SUMMARY.

	£	s.	d.
WALLS (per square)—			
(1) 11in. Hollow Brick Walls, plastered ..	6	18	9
(2) Stud Walls, weatherboarded and lined..	6	18	8
(3) Fibro Cement Walls, unlined	3	4	6
ROOFS (per square)—			
(1) Slating	6	8	4
(2) Tiling	4	0	10
(3) Fibro Cement Slating	4	14	3
(4) Malthoid	4	12	2
(5) Corrugated Iron	4	10	4
(6) Fibrolite (Fibro Cement corrugated) ..	4	12	2

(1) 11in. Hollow Brick Walls, plastered—

Brickwork in cement mortar, 100 ft. of one brick thick = 66 ft. reduced at £24 rod; labour and materials, including wall ties ..	5	16	6
Render, float and set wall 100 at 2/- per yard	1	2	3
9			
Total	£6	18	9

(2) Stud Walls covered with weatherboarding outside, and T.G. lining inside and painted both sides—

Weatherboarding, 8in. redwood rusticated:			
Cost	2	0	0
Labour and nails	0	6	6
Studs, 4in. x 2in. Oregon, at 18in. centres (½ square reduced):			
Cost (28/- per 100 ft.)	0	14	0
Labour and nails (12/- per 100 ft.)	0	6	0
Lining, 6in. x ⅝in. T.G. Oregon:			
Cost	1	16	0
Labour and nails	0	6	6
Painting on weatherboarding and lining, knot, stop, and paint 3 coats, including priming coat: Labour and materials, 22⅔ yards super. at 1/4	1	9	8
Total	£6	18	8

	£	s.	d.
(3) Fibro-cement Walls on un-wrot Studs, unlined—			
Fibro-cement (No. 5, 3/16in. thick, cost 3/- yard, 100 yards	1	13	4
9			
Cutting to waste, and labour fixing	0	5	8
Cover Battens, oak, say, average per square 50 ft. lineal, at 9/- per 100, cost	0	4	6
(Labour included in Fibro-cement labour above).			
Studs, 4in. x 2in. Oregon, at 2ft. centres, and 2in. x 2in. horizontal fillets at 4in. centres (say, 2/5 square reduced): Material, labour and nails, at 40/- per 100ft.	0	16	0
Painting on stop moulds, labour and materials, 20 yards lineal at 3d.	0	5	0
Total	£3	4	6

ROOFS PER SQUARE.

Note.—Oregon = 28/- per 100ft. reduced. Oregon, including labour (and nails), to rafters = 40/- per 100ft. reduced.

(1) Slating (Countess, 3in. lap) Battens and Rafters—			
Slates: 180 Purple Bangor (this allows 5 per cent. for waste), at £25/10/- per 1000, cost	4	11	10
Labour laying slates and fixing battens	0	8	0
2lbs. compo slate nails at 6d.; and batten nails at 6d.	0	1	6
Battens, 2in. x 1in. Oregon, 150ft. lineal (equals ¼ square reduced), cost	0	7	0
Rafters, 4in. x 2in. Oregon, at 18in. centres (½ square reduced), labour, material and nails	1	0	0
Total	£6	8	4
(2) Tiling (Wunderlich's Tiles)—			
Tiles, 135 at £18 per 1000, cost	2	8	7
Labour fixing tiles and battens	0	6	0
Wire and nails	0	2	0
Battens, 2in. x 1in. Oregon, 90ft. lineal (15ft. reduced), cost	0	4	3
Rafters, 4in. x 2in. Oregon, at 18in. centres (½ square reduced), labour, materials and nails	1	0	0
Total	£4	0	10

