THE

MECHANICAL MINERS' GUIDE

ISSUED BY

A. S. HALLIDIE & CO.,

Wire Rope Works,

SAN FRANCISCO, CAL.

186[illegible].

STEAM PRESS OF EASTMAN & GODFREY,
415 Washington Street.

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SOMETHING THAT FARMERS NEED. — Every farmer needs a nail box, well stocked. He should have, at least, nine sizes. The following table will show any one, at a glance, the length of the various sizes, and the number of nails in a pound. They are rated, "3-penny, up to 20-penny." The first column gives the number, the second the length in inches, and the third the number per pound. That is:

3-penny	1 in.	557 nails.	12-penny	3 in.	54 nails.
4-penny	1¼ in.	353 nails.	20-penny	3½ in.	34 nails.
5-penny	1¾ in.	232 nails.	Spikes	4 in.	16
6-penny	2 in.	167 nails.	Spikes	4½ in.	12
7-penny	2¼ in.	141 nails.	Spikes	5 in.	10
8-penny	2½ in.	101 nails.	Spikes	6 in.	7
10-penny	2¾ in.	68 nails.	Spikes	7 in.	5

From this table an estimate of quantity and suitable sizes for any job of work can be estimated.

A farmer's nail box should be divided into ten compartments; one for each sized nails and one for spikes. It need not be large, because it is only intended for jobbing, and to have a suitable sized nail for all purposes always on hand. It should have a good strong handle like the bail of a basket. Two or three gimlets, an awl or two, and a nail set should have places in the nail box, and of course the hammer. Another tool box should contain two saws, a plane or two, several files, punches, cold chisel, etc.

NOTICE.

The Scales, Tables and Rules contained in this pamphlet have been carefully compiled and condensed from the best authorities, and we have endeavored throughout to make use of only such as the requirements of the mechanical miner call for.

The compiler has for many years resided and worked in the mining region, and has often felt the want of a small pamphlet containing the weight and strength of different materials; rules for calculating the velocity and power of water, &c., &c., and the strength and weight of ropes and chain.

We therefore offer this, with a full description and explanation of our Wire Rope, to those interested, trusting to meet their approbation.

A. S. HALLIDIE & CO.

☞ We would particularly refer the reader to pages 10, 18, 23, 28, and 31.

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PACIFIC WIRE ROPE WORKS,

SAN FRANCISCO, CAL.

1863.

We are prepared to furnish the Mining, Shipping, and Ferry Interests on the Pacific coast, with our Patent Wire Rope, in any length, size, and quantity desired, from our manufactory in San Francisco, or through our agents, on favorable terms.

A. S. HALLIDIE & CO.

Wire Rope is now generally employed for Mining, Ferry, Shipping, and general purposes ; and thirty years' experience has proved that it possesses many great advantages over Hemped Ropes, — being lighter, stronger, more durable, and cheaper than Hemp, and is not affected by atmospheric changes.

The many purposes to which Wire Rope has been applied where Hemp Rope would soon have been destroyed, and chain found too heavy, soon induced its general adoption throughout the mining regions of the world ; but in no place is it used more extensively than in the coal and iron districts of Pennsylvania and Great Britain, where shafts and incline planes are sunk to an immense depth, and the universal preference given to it over other ropes and chain, is a sufficient guarantee of its superiority. In California, the consumption of rope for mining purposes is enormous. Until the erection of our Works, Wire Rope has not been in the market, although the requirements of the mining and shipping interests have long since demanded it. The demand we are now able to supply, by the erection of suitable machinery, and by the steady importation of the raw ma-

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It is almost impossible to specify the precise uses to which Wire Rope is adapted in preference to hempen ropes or chain; but for the following purposes it has been a long time in use, and in every respect is much preferred:—

For Hoisting from Deep Shafts and Incline Planes;
For Guy Ropes for Derricks;
Por Pump Ropes for driving River Machinery;
For Suspension Cables for Water Conduits or Aqueducts;
For Signal Cord;
For Ferry Ropes;
For Ships' Standing Rigging;
For Tiller Ropes for Steamers;
For Guy Ropes for Smoke Stacks;
For Sash Cord for Window Sashes, Hanging Pictures, &c.;
For Power Ropes, for conveying power to any distance.

Explanation of the Signs used in this Work.

Addition or plus, . . $+$	Division, . . $\div$	Cube Root, $\sqrt[3]{}$
Subtraction or minus, $-$	Equal to, . $=$	Square, . . ^{2}
Multiplication, . . . $\times$	Square Root. $\sqrt{}$	Cube, . . . ^{3}

ON THE POWER OF BLOCKS AND TACKLES.

RULE FOR ASCERTAINING THE POWER TO BE EXERTED IN RAISING WEIGHTS BY PULLEYS.

When only one Rope or Cord is used.

Rule.—Divide the weight to be raised by the number of the parts of the rope engaged in supporting the lower or moveable block.

Ex. 1. What power is required to raise 1200 lbs. when the lower block contains six sheaves, and the end of the rope is fastened to the upper block?

1200lbs. $\div$ 12 $=$ 100lbs., the power to be exerted.

Ex. 2. Suppose the end of the rope is fastened to the lower blocks, what power is required?

1200lbs. $\div$ 13 $=$ 92 4-13lbs., the power to be exerted.

TO ASCERTAIN WHAT WEIGHT CAN BE RAISED BY CERTAIN POWER EXERTED.

Rule.—Multiply the number of the parts of the rope by the power exerted.

Example. Suppose six parts of rope to be used and fifty pounds power exerted — the weight that can be raised will be 300lbs.

WIRE ROPE FOR SHIPS' STANDING RIGGING

Possesses many advantages over Hemp, requiring no stripping or refitting, as Hemp Rope must have every few years; and being once set up, it obviates the attention and trouble caused by the stretching and shrinking of Hemp, and by its extreme lightness, being but ⅔ the weight of Hemp, increases the ship's capacity for cargo. And the advantage derived from the smaller surface opposed to the wind, (wire rope being one half the size of hemp,) especially in beating to windward, needs no comment — while for the jib and flying-jib stays, its smallness and smoothness permit the hanks to travel on it much more freely.

