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DESCRIPTION OF STATE-STREET BRIDGE OVER THE ALBANY BASIN.

This bridge was designed by E. Willard Smith, Civil Engineer, December 1845; and the work of construction commenced in July, 1848, and completed the following December. It was constructed at the expense of the Albany Pier Proprietors. It is of iron, and consists of nine spans of 42 feet each, supported by eight cast iron piers and two cut stone abutments; the piers being placed 44 feet from centre to centre. The whole width between railings is 33 feet, with two side walks 5½ feet each; the remainder being used as two roadways.

Piers. Each pier is composed of three cast iron columns of 2 feet external diameter, and 1 inch thick. These columns support arch-plates, which are bolted to each side of the shaft, and form the upper part of the pier on which the floor joist rest. On the upper end of each column is a cap piece, which rises above the arch-plates, and on which the shoes of the trusses rest and are bolted. The base of each column terminates in four projecting arms, making a base 4 feet in diameter.

Foundation of Piers. The foundation is made of two rows of piles, twenty-four in all, well driven, and the heads sawed off perfectly true. On top of each row is bolted a cap piece 6 by 15 inches; transversely, and on the top of these cap pieces, is spiked a flooring of three inch plank, and longitudinally on top of this floor is a second of three inch plank, making a platform 28 feet long and 5 feet wide; the upper surface of which is 1 foot below extreme low water. On this platform three iron columns are placed 10 feet 9 inches from centre to centre, and bolted down with eight bolts each. The foundation of the abutments are constructed in the same manner as those of the piers.

The abutments are constructed of cut lime stone 43 feet in length on top, 5 feet thick at bottom, and 4 feet at top, with a batter of one inch to a foot on the face, and the beds of the stones at right angles with the face.

Superstructure. The height of the floor is 12 feet above low water at the abutments, and 18 feet above at the centre; the centre span being level. The superstructure of one span consists of three trusses placed 10 feet 9 inches apart, transversely with each end resting on a column. Attached to these are two transverse girders of cast iron; the girders being 34 feet in length, and cast in one piece each. Each truss is made of three pipes of 4 inch bore and ¾ inch thick; one being used as a straining beam and two others as braces. The connection at the joints, between the straining beam and the braces, is made by a cast iron elbow, at each end of which is a round tenon that is turned and fitted into the pipes after they are bored out. At the foot of each brace is a shoe with a round tenon fitted into the brace. These shoes are tied together by two wrought iron tie-rods 1¼ inches in diameter. Through each elbow passes a suspending rod 1¼ inches in diameter, which passes through a hole in the iron girders which rest upon the tie-rod. Under the tie-rod is a large cast iron washer, which is kept in its place by a nut on the lower end of the suspending rods. The whole frame is stayed laterally by diagonal ties of ¾ inch round iron.

Flooring. The flooring is made of pine floor joist 4 by 12 inches, resting upon the iron girders, and planked with 3 inch oak plank. There is a light railing of wrought iron on the outside of each side walk.

The contract for the iron work, was taken by Franklin Townsend & Co., of Albany; and the castings are of superior quality. The weight of cast iron used was 242,000 lbs., and the wrought iron 31,000 lbs.

COST OF ABOVE INCLUDING SUPERINTENDANCE.

Amount of contract for iron work and paint	$10,250
" " for timber work and piles	4,150
" " for masonry, earthwork, &c	1,600
	$16,000

ON WATER CEMENTS.

BY HENRY S. DEXTER, Civil Engineer.

The State of New-York abounds in limestone embracing almost every variety from the purer carbonate to the argillaceous or cement stones; and it possesses, without doubt, the material, if rightly employed, for mortars capable of acquiring a hardness equal to the best European water cements.

An opinion, fatal to the permanency of cement mortars, has long prevailed that our natural cements were water limes. By a comparison of the analysis of the two it will be seen that they differ materially in their constituent parts. The following table exhibits the analysis of some of the most celebrated water limes in Europe.

ANALYSIS OF VARIOUS HYDRAULIC LIMESTONES.