	£	s.	d.
(3) Fibro-cement Slating (greys, battens and rafters)—			
Fibro-cement slates, 105 greys, at £30 per 1000, cost	3	3	0
"Crampons", copper, 100 at 30/- per 1000, cost	0	3	0
Nails (galvanised), 1lb., cost	0	0	6
Labour fixing slating and battens	0	6	6
Battens, 2in. x 1in. Oregon, 168ft. lineal (28ft. reduced), cost	0	7	11
Rafters, 4in. x 2in. Oregon, at 2ft. centres (1/3 square reduced), labour and material	0	13	4
Total	£4	14	3
(4) Malthoid, 1in. T.G. Boarding and Rafters)—			
Malthoid, cost of 100ft. super., at 35/- roll (one roll covers 200ft. net)	0	17	6
Labour fixing	0	4	0
Nails	0	0	6
Painting (100 yards at 1/4)	0	14	10
Boarding, 6in. x $\frac{9}{8}$in. T.G. Oregon, wrot one side, cost	1	13	0
Labour to boarding	0	6	0
Rafters, 4in. x 2in. Oregon, at 2ft. centres, (1/3 square reduced), labour and material	0	13	4
Total	£4	12	2
(5) Corrugated Iron, 24 Battens and Rafters—			
Corrugated iron, 24 gauge, galvanised, cost £46* ton (covers 13½ squares), (approx. average), fixed with 1½ corrugations side laps and 9in. end laps, cost	3	8	2
Labour and screws and washers to corrugated iron	0	8	0
Battens, 3in. x 1½in. Oregon, at 3ft. centres (equals 12ft. reduced): Cost (at 28/- per 100ft.)	0	3	4
Labour and nails (at 7/- 100ft.)	0	0	10
Rafters, 4in. x 2in. Oregon, at 3ft. centres (equals ¼ square reduced), material, labour and nails	0	10	0
Total	£4	10	4

*Note.—Although priced at £46, corrugated iron is almost unprocurable in any quantity.

(6) "Fibrolite" (Fibro-cement corrugated)—

Note.—Owing to the scarcity of corrugated iron, and the exceptionally high price of that which is obtainable, the use of other materials in lieu thereof has to be considered. One of these materials now on the market is a corrugated fibro-cement sheeting, fixed in a similar way to corrugated iron. Prices herewith.

"Fibrolite" (Battens and Rafters)—

	£	s.	d.
100ft., plus 20 per cent. for laps = say, 14 yards at 5/-, cost	3	10	0
Labour, screws and washers, as to corrugated iron	0	8	0
Battens, 3in. x 1½in. Oregon, 3ft. centres (as to corrugated iron)	0	4	2
Rafters, 4in. x 2in. Oregon, 3ft. centres (as to corrugated iron)	0	10	0
Total	£4	12	2

(i) Analyses of Prices.

(a) Correct analysis is the root of all successful pricing, and too much emphasis cannot be laid on this point. Two typical examples are herewith given:—

1.—CEMENT CONCRETE.

	£	s.	d.
(6/1 per cubic yard.)			
Bluestone metal, 2in. gauge (1 ton = 24 cu. ft. approx.), 27 cu. ft., 9/6 per ton	0	10	8
Sand (1 ton = 20 cu. ft. approx.), 12 cu. ft., 6/- per ton	0	3	7
Portland Cement, 4 bags, 4/4	0	17	4
Labour—mixing, wheeling 20 yards, depositing and ramming (and water)	0	10	0
Total	£2	1	7

2.—BRICKWORK.

(Common brickwork in cement mortar.)			
Bricks, 4000 at 50/- 1000	10	0	0
Cement, 15 bags at 4/4	3	5	0
Sand (1 ton = 20 cu. ft. approx.), 53 cu. ft., 6/- per ton	0	15	11

	£	s.	d.
Water	0	0	6
Labour—assuming that one bricklayer lays approx. 450 bricks per day, with 1 labourer to 2 bricklayers, then 1 rod = 9 days approx.—bricklayer at 1/9 per hour = 14/- per day; (½) labourer at 1/6½ per hour = 6/2 per day; 9 days at 20/2	9	1	6
Add for scaffolding, etc.	0	10	0
Total	£23	12	11

(b) In the preparation of speedy preliminary estimates it is useful to know the values of the different items of the various trades. For example, joinery, such as doors, windows, &c., at per foot superficial, or other suitable unit. In order that the estimator may economise in time as much as possible, and to arrive at such values, it is a good plan to take one typical item and analyse it, the consequent resultant being adopted as a unit value. Examples are given below:—

1.—EXTERNAL DOOR AND FANLIGHT.

	£	s.	d.
Door, 7ft. x 3ft. x 1¾in. m.b.s. reduced door	1	10	0
Labor hanging	0	5	0
Fanlight, 3ft. x 1ft. 6in. x 1½in.	0	6	6
Labour hanging	0	2	0
Frame and Transoms, 5in. x 3in. Oregon	1	0	0
Labour fixing	0	10	0
Glass, 4ft. super. of "G" glass at 1/6 ft.	0	6	0
Labour glazing, 4ft. at 6d.	0	2	0
Architraves, 4in. x 1¼in. redwood, labour and material, fixed, 23 ft. at 3d.	0	5	9
Quadrant Mould, 1¼in. redwood, fixed, 21ft. at 2d.	0	3	6
Butts, 1 pair 4in., 1/6; 1 pair 3in., 1/- (fixing included with door and fanlight)	0	2	6
Fanlight Opener, p. cost 4/-; price fixed	0	5	0
Door Lock and Furniture, p. cost 4/6; fixed	0	7	6
Total	£5	5	9

Not including painting.