TILLER ROPES.

As a Tiller Rope for river steamers, it is superior to chain, being lighter, cheaper, and more easily managed; and the objection caused by the links of the slack chain crossing each other, and catching in the rollers—thus endangering the safety of the boat—is entirely removed.

Moreover, in case of a fire on board, it is free from danger; while a hemp rope, running as it does from one end of the boat to the other, is the first thing to become destroyed. With a Wire Rope, the pilot can stick to the helm as long as the fire will permit him.

TENSILE STRENGTH OF MATERIALS.

Weight or force necessary to tear asunder 1in. square in lbs.

Metals.

Copper, ...lbs.	32,500	Lead, cast,.......lbs.	880
Copper Wire,..... "	61,200	" milled,..... "	3,320
Gold, cast,....... "	20,000	Platinum Wire,... "	53,000
Iron, cast, lbs., 18,000 to	50,000	Silver, cast,...... "	40,000
" medium bar,.lbs.	60,000	Steel, soft,....... "	120,000
Iron Wire,....... "	103,000	" razor, ... "	150,000

Woods.

Ash, ...lbs.	16,000	Mahogany,.......lbs.	21,000
Beech,........... "	11,500	Oak, Amer. white, "	11,500
Cedar,........... "	11,400	Oak, seasoned, ... "	13.600
Elm,............ "	13,400	Pine, "pitch," ... "	12,000
Fir, strongest,.... "	12,000	Teak, Java, ... "	14,000
Lignum Vitæ,.... "	11,800	Walnut, ... "	7,800

Miscellaneous Articles.

Brick............lbs.	290	Slate,............lbs.	12,000
Ivory,........... "	16,000	Whalebone, ... "	7,600

Note.—The practical value of the above is about one fourth.

To find the strength of direct cohesion.

Rule.—Multiply area of transverse section in inches by weight given in the preceding table—the product is the strength in lbs.

Example.—What is the strength of a bar of medium iron 2 inches square?

Transverse section of 2 inches=4 inches, multiplied by 60,000, equals 240,000 lbs., the answer required.

The absolute strength of materials pulled lengthwise, is in proportion to the square of their diameters.

WIRE ROPE FOR HOISTING. (See p. 23.)

From Deep Shafts, Incline Planes or Slopes, it is particularly well adapted, being so much lighter than other ropes or chain, requires proportionately less power to hoist it, and occupies less than half the space on the drum. Its durability is from three to five times that of hemp or Manilla, and its weight is not increased or its fibres destroyed by working in wet situations.

As a practical illustration of its advantage over hemp in hoisting from a wet shaft, say 300 feet deep, where a single rope is used, the bucket containing 10 cubic feet of gravel weighing about 150 lbs. per foot=1500 lbs.,—add weight of bucket about 150 lbs., and weight of 300 feet of $1\frac{3}{4}$ in. diam. hempen rope, when wet weighs $2\frac{1}{2}$ lbs. per foot=750 lbs. Total weight to be raised, 2400 lbs.

Wire Rope, same strength of $1\frac{3}{4}$ in. diameter hemp would be $\frac{5}{8}$ diameter, weighing $8\frac{1}{2}$ ozs. per foot=160 lbs. total weight to be raised with the wire rope, 1810 lbs., being a saving of about 20 per cent. effected by the application of Wire Rope:—or, supposing you raised 100 buckets of dirt in 10 hours with hemp rope, with precisely the same expenditure of power, and by the application of Wire Rope 120 buckets of dirt could be raised, or you could save fuel in the same ratio.

This is a matter worthy the consideration of those interested in working heavy claims where much power is expended in hoisting oftentimes uselessly.

The Transverse Strength of Materials

Of any beam or bar of wood or metal is as the square of the depth multiplied by the breadth and divided by the length between the supports.

The transverse strength of any square beam of equal length, is as the cube of their depth,—and that of cylindrical beams as the cube of their diameter.

The strength of a projecting beam is only one fourth of what it would be if supported at both ends, and the weight applied in the middle.

The strength of a projecting beam is only one sixth of what it would be if *fixed* at both ends, and the weight applied to the middle.

The strength of a beam to support a weight in the centre of it when the ends rest merely upon two supports, compared to one the ends being fixed, is as 2 to 3.

Table of the Transverse Strength of American Timber.

"Seasoned"	Breaking W'ght in lbs.	Greatest deflection.	Weight borne with safety.	Value for general use.
White Oak,.....	240	9 ins.	196 lbs.	30
Yellow Pine, ...	150	1.7 "	100	30
White Pine, ...	135	1.4 "	95	32
Ash,...........	175	2.4 "	105	25
Hickory,.......	270	8 "	200	32

Each of the above were 1 foot long and in square *with weight suspended from one end.*

Cylinder 1 foot long.

	Breaking W'ght in lbs.	W'ght borne with safety.	Value for general use.
White Pine, 2 in. diam....	610	460	20
" " 1 " "	75	56	

Wire Rope as a Suspended Carriage Way

For delivering Rock, Lumber, &c., over otherwise inaccessible points.

There are many points in the mountains where it is impracticable to build a roadway, railway track, or shoot. In such a place, the most practical and economical method of delivering material is to extend a Wire Rope from the upper to the lower points, stretching it sufficiently tight to clear all points and obstructions, and on this Wire Rope to run a pulley, below which hangs a basket or box containing the rock,—or, if it is lumber, a pulley at each end of the lumber is necessary. In many cases in sending down rock, &c., it is found better to use three pulleys, two above and one below the rope, one of the upper pulleys being in advance and the other behind the lower one. By this means the pulleys are kept in the same direction as the rope.

The pulley should be of a large diameter, the groove to be of the same size as the rope.

Transverse strength of Material—Continued.

Table of the Transverse Strength of Cast and Wrought American Iron, weight suspended from one end.

Cylinder 1 foot long and 3 inches diameter.