Constituents in 100 parts.		Carrara marble.*	Lena, Sweden.	Metz, France.	Nismes, France	Baraigne bituminous, France	Barree, France.	Yellow limestone of Fleury, France.	Calcareous marl of Senonches, France.	Artificial hydraulic lime, of Paris.	Aberthaw blue lias limestone, England.	Barrow blue lias limestone, England.
Water,		03.00	.....	2.25	.....	.....	.....	.....	.....	.....	2.60	
Carbonic acid,		33.00	.....	39.00								
	Carbonate of lime,	.....	.....	.....	82.50	82.25	65.00	77.40	.....	.....	85.20	78.70
Lime,		64.00	90.00	44.50	.....	.....	.....	.....	68.30	74.60		
Ocherous clay, Silex,		.....	.....	5.25	8.40	10.50	26.25	13.25		.....		
Ocherous clay,	Clay,	.....	4.00	.....	.....	.....	.....	.....	24.00	7.80		
Ocherous clay, Alumine,		.....	.....	1.25	5.00	5.50	8.00	8.35				
Ocherous clay,		.....	.....	.....	.....	.....	.....	.....	.....	.....	11.20	21.30
Manganese,		.....	6.00	3.50								
Magnesia,		.....	.....	.....	4.10	.....		.....	2.00	16.00		
Oxide of iron,		.....	.....	3.20	.....	1.71	0.75	1.00	5.70	1.60		
Loss,		.....	.....	1.05								

* Carrara marble is the purest variety of the carbonate of lime, and is not hydraulic. It is introduced in the table for the purpose of comparison. All the limestones are hydraulic in various degrees.

By comparing the preceding table with the following analysis of cement stones, it will be seen that the hydraulic limes are alloyed in their natural state, with from 10 to 30 per cent of clay, while natural cements, before calcination, contain 30 to 40 per cent ordinarily, and that some of the best varieties are alloyed as high as 30 to 50 per cent. It is manifest in the manufacture of mortars, that a cement or lime naturally alloyed to the extent of 30 or 50 per cent, cannot bear the same proportion of sand as a pure carbonate of lime. Yet the practice in this State has been to treat them very nearly alike.

ANALYSIS OF NATURAL CEMENT STONES, EXTRACTED FROM THE BEST AUTHORITIES.

Constituents in 100 parts.	England.						France	State of New-York.			
	Sheppy stone No. 1.	Sheppy stone No. 2.	Sheppy stone No. 3.	Southend stone.	Y'kshire stone.	Harwick stone.	Boulogne pebbles.	Ulster county stone.	Madison county stone.	Manlius stone.	Rochester shale.
Carbonate of lime,	65.70	61.20	64.00	63.85	61.50	52.00	61.60	59.70	66.00	65.04	60.20
Ocherous clay, Silex,	18.00	18.00	17.75	12.00	24.00	9.37	15.00	15.37	8.95		
Ocherous clay, Clay,	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.50	24.00
Ocherous clay, Alumine,	6.60	3 10	6.75	13.00	6.75	9.50	4.80	9.13	4.90		
Ocherous clay, Magnesia,	50	20	50	1.52	1.04	.....	.....	12.35	16.70	18.80	14.50
Ocherous clay, Manganese,	1.90	6.75	1.00								
Ocherous clay, Oxide of Iron,	6.00	5.25	6.00	8.80	.....	17.75	9.00	2.25	1.75	1.25	1.00
Water,	1.30	.....	3.00	.....	1.31	3.88	6.60	1.20	1.70	1.41	
Loss,	.....	5.50	1.00	83	5.40	.....	3.00	.....	.....	.....	30
Sulphate of Soda, Muriates of Lime, of Magnesia and of Soda,	.....	.....	.....	.....	.....	7.50					
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

In slaking, water limes increase in bulk and disengage more or less heat in proportion as they are slightly or highly hydraulic. But water cements do not slake by the addition of water, or increase in bulk, or disengage any noticable degree of caloric, and they can only be reduced to powder by grinding.

The best English cement—that known as Parker's Roman Cement, or the Harwich, hardens almost immediately when put in water. But water limes are slow in setting when immersed. That they ultimately acquire a hardness equal to cements is probable. The French engineers prefer their water limes to cements, although natural cement stones are abundant in France. This preference arises either from ignorance, servile obedience to established practice, or prejudice; for they have analysed and submitted them to a careful test by experimental trial. On the other hand the English engineers prefer water cements to hydraulic limes, and their opportunities for testing them have been equal, if not superior to those of their continental neighbors.

