less liable to retain moisture, and I here give a report published of the manufactory at Liverpool, of slabs made from one-third cement and two-thirds clinker, and ash taken from the garbage destroyer.

COST OF MANUFACTURE OF ONE YARD OF CLINKER CONCRETE FLAGGING, 2½ INCHES THICK.

Materials.	Cost.	Remarks.
65 lbs. of Portland cement	10¾d.	Varies with cost of cement.
152 " of clinker.....	nil.	Really a saving of 1¾d.
Water	¼d.	This item could be dispensed with where pressure is obtained by using steam power of destructor.
Labor	5½d.	
Plant contingencies and supervision	3¼d.	
Total cost per yard	1s. 7¾d.	

The total cost of manufacture is thus about 1s. 7¾d per square yard, without reckoning the saving in using the clinkers. The sizes of the slabs that are made are 2 feet by 2 feet, 2½ feet by 2 feet, and 3 feet by 2 feet, each being 2½ inches in thickness.

Some of these slabs have been laid twelve months and show no sign of wear. From the experience already gained, engineers believe that this class of flag will have a life as long, if not longer than stone, and owing to the porous material with which they are made, the clinker paving slabs have a foothold much better than the natural stone.

TESTS MADE AT LIVERPOOL OF MACHINE-MADE CLINKER CONCRETE FLAGS 2½ INCHES IN THICKNESS.

Age of flag.	Breaking load applied at centre of flag.	Age of flag.	Breaking load applied at centre of flag.
4 months .....1,804 lbs.		6 months .....2,061 lbs.	
4 " .....1,474 "		6 " .....1,966 "	
4 " .....1,742 "		4 " .....1,859 "	
4 " .....1,917 "		4 " .....1,659 "	
4 " .....1,608 "		4 " .....1,589 "	
4 " .....1,752 "			

Concrete sidewalks made from granite chips and cement are pleasant and safe to walk on for about eight months in the year, the balance they are very slippery and dangerous. Wood sidewalks are slippery in wet weather, unsanitary, and at all times unsuitable. So that something in the shape of slabs that can be taken up and again replaced, and that are not slippery, also having a smooth surface, seems to be in demand. In places where they use a suitable wood set on a well drained thick concrete foundation, for street pavements, its wearing power is almost equal to good stone, having the advantage of being noiseless and easy for horses' feet. The wood most in favor at the present time in Europe is Australian hard wood, the best being called karri and jarrah. See table of strength, etc., below, prepared by James P. Norrington, C.E., London, England:—

	Local Name.	Weight per cubic foot in lb.	Breaking stress in lb. per square inch.	Elasticity in lb. per square yard.
West Australia.	Karri	65·00	215·00	7,070·000
	Jarrah	56·00	171·00	2,940 000
New South Wales.	Ironbark	73·85	25·08	5,526 400
	Blackbutt	65·69	21·70	3,105·979
	Mahogany	75·06	19·75	3,741 376
	Tallow wood	72·06	16·16	2,274·790

Colonel Bell, United States Consul, at Sydney, strongly recommends his own countrymen to use the Australian hardwood for paving in place of their own lumber. A test made of wood pavements at Euston Road, London, Eng., by James P. Norrington, C.E., proved that at the end of three years, the wear of jarrah and karri was only ¼-inch, and with yellow deal, it was worn down 1⅜-inches. I suppose our Canadian light cedar blocks would have gone out of sight altogether. The same engineer gives the cost of pavement complete with one foot thick concrete foundation to be $3 per square yard.

For sidewalks, cement and brick are good wearing when properly made, having a dry foundation of broken clinkers or coarse gravel. Tar pavements are smooth, durable and noiseless when made with well-seasoned material. The tar should be stored in a cistern for over six months before using, so that the volatile oils and moisture come to the top, and are removed, then mix the tar with clean, small broken stone, say from one to three-eighths in size, heated to a high temperature, so that the stone will absorb the tar without ignition. The longer the material is mixed before being used, the better road it will make, say within two years. This kind of road can be freshened and repaired with boiling tar and sharp sand when defects occur.

The best and most durable roads are made of pure genuine asphalt scientifically mixed with suitable materials; but, unfortunately, this is seldom except on sample patches, and the adulterated article cracks, gives out, and rots away under vibrating traffic. Asphalt is found in several countries, the best quality and largest supply is at present at Trinidad.

Asphalt is black and brittle at an ordinary temperature; when broken, the fracture takes the shape of a shell; when two pieces are rubbed together, an agreeable odor is emitted, having no resemblance whatever to coal tar. Crude asphalt weighs 65 lbs. per cubic foot, and refuses to attract moisture. It becomes partially soluble in turpentine, ether, petroleum or naphtha. Almost from the creation of man, what is now called asphalt seems to have been known and used. Its use and value is now being increased. Asphalt pavement is a composition with pure refined asphalt as the basis, mixed with 68 parts of sharp sand, 15 of powdered limestone, and 17 of asphalt, all the portions heated to a high temperature, and mixed by machinery while hot, and afterwards stored in a dry place or carted in a covered wagon to the place needed, and laid down warm. When laid on a firm and strong concrete foundation, the road will wear well, and stand heavy traffic.

For THE CANADIAN ENGINEER.

FRICTION.

BY WILLIAM PERRY.

Friction is greatly influenced by the hardness or softness, smoothness or roughness of the surfaces rubbing against each other. It is in proportion to the pressure or load, that is, a double pressure will produce a double amount of friction, and so of any other proportionate increase of the load. The friction does not depend upon the extent of surface, the weight of the body remaining the same. The friction is greater after the bodies have been allowed to remain at rest for some time in contact with each other, than when they are first so placed; as, for example, a wheel turning upon gudgeons will require a greater weight to start it after remaining some hours at rest than it would at first. The cause of this appears to be that the minute asperities, which exist even upon the smoothest bodies, gradually sink into the opposite spaces, and thus hold upon each other; it is for the same reason that a greater force is required to set a body in motion than to keep it in motion. If about one-third the amount of a weight be required to move that weight along in the first instance, one-fourth will suffice to keep it in motion. The friction of axles does not at all depend upon their velocity; thus, a railroad car traveling at the rate of 20