	Breaking w'ght in lbs.	W'ght borne with safety.	Value for general use.
Cast Iron, cold blast,.....	12,000	8,000	300

Square Bar 1 foot long by 2 inches.

	Breaking w'ght in lbs.	W'ght borne with safety.	Value for general use.
Cast Iron, cold blast,......	5,781	4,000	450

Square Bar 1 foot long by 1 inch.

	W'ght borne with safey.	Deflection from horizontal plane without rupture.	W'gt that gave a permanent bend.	Deflection in inches with last weight.	Value for general use.
Wrought Iron...	1520lbs.	53°	600	1	300

The values above given are for good iron. If inferior iron is used, a corresponding deduction should be made.

RULE to find the transverse strength when a rectangular bar or beam is *fixed* on one end and loaded at the other :—

Multiply the *value* in the preceding table by the breadth and square of the depth in inches, and divide the product by the length in feet. The quotient is the weight in lbs.

N. B. When the beam is uniformly loaded throughout its length, double the result.

Example.—What weight will a 2 in. square wrought iron bar bear, projecting 2 ft. 6 in. in length ?

Value for wrought iron, $300 \times 2 \times 2^2 = 2400 \div 2\frac{1}{2} = 960$lbs. Answer required.

WIRE STRAND FOR FENCING.

Made in half-mile lengths, coiled on reels, ready for stretching. Fences are put up very expeditiously by placing the reels (as many as there are rails) in a wagon in such a manner as to allow the strand to "pay out" behind, while the wagon is hauled along the line of the proposed fence: the strand is then lifted from the ground and secured to the posts by staples. By this means a few men can fence in an immense amount of land in a very short time. Strand being free from kinks, and requiring no splicing or joining, can be put up much neater and more expeditiously than a single thick wire.

A Wire Strand Fence, properly put up, will last as long as six board fences; and when put up, it requires no further work on it.

By running a narrow strip of board along the top rail, any objection to wire fence (wire strand is not open to this objection as much as a single wire) on account of wild cattle not seeing it, can be easily obviated.

Galvanized Wire Strand needs no painting, it being free from rust, &c.

[For list of prices, see last page.]

Transverse Strength—Continued.

When the beam is *fixed* at both ends and loaded in the middle :—

Rule. Multiply the *value* in the preceding table by six times the breadth, and the square of the depth in inches, and divide by length in feet. The result must be doubled when the weight is evenly distributed along its length.

Example.—What weight will a bar of cast iron 2 in. square and 5 feet in length support in the middle, when *fixed* at the ends?

Value for cast iron, $450\times(6\times2\times2^2=48=21600\div5=4320$ lbs., answer.

When the bar or beam is supported at both ends and loaded in the middle :—

Rule.—Multiply the *value* in the preceding table by the square of the depth, and four times the breadth in inches, and divide the result by the length in feet.

Note.—When the weight is uniformly distributed, double the result.

Example 1. What is the weight a cast iron bar 5 ft. between the supports and 2 inches square, will support?

Value for cast iron, $450\times2^2=1800(\times2\times4)\ 8=14400\div5=2880$ lbs., answer.

Example 2. What is the weight a white pine beam, 10 feet between supports, and 8 inches deep by 4 inches in breadth, will bear?

Value for white pine, $32\times8^2=2048\times(4\times4)=16=32768\div10=3276\ 8\text{-}10$ lbs., answer required.

WIRE ROPE FOR SUSPENDING HYDRAULIC HOSE CLEAR OF A CAVE.

The high banks down which a hydraulic hose descends are very apt to cave and destroy the hose. In order to insure its safety, a wire rope is stretched from the top of the bank to the bottom of the claim, at a sufficient angle to escape the bank in case of a cave. To this wire rope the hose is attached, and in such a position as to be perfectly secure from any danger of destruction by the caving of the bank.

The loss of one hydraulic hose would buy many Wire Ropes.

Transverse Strength—Continued.

To find the diameter of a solid cylinder to support a given weight in the middle between the supports :—

Rule.—Multiply the weight in pounds by the length in feet, divide by the value, and the cube root of $\frac{1}{4}$ of the quotient is the diameter in inches.

Example 1. What is the diameter of a cast iron cylinder 8 inches long between the supports, that will support 60,000 lbs. suspended in the middle ?

$60{,}000 \times \frac{2}{3} = 40{,}000 \div 300$ (value for cast iron cylinder) $= 133\frac{1}{3} \div 4 = 33\frac{1}{3}$, cube root of which is 3 1-5 inches, answer.

Example 2. What is the diameter of a white pine cylinder 2 feet long, to support same weight ?

$60{,}000 \times 2 = 120{,}000 \div 20$ (value) $= 6000 \div 4 = 1500$, the cube root of which is $24\frac{2}{4}$ inches, answer.

Oak, in seasoning, loses at least one third of its weight, and this process is facilitated by steaming or boiling.

By steaming, the specific gravity of a piece of oak was reduced from .... 1050 to 744
By boiling, from .... 1084 to 788
By exposure to the air, from .... 1080 to 928

Stiffness of Oak to Cast Iron, is as .... 1 to 13
Strength " " " " .... 1 to $4\frac{1}{2}$

Wood is from 7 to 20 times stronger transversely than longitudinally.

WIRE ROPE FOR RIVER MINING.

For Pump Ropes, especially if of a great length, the advantage of using Wire Rope is obvious. The fact that when spliced and put on the pulleys, it does not stretch and allow the pump to stop working, is a matter of very great moment to the river miner, saving him an immense amount of trouble and care; and those who have once experienced the loss of time and money by the filling up with water of a large and deep pit, can more fully appreciate this.

FERRY ROPES

Stretched across the river, being lighter, is more easily set up, and being more perfectly round and smaller, it allows the pulley blocks to run much freer and more rapidly over the rope, and removes the sudden strain caused by checking (as with a hemp rope) when the boat is in the centre of the stream, and does not require the constant attention of the ferryman to set up or slack off the rope according to the state of the weather; and as the sun does not rot it, it can be kept stretched during the summer. For this purpose, we would recommend brass sheaves for the pulley blocks. Iron sheaves should in *no case* be used on Wire Ferry Ropes.