The proportion of sand proper to mix with cements has been a subject of controversy, and may perhaps admit of a doubt. The English engineers rarely use a greater proportion of sand than equal parts measured dry. American engineers rarely use less than two parts sand to one of cement. Perishable masonry, if not more common in this country than in England, is sufficient so to render the causes of want of durability an interesting subject of professional research.

In constructing the Thames tunnel, Mr. Brunel employed cement mixed with equal measures of sand, for the foundation and lower part,—half that proportion for the piers, and pure cement for the arches. Col. Pasley asserts, that a joint of brick work, laid in pure cement, becomes harder in half an hour, than a similar joint of mortar, made of the best hydraulic limes of England, does in six months, or even more.

The practice of mixing from two to three parts sand with cements for mortars, is a proportion of sand which both Gen. Treussart of the French, and Col. Pasley of the English engineers deem too great even for their best water limes.

The wretched condition of the old masonry upon the Erie canal, is owing in a great measure to the failure of the mortars. Our natural cements were employed, and the proportion of sand with which they were mixed, was unquestionably greater than they would bear. The consequence of which has necessitated the rebuilding of so much of the masonry in a comparatively short period; together with the outlay of large sums in repairs.

The effect of sand when mixed with cement, is shown by the following experiments by Col. Pasley. He caused bricks to be connected together with pure cement, and others by a mixture of the same cement with sand in equal parts, with a view to determine the exact cohesion of these mortars to bricks. The results which he obtained with cements, and also with quick lime mortar 30 years old, are given in the following table:

COMPARATIVE COHESIVE STRENGTH OF PURE CEMENT, OF CEMENT MIXED WITH SAND, AND OF COMMON CHALK LIME MORTAR.

No. of the experiments.	Whether with cement or with chalklime mortar.	Age in days or years.	Weight that tore the joint asunder in pounds.	Average fracturing weight in pounds.
1	Pure cement,	11 days.	1,241	
2	Pure cement,	17 do	1,003	1,092
3	Pure cement,	17 do	1,031	
1	Cement and sand equal parts,	11 do	205	
2	Cement and sand equal parts,	11 do	257	225
2	Cement and sand equal parts,	17 do	313	
1	Chalk lime mortar, quick lime.	30 years.	334	
2	Chalk lime mortar, quick lime.	30 do	64	
3	Chalk lime mortar, quick lime.	30 do	75	
4	Chalk lime mortar, quick lime.	30 do	47	155
5	Chalk lime mortar, quick lime.	30 do	205	
6	Chalk lime mortar, quick lime.	30 do	204	

"Hence," observes Col. Pasley, "it appears that pure cement, is more than four times as strong, at the same age, as the customary mixture of sand in equal parts by measure, which is in common use in and near the British metropolis."

ANALYSIS OF NATURAL CEMENTS IN THE STATE IN WHICH THEY ARE ORDINARILY USED. (EXTRACTED FROM VARIOUS AUTHORITIES.)

Constituents in 100 parts.	ENGLAND.				FRANCE.			STATE OF N. Y.	
	Col. Pasley's artificial cement.	Parker's patent cement.	Harwich cement.	Yorkshire cement.	Boulogne cement.	Pouilly cement.	Baye cement.	Ulster county cement.	Madison county cement.
Carbonic acid, } Carbonate of lime,								5.00	10.90
Carbonate of lime,		55.40	49.00	62.00	54.00	42.86	32.00		
Lime, } Carbonate of lime,	40 lbs.							37.60	39.50
Ocherous clay, Silex, } Clay,								22.75	
Clay,		36.00			31.00		52.60		16.56
Alumina, } Clay,								13.40	
Ocherous clay,	100 lbs.		47.00	34.00		57.14			
Magnesia,		a trace.					4.00	16.65	22.27
Oxide of iron,		8.60			15.00		9.40	3.30	10.77
Water,							3.00	1.30	
Loss,			4.00	4.00					
		100.00	100.00	100.00	100.00	100.00	101.00	100.00	100.00

It will be seen that all these cements, when calcined and reduced to a powder, combine about an equal proportion of the carbonate of lime, although they vary materially in the constituent parts of ocherous clay.