For glazed door add cost of glass and glazing.

Overall size measured over frame = 3ft. 4in. x 8ft. 10in. approx. = 3s. 8d. ft. super. = 29 ft. super. approx.

CASEMENTS AND FRAME.

(3-light window, 7ft. x 4ft. 6in., with two mullions.)

	£	s.	d.
Frame and mullion, 4½in. x 3in. Oregon, 27ft. lin., at 1/- ft.	1	7	0
Cill, 6in. x 3in. tallow wood, 8ft. lin., at 1/6 ft.	0	12	0
Sashes, 1¾in. redwood, 26ft. sup., at 1/- ft	1	6	0
Labour fixing frame and sashes, item	0	7	6
Glass, 26oz. sheet, 24ft. sup. at 1/- ft.	1	4	0
Labour glazing, 24ft. sup. at 6d. ft.	0	12	0
Lining, 6in. x ½in. redwood, labour and material, fixed, 16ft. lin. at 6d. ft.	0	8	0
Architrave, 4in. x 1¼in, redwood, labour and material, fixed, 18ft. lin. at 4d. ft.	0	6	0
Quadrant Mould, 1¼in. redwood, labour and material, fixed, 16ft. lin. at 2d. ft.	0	2	8
Window nosing, 6in. x 1in. redwood, labour and material, fixed, 8ft. lin. at 1/- ft.	0	8	0
Butts (cost only, fixing included with sashes above), 3 pairs, at 1/- pr.	0	3	0
Casement stays, p.c. 3/- each, price fixed, 3 at 3/6	0	10	6
Casement fasteners, p.c. 1/8 each, price fixed, 3 at 2/- ea.	0	6	0
Total	£7	12	8

Overall size measured over frame = 31ft. 6in. sup. = 4/10 ft. sup. approx.

(j) N.S.W. Labour Rates.

To ensure successful estimating, it is essential that the estimator should acquaint himself with every award in reference to labour rates, more especially in those trades where the line of demarcation is so fine that a thorough knowledge of the awards is necessary in order to determine the correct adjudication of those particular points.

Hereunder are given some of the principal current labour rates of New South Wales, as set out in the latest awards published. Generally speaking, the minimum rates only are given, and the allowances of rates for work done under

special conditions can easily be ascertained by reference to the awards:—

Trade.	Details.	Hourly Rate. s.	d.
Bricklayers ..	Minimum rate	1	9
	Tunnel or sewer works and underground shafts exceeding 1 cu. ft. deep	1	10½
Carpenters and Joiners	Minimum rate	1	8
	Bridge carpenters .. .. (Country, special allowances).	1	8
Electrical Trades	Shift Electricians, Installation Electricians, Electrical Fitters, Battery Fitters, Cable Jointers ..	1	8½
	Electric Mechanics, Linesmen ..	1	6½
	Arc Lamp Trimmers	1	3½
Builders' Labourers	Metropolitan and Newcastle .. .. (Award 27th April)	1	3¾ to 1 6½
	Country	1	1½ to 1 3
Marble and Slate Workers ..	Masons	1	6
	Polishers	1	4
	Machinists	1	4
Metal Ceiling Fixers	Minimum	1	5
Painters	Minimum	1	6¾
	Ship Painting	1	7¾
	Writers, Grainers and Gilders	1	9¾
Plumbers	Minimum	1	8
Quarrymen ..	Minimum	1	8
	Gutterers	1	9½
	Scabblers	1	8
	Machine Men for channel and guttering	1	5
	Crusher feeders (sandstone)	1	6
	Disc Crushers	1	6
	Blue Metal (jaw crushers)	1	4
	Powder Monkeys	1	6
	(Also many other prices, dependent upon the labour engaged on, such as Spawlers, Trimmers, Greasers, &c.)		