For a Swinging Ferry, where the rope lays in the water, it does not rot—nor does it, like hemp, absorb the water until it becomes water-logged and clumsy. Hemp rope, thus saturated, will have *four times* the weight of Wire Rope placed in the same position: thus in slack water, with Wire Rope there is no useless expenditure of the force of the current in carrying the rope across; and consequently, smaller and lighter buoys are required.

N. B. We have had Wire Ropes working as above for four years.

Weight of a Cubic Foot of different material.

	lbs.		lbs.
Water	62½	Lead	709
Sand	112½	Silver (pure cast)	655
Clay	124	Gold (pure cast)	1203
Gravel (wet)	145	Quicksilver	848
Quartz	166	*Woods.*	
Loose Earth	106	Ash	48
Compact Earth	125	Beech	44
Salt (common)	133	Elm	35
Metals.		Fir	40
Cast Iron	450	Lignum Vitæ	83
Wrought Iron	480	Live Oak	70
Steel	490	Oak	56
Copper	550	Pitch Pine	41

Velocity of Streams and Resistance of Soils.

Ordinary nature of current.	Velocity In Feet per Second.	Velocity In Miles per Hour.	Materials that resist these velocities and yield to more powerful ones.
Very Slow	0.25	0.171	Wet Ground—Mud.
Gliding	0.50	0.341	Soft Clay.
Gentle	1.00	0.682	Sand.
Regular	2.00	1.364	Gravel.
Ordinary velocity,	3.00	2.046	Stony.
Rapid Floods	3.35	2.284	Broken Stones, Flints, &c.
Rapid Floods, (extraordinary)	3.50	2.380	Collected Boulders, soft Schistose.
Torrents & Catar'cts	9.86	6.723	Hardened Rock.

WIRE ROPE FOR "DERRICK GUYS."

The universal adoption of the Derrick for working deep claims in the river bars, &c., in preference to any other method, being much cheaper and more expeditious, has drawn attention to its erection, and to the necessity of keeping the derrick *mast* in its proper position. With Manilla Guy Ropes this is impossible. The constant stretching and shrinking of hempen ropes require the almost constant slacking and tightening of them, according to the state of the atmosphere; and when the mast leans out of its position, it is almost impossible to swing the boom to its proper point.

Wire Rope being unaffected by the weather, this trouble and expense is saved: being 40 per cent. lighter, it is much more easily and more tightly set up; and as the sun does not rot and destroy its fibres by its being exposed to the summer heat, it will last an incredible long time.

Wire Cables for Suspension Flumes or Water Conduits.

For conveying water across deep gulleys, cañons, rivers, &c., with galvanized iron piping, joints, suspension rods, &c., &c., complete—the most economical way of carrying water over a deep cañon, &c. Guaranteed to keep in perfect order. Estimates given, and materials furnished low.

To Ascertain Velocity of Water in a Brook.

RULE.—Take the number of inches that a floating body passes over in one second in the middle of the current, and extract its square root; double this root, subtract it from the velocity at top, and add 1; the result will be the velocity of the stream at the bottom—and the mean velocity of the stream is equal to the velocity at the surface, less the square root of the velocity at the surface +.5+0.5.

Example. If the velocity at the surface and middle of a stream be 36 inches per second, what is the mean velocity?

Square root of 36=6×2=12 to be subtracted from 36=24, and 1=25 inches per second, velocity at bottom. Then 36 less 6=30 add 5=30.5 inches, answer, mean velocity.

To find the quantity of water which will flow out of an opening.

RULE. Multiply the square root of the depth of the water by 5.4; the product is the velocity in feet per second: this multiplied by the area of the opening in feet will give the number of cubic feet per second.

Example. If the centre of an opening is 10 feet below the surface of the water, and its area is 2 feet, what quantity of water will run out in one minute?

$\sqrt{10}=3.16\times5.4\times2=34.1496$ feet =(34 1-7 feet.)

Water will fall through 1 foot in $\frac{1}{4}$ second, 4 feet in $\frac{1}{2}$ second, 9 feet in $\frac{3}{4}$ second, and so on—being actuated by the same laws as falling bodies.

For Conveying Power to any Distance,

Wire Rope is employed extensively for conveying power from one point to another, as in the case of a mill situated half a mile or so from the water-wheel from which power is obtained, and has been found to be very economical and durable. In France, Wire Rope is used wherever an economical motive power exists and can be attached, in many cases there being 1000 yards between the motive power and the machinery to be set in motion.

It will be seen that by this means there is a very great economy, where water can be employed, over that of steam power, especially if fuel is expensive.

It should be borne in mind that the slower a rope runs, the longer it wears, and consequently it is advisable to have the pulleys of a large diameter, besides the advantage an increased diameter gives of a greater frictional surface, which prevents any slipping of the rope.

On the Size of Pulleys, Drums, etc.

We cannot too strongly call the attention of the mechanic and miner to the general errors committed in proportioning the Pulley, Drum, or Whirls, of hoisting or driving gear. We would remind them that when a pulley is under a certain diameter for certain sized ropes, be the rope of hemp or wire, it will very soon destroy the fibres by the constant chafing and wearing of the internal portion of the rope, long before it has had a chance to test its strength or durability. An examination of a pump-rope after running for some time on a pulley of a small diameter, will fully and clearly demonstrate the fact to the examiner; moreover, as it requires some exertion to bend a rope around a small circle, an unprofitable expenditure of power is required, and besides there is a loss of frictional surface, and this is a serious matter in driving heavy machinery; therefore, it is very essential that the diameter of the drum or pulley should be attended to, and for the guidance of those erecting such machinery, we offer them the following general rule:

Rule.—For Wire Rope, for every inch in circumference of rope, the pulley or drum should have a diameter of two feet. For hemp rope, for every inch in circumference of rope, the pulley should have a diameter of one foot.

It will be seen that the same size pulleys answer for both wire and hemp rope *of the same strength.*

See Table of Comparative Strength of Ropes.

Velocity of Water in Pipes and Sewers.