The peculiar properties of hydraulic limes and cements have long occupied the attention of chemists, and the facility with which they harden under water has been variously attributed to clay, silex, oxide of iron, and the oxide of manganese. It is now, however, well settled that the presence of a large proportion of clay in calcareous minerals furnishing water cements, is to be attributed their property of indurating under water.

Ancient Roman mortars, found in edifices erected two thousand years since, are of such rare hardness, that it was for a long time believed that the Roman architects were acquainted with modes of mixing them superior to those known at the present time. This opinion gave rise to numerous pretended discoveries of the Roman manner of making mortar, and many whimsical theories of the proper methods of treating lime to produce mortars of equal hardness. But recent examinations and analysis of the hardest and oldest mortars have shown that they are mixtures precisely similar to those now in use.

The researches of the most eminent chemists and engineers have failed fully to develop the cause of the induration or solidification of mortars.

The carbonic acid, with which lime is combined to calcareous minerals, is expelled by calcination; and it has been supposed, that a re-saturation with the acid thus expelled would restore the lime to its original hardness. Upon this hypothesis the hardness of ancient mortars, and the induration of mortars, have been attributed to the re-saturation of the lime with the carbonic acid of the atmosphere. This opinion has been shown to be erroneous by the analysis of the most ancient mortars, none of which contain carbonic acid in sufficient quantity to saturate the lime, and some of the oldest do not contain a fourth part necessary for this purpose.

An opinion also prevailed that chemical affinity takes place in the hardening of mortars, and that the sand being acted upon by the lime enters into combination with it. Experiments, recently made, have shown that lime has no effect upon sand, and that no combination between the lime and sand can take place. Upon the whole the present knowlege of this subject amounts to no more than the certainty that the theories heretofore advanced are insufficient to account for all the phenomena of induration of mortars.

Nearly as various are opinins among engineers as to the relative superiority of coarse or fine sand, when combined with cement for mortars. The following table indicates General Treussart's opinion and the authority upon which it rests.

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MORTARS COMPARED WITH REFERENCE TO SIZE OF SAND MADE USE OF.

NAMES.	PROPORTIONS				Absolute resistances per square inch.
	Lime paste.	Fine sand.	Coarse sand.	Small gravel.	
					lbs.
Mortars of the eminently hydraulic lime of Labourgarde. (Tarn et Garonne) 23 months old..........	1.00	1.80	....	....	165.40
	1.00	....	1.80	....	134.50
	1.00	....	....	1.80	79.70
	1.00	0.90	0.90	....	148.02
Mortars of the eminently hydraulic lime of Baraigue, (Lot) 14 months old,..........	1.00	1.80	....	....	263.89
	1.00	....	1.80	....	177.20
	1.00	....	....	1.80	135.50
	1.00	0.90	0.90	....	222.04
Mortars of the moderately hydraulic lime of St. Cere, (Lot) 1 year old,..............	1.00	1.80	....	....	84.68
	1.00	....	1.80	....	65.47
	1.00	....	....	1.80	48.68
	1.00	0.90	0.90	....	105.89
Mortars of the very* rich lime of Lanzac, (Lot) 22 months old......................	1.00	2.00	....	....	41.00
	1.00	....	2.00	....	54.66
	1.00	....	....	2.00	51.24
	1.00	1.00	1.00	....	47.82

* It must be recollected that each result is the mean of many experiments, made with all the exactness of which this kind of investigation is capable

The foregoing table, however directly in opposition to the prevailing opinions among contractors and masons in this country, is fully sustained by the experimental researches of several Engineers in England and the United States.

There is a diversity of opinion, whether river or pit sand is the best for mortars; but there is none whatever, that clear sharp sand is superior to that containing earthy matter.

The following experiments of Gen. TREUSSART manifest the importance of employing clean sand in the manufacture of mortars:

MORTARS COMPARED WITH REFERENCE TO CLEAN AND EARTHY SAND MADE USE OF.

