storus this came a course and whom Une parte concrete forned of broken stones quicklina Another course which formed Chickwest_ tiles and hottery mined This last mixture was spread in thin layer and were inbedded the large blocks stone which formed the fea oner were so her litted together Unak joints were searcely perceptible Thickness of the road when completed was are many other forms of common roads not here mentioned to an into account a detailed description mode them and enstruction would require more labor than is generally lime and given to any subject that may be for

of mortar, upon which was laid a course of large flat stones, and upon this came a course of concrete formed of three parts of freshly broken stones to one part of quicklime.

Another course which formed one-fourth of the whole thickness was composed of broken bricks, tiles and pottery, mixed with lime. This last mixture was spread in a thin layer, and in it were imbedded the large blocks of stone which formed the pavement. These stones were so perfectly fitted together that the joints were scarcely perceptible. The entire thickness of the road when completed was about three feet.

There are many other forms of common roads not here mentioned; to go into account and give a detailed description of them, and the mode of their construction, would require more time and labor than is generally given to any subject that may be intended for a Thesis.

arding what has been written amply suficient Deconclude 1 wir will mel main . :

Regarding what has been written as amply sufficient, I conclude, hoping it will meet with some approval