Table of the heads of water necessary to maintain different velocities of water in 100 feet of pipe.

V represents the velocities in feet per minute, and *C* the constant number for those velocities.

V	*C*	*V*	*C*	*V*	*C*
60	8.62	90	17.95	140	38.90
70	11.40	100	21.56	150	44.
80	14,58	120	29.70	180	62.13

Table of the comstant number for different velocities.

D represents diameter of pipe, in inches, and *c* the constant number for their diameters.

D	*c*	*D*	*c*	*D*	*c*
4	.028	6	.078	8	.134
5	.053	7	.104		

RULE. Then when H represents the head of water $\frac{c}{D \times C} = H$.

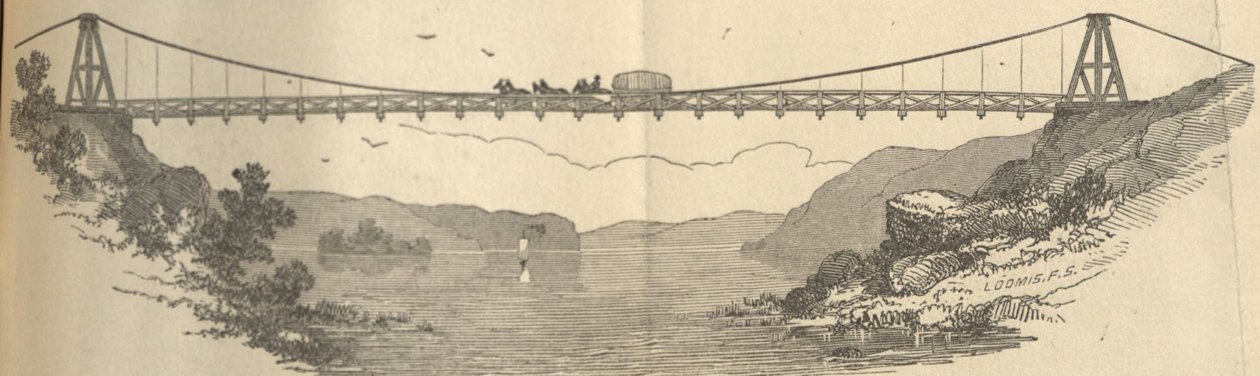
Example. It is required to determine what head of water would be necessary to send water through 1500 feet of six-inch pipe, to an elevation of 80 feet, and at a velocity of 180 feet per minute.

C.=62.13 ÷ (6+c.078) 6.078=10.22 ins. which ×15 (the number of 100 feet) =153.3 ins (12 ft. 9 ins.) this added to 80 gives 92 ft. 9⅓ ins., answer.

The time occupied in an equal quantity of water through a pipe or sewer of equal length and with equal falls, is proportionately as follows: In a right line, as 90, in a true curve, is as 100, and in a right angle as 140.

Wire Suspension Bridges and Flumes.

Having been engaged for eight years in building Wire Suspension Bridges and Flumes, we are prepared to do such work



ERECTED BY A.S. HALLIDIE & CO. S.F.

ing its undulations, but having a general angle of about 30°. The Wire Rope is exposed to the fullest action of the weather.

Certificate from Gray Eagle City, El Dorado County.

Sept. 13th, 1858.

DEAR SIR: I take pleasure in answering your inquiry relative to your Wire Rope. I have had two of your Ropes in operation, one tionately as follows : In a right line, as 90, in a true curve, is as 100, and in a right angle as 140.

Wire Suspension Bridges and Flumes.

Having been engaged for eight years in building Wire Suspension Bridges and Flumes, we are prepared to do such work in a thorough and economical manner.

We have built and erected bridges and Flumes in almost every portion of the State, of spans varying from 200 to 400 feet; all of which have been built to the owners' satisfaction, and to whom we take pleasure in referring those who are about to build.

Our facilities for erecting these bridges are unequalled. All the wire employed by us is drawn for that purpose expressly, and to parties about to build we would say that we can erect their whole work in a thorough manner; or, we will furnish plans and specifications of their bridges and all wire and iron work, at a low and satisfactory figure.

A personal examination made, and definite estimates of the cost of all or any portion given if desired, upon payment of expenses.

Certificate from the Bay State Quartz Mining Company.

AMERICAN BAR, NEAR MICHIGAN BLUFF, PLACER CO.
March 10th, 1860.

Messrs. A. S. HALLIDIE & Co.

GENTS: We have used one of your $2\frac{1}{2}$ inch circumference Patent Wire Ropes, 1200 feet long, for twenty-seven months, constantly winding over a capstan 38-inch diameter, and lowering rock to our mill. IT HAS LASTED AS LONG AS TEN MANILLA ROPES, working in the same place under the same circumstances; each rope of equal cost with your Wire Rope. We used Manilla Rope the first year, but would not now take it as a gift after testing your Patent Wire Rope.

Yours truly, BAY STATE QUARTZ MINING CO.
Per JAMES H. BERRY.

The above company has a double track laid on the hill-side, following its undulations, but having a general angle of abont 50°. The Wire Rope is exposed to the fullest action of the weather.

Certificate from Gray Eagle City, El Dorado County.

Sept. 13th, 1858.

DEAR SIR: I take pleasure in answering your inquiry relative to your Wire Rope. I have had two of your Ropes in operation, one on my Ferry at "Gray Eagle Bar" and one on my Ferry at "American Bar," and I can safely state, they are far superior to Manilla or Hemp for a Ferry Rope, not stretching or shrinking, according to the weather, thus saving much trouble and attention. Your ropes being smaller and rounder, the sheaves of the pulley block run much smoother, thus preventing any sudden strain. I should recommend the use of hard wood sheaves in preference to iron.

Yours,
R. M. RICHARDS.

To ANDREW SMITH HALLIDIE,
Wire Rope Manufacturer.

Certificate from the Union Mining Company.

HOWLAND FLAT, SIERRA COUNTY,
Oct. 3d, 1860.

Messrs. A. S. Hallidie & Co.