	COMPOSITION OF THE MORTARS.	Weight suppported before breaking.
		lbs.
Quicklime,.	Mortar made of one part of fresh lime, measured in paste and two parts of common sand,..................	77
Moderately hydraulic,	Mortar made of one part of Lixen lime, measured in paste and two parts earthy sand,..................	22
	Mortar of one part of the same lime do and two parts river sand,......	143
	Mortar of one part do do and two parts of earthy sand washed,........	176
Moderately hydraulic,	Mortar of one part of Dosenheim lime and two parts of earthy sand,..	22
	Mortar of one part of the same lime and two parts of river sand,......	132
	Mortar of one part of do and two parts of earthy sand washed,.......	176
Hydraulic lime, ...	Mortar of one part Obernai lime and two parts of earthy sand,........	132
	Same mortar with the same sand after being washed,..............	221

I cannot close this subject more appropriately than by the concluding paragraph of General TREUSSART's memoir of mortars.

"I must urge," he remarks, "upon Engineers to study, in their several localities, the materials most proper to make good mortars. The fabrication of mortars has been, for a long period, abandoned to a routine which has produced perishable masonry; requiring frequent repairs, and thus consuming funds which might have been applied to the construction of new work, or the amelioration of the old. Engineers should not consider it beneath them to be occupied in this kind of research; and they should leave behind them, at each place, a relation of the experiments they have made, and the results they have obtained. These operations require minute attention, certainly; but this will be recompensed by works of long duration."

PAPERS ON THE QUICKSAND EXCAVATION IN THE DEEP CUT OF THE GENESEE VALLEY CANAL.

Among other questions of profits and damages submitted to the Canal Board in 1843, after the suspension of the work on the Genesee Valley Canal, there was one in relation to sand and quicksand excavation which occurred on section 54, commonly called the Deep Cut.

The testimony of H. S. Dexter, Esqr., C. E., a diagram and statement of the nature of the claim, and the opinions of several eminent engineers, who were consulted, are comprised in the following papers, and will doubtless prove valuable to the profession.

TESTIMONY OF H. S. DEXTER, Esq.

I, Henry S. Dexter, was Resident Engineer upon the Northern Division of the Genesee Valley Canal.

The deep cut, (Sec. No. 54, I believe), Sharp and Quinn, contractors, was not on my division. During the progress of the work, nearly up to the suspension in 1842, I saw the work frequently, passing over the same in company with the acting commissioners, Mr. S. B. Ruggles and Mr. George H. Boughton.

The deep cut was composed of clay, sand, gravel, indurated clay, and quicksand; of this last there were large quantities.

The contractors had on a very large force of men, teams, and railway cars. I had previously known the contractors, and considered them efficient and capable men in their business.

In 1846, they called upon me for my opinion of whether or not they were entitled to the quicksand price for quicksand, after the same had been drained, so as to change the character of the material.

The opinion I then gave I still believe to be just, namely, that under their contract containing, as it did, discriminating prices for the various kinds of earth which made up the deep cut, they were entitled to their quicksand price for all material which was quicksand at the time they entered upon the work; and if, in the prosecution of the job, they succeeded in clearing off nearly all or any portion of the water in the quicksand, and thereby made the same of easier excavation, they were entitled to all the benefits arising either from their skill or good fortune. That so long as they, by their own acts, changed the character of the material, the state could not, under their contract, reap any of the benefits, as it took none of the risks.

They dug ditches, to my knowledge, and kept them open to carry off the water. The state paid none of the expenses of these ditches, as I was informed and believe. Under their contract, if it had been necessary to put in pumps, in my judgment, they could not have been paid for the same by the state, nor was it right to pay them for the ditches they dug.

Quicksand can be drained so as to materially alter its character, and make it of easier excavation. I have often seen quicksand of the most troublesome sort, drained both by ditches and pumps, and its subsequent removal rendered comparatively easy.

By the request of Messrs. Sharp and Quinn, in 1846, I examined the maps and profiles of Mr. Morse, the assistant engineer, on this section 54. The estimates which he made I think fair and just, so far as it is possible to make such computations. I also by their request drew up a statement of their case as it was submitted to me, and sent the same to some of the most distinguished engineers in the states.

I herewith append a copy of my statement, and their replies. They are from the following gentlemen, viz:

Col. J. J. Abert, U. S. Engineer, Washington, February 18, 1846.
W. G. McNeill, C. E., New-York, February 24, 1846.
Edward Miller, C. E., Philadelphia, February 21, 1846.
M. Robinson, C. E., Philadelphia, March 13, 1846.
T. S. Brown, Chief Engineer, N. Y. & Erie R. R., New-York, March 4, 1846.