GENTLEMEN: In order to have some rope on hand this winter, and to avoid the trouble of getting it up through the deep snow which will visit us again, here in the mountains, in a very short time, I would request you to manufacture 1000 feet of the same kind Wire Rope you sent up last time. Ship "care of Van Muller, Marysville." The last rope is working well—the company is well satisfied with it. We tar the rope once a week. There are two more companies near here who have adopted the Wire Rope. I am satisfied that in a short time Wire Rope will be in common use, in place of other rope. I think this last rope you sent will last at least four months, working day and night. One Manilla rope would last us two weeks.

Respectfully yours,
E. H. STROH.
Sec'y Union Mining Co.

This company use 500 ft. 2½-inch circumference Wire Rope. It works on a 3-ft diameter drum, and draws the car up through an incline tunnel having an angle of 45°.

Certificate from different Mining Companies—Placer Co.

HORSESHOE BAR, MIDDLE FORK AMERICAN RIVER,
May, 1860.

Messrs A. S. Hallidie & Co.

GENTLEMEN: Our derricks, worked by overshot water wheels, are all rigged with your Patent Wire Rope Guys. They are better and cheaper than any other kind of rope. With them we can keep our mast in position, as they are not constantly stretching and shrinking. Once set up they are no further trouble. We can strongly recommend them. No derrick can be worked to advantage without Wire Rope Guys.

We remain, etc.,

GET UP AND GET CO., Horseshoe Bar. Per GEORGE LANDON.
UNION MINING CO., American Bar. Per DAVID MEANS, Manager.
AMERICAN BAR CO., American Bar. Per J. H. CLANCEY, Manager.
STONY BAR CO., Stony Bar. Per M. HASSETT, Manager.
LITTLE PLEASANT BAR CO., Per DONELLAN & PAGON.
BOSTON BAR CO., Per J. ROACH. And numerous other Companies.

Certificate from Lathrop's Ferry, Feather River.

MESSRS. A. S. HALLIDIE & CO.,
Wire Rope Manufacturers—

OROVILE, BUTTE CO., *Feb.*, 1861.

GENTS: I have thoroughly tested the Wire Rope you put on my Ferry, and to my entire satisfaction. After the wear and tear of nearly two seasons, I judge it to be as good as when put up. I run the Ferry at all stages of water, when others are compelled to stand still. On one occasion, by a sudden rise of the river, an immense boom used above for collecting saw logs, and an accumulation of logs, became fastened on the Wire Rope, carrying away the fastenings on one side, but the rope remained perfect. We use soft brass sheaves, and the boat travels across very smoothly. I can strongly recommend the use of Wire Rope for Ferry purposes—satisfied that it is cheaper, safer, and more easily managed.

H. B. LATHROP.

Certificate from Columbia.

COLUMBIA, *March* 1, 1861

GENTS: The Wire Rope ordered by telegraph yesterday, is to take the place of the one we got last October, which gave good satisfaction. A Manilla or Hemp Rope, in the same place, could not have lasted more than one sixth as long. Four large Mining Companies are now waiting for the New Rope.

Yours truly,
FREDENBURR BROS. & CO.

MESSRS. A. S. HALLIDIE & CO.,
Wire Rope Manufacturers.

Certificate from Vulcan Iron Works.

San Francisco, March 20, 1861.

MESSRS. A. S. HALLIDIE & CO.,
Wire Rope Manufacturers:—

GENTLEMEN: The Wire Rope you put up for us last October, fully answers our purpose: it is 420 feet long, and we use it to convey power from the engine to the punching machine. It works over a 28-inch driving pulley, and has its direction changed at right angles in two places by guide pulleys. We could not use any other kind of rope for this work, and belting or a line of shafting, would be troublesome and expensive.

Yours truly,

VULCAN IRON WORKS CO.,

Per P. TORQUET.

KINGSTON, KING'S RIVER, *Feb* 3, 1862.

Messrs A. S. HALLIDIE & Co:—

GENTS: Most of the Ferry Ropes on this River—San Joaquin and Merced—have broken and some boats lost, my boat and rigging all right and at this time in good running order. Your Wire Rope stood the test. I consider this the best and only safe rope that can be used.

Yours respectfully,

O. H. BLISS.

Below we append a Scale of the comparative Size and Weight per 100 feet of Wire Ropes, Hemp Ropes, and Chains, of equal strength.

WIRE ROPE. Circumference.	WIRE ROPE. Weight pr. 100 feet.	HEMP ROPE. Circumference.	HEMP ROPE. W't. per 100 ft.	CHAIN. Diameter.	CHAIN. W't. per 100 ft.	BREAKS AT Tons.	WORKING LOAD. In lbs.
$1\frac{3}{4}$ ins.	40 lbs.	4 ins.	63 lbs.	7-16 in.	183lbs.	5	1666
2 "	52 "	5 "	100 "	$\frac{1}{2}$ "	266 "	7	2333
$2\frac{1}{4}$ "	66 "	$5\frac{1}{2}$ "	117 "	9-16 "	300 "	$8\frac{1}{2}$	2666
$2\frac{1}{2}$ "	83 "	6 "	130 "	19-32 "	341 "	11	3700
$2\frac{3}{4}$ "	117 "	$6\frac{1}{2}$ "	145 "	$\frac{5}{8}$ "	400 "	13	4300
3 "	139 "	$7\frac{1}{4}$ "	185 "	11-16 "	466 "	15	5000
$3\frac{3}{8}$ "	170 "	8 "	236 "	$\frac{3}{4}$ "	533 "	19	6300
$3\frac{3}{4}$ "	240 "	9 "	297 "	13-16 "	650 "	24	8000
4 "	260 "	$9\frac{1}{2}$ "	330 "	$\frac{7}{8}$ "	750 "	28	9400

The above scale can be understood at a glance—all ropes are measured by their circumference (=3 1-7 their diameter.) Thus, for instance, a Wire Rope $2\frac{1}{2}$ inches circumference, weighs 83 lbs. per 100 feet; a hemp rope, 6 inches circumference, weighs 130 lbs. per 100 feet; and a chain, 19-32 inch link, weighs 341 lbs. per 100 feet. Each of them breaks at a strain of 11 tons.

N. B. The working load should never exceed one-fifth of the breaking strain.

FLAT ROPES.

For a vertical shaft, where two ropes are used, flat ropes work to very great advantage, the form of the rope not allowing the bucket or rope to revolve.

These ropes are arranged to work on a drum, the flanges of which are of a large diameter, and the space between them sufficient to allow it to wind on the barrel, *like a tape line*; thus, the diameter of the descending rope is decreasing in the same ratio as the barrel of the ascending one increases, thus counterbalancing each other in whatever position the buckets may be.

Below we give a scale of the comparative size, weight and strength of flat Wire and hemp rope.

Scale of Weight, Size and Strength of Flat Wire Rope compared with Flat Hemp Rope.

FLAT WIRE ROPE. Size in ins.	FLAT WIRE ROPE. W't pr yd.	FLAT HEMP ROPE. Size in ins.	FLAT HEMP ROPE. W't pr yd.	BREAK'G STRAIN. In tons.	WORK'G LOAD. In lbs.
$2\frac{1}{8}$x$\frac{1}{2}$	$4\frac{1}{2}$lbs	4x1	$8\frac{1}{4}$lbs	16	4032
$2\frac{1}{2}$x$\frac{1}{2}$	5	$4\frac{1}{2}$x$1\frac{1}{8}$	10	18	4480
$2\frac{3}{4}$x$\frac{5}{8}$	$6\frac{1}{4}$	5x$1\frac{1}{4}$	12	$22\frac{1}{2}$	5600
3x$\frac{5}{8}$	$7\frac{1}{2}$	$5\frac{1}{2}$x$1\frac{3}{8}$	13	27	6960
$3\frac{1}{2}$x$\frac{5}{8}$	9	6x$1\frac{1}{2}$	14	32	8064
4x$\frac{5}{8}$	10	7x$1\frac{7}{8}$	18	36	8960
$4\frac{1}{2}$x$\frac{5}{8}$	$11\frac{1}{4}$	$8\frac{1}{4}$x$2\frac{1}{8}$	20	40	10.080
5x$\frac{5}{8}$	$12\frac{1}{2}$	$8\frac{1}{2}$x$2\frac{1}{4}$	$22\frac{1}{2}$	45	11:300

One-seventh of the breaking strain is the usual working power or load.

OVERSHOT WATER-WHEEL.

RULE TO ASCERTAIN POWER.—Multiply the weight of water, in lbs., discharged upon the wheel in one minute, by the height or distance, in feet, from the lower edge of the wheel to the çentre of the opening in the gate ; divide the product by 50,000, and the quotient is the number of horses' power.

Example.—Suppose the weight of water discharged per minute is 39,000 lbs. If the height of the fall is 23 feet, the diameter of the wheel 22, what is the power of the wheel?

23 feet less 8 inches clearance below=22′ 4″=22.33. 39,000 ×22.33=870,870÷50,000=17.41 horse-power.

RULE TO ASCERTAIN VELOCITY OF WATER AND WEIGHT PER MINUTE, IN POUNDS, DISCHARGED ON OVERSHOT WATER-WHEEL.—Extract square of height of head of water (from surface to middle of gate) and multiply by 8 if the opening is large and head small ; if the reverse, multiply be 5.5 ; or, from 8 to 5.5 in proportion to size of opening and head of water.

Example.—The dimensions of the stream are 2 by 80 inches, with a head of 2 feet to upper surface of water. What is the velocity of the water per minute?

2 feet plus half of 2 ins.=25 ins. =2.08, the square of which is 1.44×6.5 (estimate of velocity)=9.36×60=561.60 feet.

What is its weight?

Example.—80 inches ×2×6739.20 inches (=561.60 feet)= 1078272÷1728 (inches in a cubic foot)=624 cubic feet×62½lbs. (weight of cubic foot of water)=39000lbs. weight discharged in one minute.

GENERAL REMARKS ON WIRE ROPE.

The numerous purposes to which rope is applied, its great cost being a large item in a mining company's expenses, necessitates the use of economy in its application : therefore, when it is satisfactorily proved, that by the application of wire instead of hemp ropes, a saving can be effected, it should be a guarantee of its general adoption.

When the machinery is properly arranged, and drums and pulleys properly proportioned, the durability of wire rope over the best quality of hempen ropes, is as 3 to 1. But wire rope can be destroyed, like other rope, if badly used ; and as we do not claim for wire rope more than it deserves, the surest test is a fair trial ; but we do claim for it the following advantages over other ropes, under a fair and legitimate trial :—

1st—It is less than two thirds the weight of a dry hemp rope.

2d—It is but one fourth the weight of a wet hemp rope.

3d—It is less than one half the size for same strength.

4th—It does not stretch and shrink, (being unaffected by the atmosphere,) nor does it absorb moisture.

5th—It is three to five times as durable.

6th—The excessive heat of the summer sun does not rot it, nor does the moisture of winter cause it to swell.

7th—It can be spliced as easily, wet or dry—frozen or otherwise—and more snugly and neatly than hemp rope.

8th—And lastly—We do not have to send to Manilla or Russia, or any other foreign country, for the raw material, but obtain it from the iron-fields of our own country, thus being essentially a home-manufactured article.

[See testimonials on page 25.]

WEIGHT OF BAR IRON.

Square from 3/8 to 2 1/2 inch, and 1 foot long.

Size in inches.	Wg't in lbs.	Size in inches.	Wg't in lbs.	Size in inches.	Wg't in lbs.	Size in inches.	Wg't in lbs.
3/8	.475	7/8	2.588	1 3/8	6.390	1 7/8	11.880
1/2	.845	1	3.380	1 1/2	7.604	2	13.520
5/8	1.320	1 1/8	4.278	1 5/8	8.926	2 1/4	17.112
3/4	1.901	1 1/4	5.280	1 3/4	10.352	2 1/2	21.120

Round Bar from 3/8 to 2 1/2 inches diameter and 1 foot long.

Diam'r.	W't in lbs.	Diam'r.	W't in lbs.	Diam'r.	W't in lbs.	Diam'r.	W't in lbs
3/8	.373	7/8	2.032	1 3/8	5.019	1 7/8	9.333
1/2	.666	1	2.654	1 1/2	5.972	2	10.616
5/8	1.043	1 1/8	3.360	1 5/8	7.010	2 1/4	13.440
3/4	1.493	1 1/4	4.172	1 3/4	8.128	2 1/2	16.680

Flat Bar from 3/4x1/8 to 5x1 and 1 foot long.

Size in in's.	W't in lbs.	Size in in's.	W't in lbs.	Size in in's.	W't in lbs.	Size in in's.	W't in lbs.
3/4x1/8	0.316	1 3/4x1/4	1.479	2 1/2x1/4	2.112	3x1	10.138
3/4x1/4	0.633	3/8	2.218	3/8	3.168	3 1/2x1/4	2.957
3/4x3/8	0.950	1/2	2.957	1/2	4.224	3/8	4.436
7/8x1/8	0.369	5/8	3.696	5/8	5.280	1/2	5.914
x1/4	0.738	2x1/4	1.689	3/4	6.336	5/8	7.393
1x1 1/8	0.422	3/8	2.534	2 3/4x1/4	2.323	3/4	8.871
x1/4	0.845	1/2	3.379	3/8	3.485	1	11.828
x3/8	1.267	5/8	4.224	1/2	4.647	4x1/4	3.380
1 1/4x1/8	0.528	3/4	5.069	5/8	5.808	1/2	6.759
1/4	1.056	2 1/4x1/4	1.900	3/4	6.970	3/4	10.138
3/8	1.584	3/8	2.851	3x1/4	2.535	1	13.518
1 1/2x1/8	0.633	1/2	3.802	3/8	2.802	5x1/4	4.224
1/4	1.266	5/8	4.750	1/2	5.069	1/2	8.449
3/8	1.900	3/4	5.703	5/8	6.337	3/4	12.673
1/2	2.535	2 1/2x1/4	2.112	3/4	7.604	1	16.897

WIRE CORD,

For Hanging Sashes, Pictures, Dumb Waiters, Clock-Weights, and for Signal Cord.

This Cord is made from iron, steel and copper wire, is very light, durable and pliable, and is not subject to rot. It has been in use for many years for the purpose of hanging window sashes, being much preferred to any other cord. No house should be without it. (See List of Prices, on page 35.)

LIGHTNING CONDUCTORS.

Copper Wire Rope Lightning Conductors are much in use among the shipping, as a protection against the effects of lightning on a ship's mast. They are superior to any other conductor, much more easily fixed, and do not get out of order. (See List of Prices, on page 35.)

WIRE.

Iron, Steel, Copper and Brass Wire, of all sizes and kinds, constantly on hand and supplied to dealers on favorable terms. Also, Baling and Suspension Bridge Wire.

A. S. HALLIDIE & CO.,
412 Clay Street, San Francisco.

MISCELLANEOUS ITEMS.

A pipe of cast iron, 15 inches diameter, $\frac{3}{4}$ inch thick, will sustain a head of water of 600 feet. One of oak, 2 inches thick, same diameter, will sustain a head of 180 feet.

When the cohesion is the same, thickness varies as the height multiplies by the diameter.

In sandy soil, the greatest force of a pile-driver will not drive a pile over 15 feet.

Table of the Value of an Ounce of Gold, of different degrees of fineness.

Fineness.	$ cts.	Fineness.	$ cts.	Fineness.	$ cts.	Fineness.	$ cts.
750	15 50	875	18 08	894	18 48	909	18 79
760	15 71	880	18 19	895	18 50	910	18 81
770	15 91	881	18 21	896	18 52	911	18 83
780	16 12	882	18 23	897	18 54	912	18 85
790	16 33	883	18 25	898	18 56	913	18 87
800	16 53	884	18 27	899	18 58	914	18 89
810	16 74	885	18 29	900	18 60	915	18 91
820	16 95	886	18 31	901	18 62	916	18 93
830	17 15	887	18 33	902	18 64	917	18 95
840	17 36	888	18 35	903	18 66	918	18 97
850	17 57	889	18 37	904	18 68	919	18 99
855	17 67	890	18 39	905	18 70	920	19 01
860	17 77	891	18 41	806	18 72	930	19 22
865	17 88	892	18 43	907	18 74	940	19 43
870	17 98	893	18 45	908	18 77	950	19 63

A horse-power is equivalent to 33,000 lbs. raised one foot high in one minute.

River Pump.—To construct and use a chain pump to the best advantage, the distance between the buckets should be equal to their breadth; and the pump barrel should have an inclination of 24°21″. With this arrangement it produces a maximum effect.

LIST OF PRICES.

Iron Wire Rope, larger than 1½ inch in circumf'ce. 25 cts per lb
If galvanized,.............30 " "
Iron Wire Rope, 1 inch to 1½ inch,..............35 " "
Iron Wire Sash Cord,....14, 18, 22 and 25 cts. per yard.
Copper " " ....25, 30, 35 and 40 " "
Sizes—...... ⅜, ½, ⅝, and ¾ in. cir. (See p. 33.)

Iron Wire Strand for Fencing.

Per hundred feet, common,..$1 20, $2 20, $2 88, $3 75.
" " " galvanized, $1 50, $2 80, $3 70, $4 75.
Sizes—3-16, ¼, 5-16, ⅜ in. diam.
(See page 14.)

Copper Wire Rope Lightning Conductor.

Per foot,....28, 32, and 37½ cts.
Sizes—1¼, 1⅜, and 1½ inch in circumference. (See p. 33.)

Parties ordering Wire Rope will please state if it is for standing purposes, or for working over a drum, etc., etc.

Samples will be forwarded on application, with a copy of this Guide, through Wells, Fargo & Co.'s Express, or this Guide will be sent FREE by mail.

Address,

A. S. HALLIDIE & Co.,
WIRE ROPE WORKS,
San Francisco, Cal.

[See Advertisement on the Cover.]