		s.	d.
Slaters, Tilers & Shinglers ..	Minimum	1	7½
Stonemasons ..	Carvers	2	6
	Cutters & Setters (plus 1d. for cutting Hawkesbury sandstone) ..	1	9¼
	Rubble Masons	1	9
	Stone Machinists	1	5¼
	Stone Machinists (on mould work)	1	7¼
	Pneumatic surface	1	10½
Tile Layers (other than Roof Tilers) .	Minimum	1	6
Tuck Pointers ..	Minimum	1	6
	(Special rates for scaffolding work).		
Plasterers ..	Plasterers and Fibrous Plaster Fixers	1	7½
	Tunnel, sewer or shaft work ..	1	9
Rockchoppers ..	Trenches, other than sewer trenches	2	0
	Sewer trenches	2	6
Boilermakers ..	Minimum	1	7½

Part II.

COSTS OF ENGINEERING WORKS.

The second part of my paper deals with the actual costs of engineering works, as carried out, and is subdivided as follows:—

(a) Various engineering works in Australia and other parts of the world.

(b) Works in British Columbia.

(c) Works in B.E. Africa and Zanzibar.

(a) Various Engineering Works in Australia and other parts of the world.

(My acknowledgments are due to Brysson Cunningham's "Dock and Harbour Engineers' Reference Book" for many of these prices.)

1.—WHARVES.

Public Works Dept., N.S.W.

(a) TIMBER.

Locality.	How Executed	Date of Completion	Cost of Wharf only	Cost per Square of 100ft Super of Wharf area.	Cost per linial foot of Pile driven	Remarks
Coffs Harbour ..	Contract ..	1898	£12,092	32		Ocean Wharf, 15 feet above H.W.
Woolgoolga ..	,,	1898	12,960	33		,,
Newcastle Harbour	Day Labour	1900	8,305	33	3/1	
,, ,,	,, ,,	1902	10 396		3/1	
,, ,,	,, ,,	1909	15,132	29	2/-	
Port Kembla ..	Contract ..	1909	13,907	60·5		
,, ,, ..	Day Labour	1914	30,308	78		
Newcastle Harbour	,, ,,	1916	12,540	55	3/4	

Recent wharves in Sydney Harbour, constructed by Sydney Harbour Trust by day labour, have cost from £40 to £50 square for large wharves—the higher price including long scarfed piles up to 120 ft. in length.

(b) Reinforced Concrete.

	s.	d.	
Sydney Harbour (wharf being erected at Jones Bay by Sydney Harbour Trust)	£60 12	per square = 0 per ft. super.	
Shanghai	8	9	,,
Dundee	16	0	,,
Rochefort	15	0	,,
Nantes	19	0	,,

2.—PILING.

(a) Timber.

Turpentine is in general use in Sydney Harbour, and the piles cost from 1/6 to 3/- foot lineal approx., according to size and length, and cost the S.H.T. on an average 6d. ft. lineal for driving only (contractor's price for driving approx. 1/- ft. lineal, including use of plant).

(b) Reinforced Concrete.

Gambetta Quay (Boulogne Harbour).

Octagonal, 16in. x 12in. dia., 36/38ft. long. Cost 9/- ft. lineal 16in., 9/4 ft. lineal 12in., plus 12/- pile for driving = approx. 3d. per foot.

Footbridge at L'Orient, 1905-6.

14in. square, 45ft. long. Cost 11/8 lineal ft., including driving.

3.—QUAY WALLS.

Approx. Constructional Cost.

	Height of Wall. Feet.	Cost per Lin. yard. £
Southampton River Test Quay	72½	351
Southampton White Star Dock	71½	195
Newcastle Quay, England	52	196
Princes Dock, Glasgow	57½	120
Dublin River Quay	42	120
Antwerp River Quay	56½	250

4.—DREDGING.

The cost of dredging varies considerably, according to the nature of the material to be dredged, and the type of dredge used. In Sydney recent prices range from 2.51d. to 22.67d. per ton, as per schedule herewith.

SYDNEY HARBOUR TRUST.

Statement of Quantity and Cost of Work done by Dredges (with towing) for twelve months ended 30th June, 1916.

	Dredging, Towing and Repairs.		
Dredges.	Tons.	Expenditure.	Price per ton.
Sydney (bucket)	91,600	£2,821 14 6	7.39d.
Charon (bucket)	112,240	4,259 1 11	9.10d.
Chi (grab)	41,540	3,181 16 10	18.38d.
Pi (grab)	30,055	2,839 9 11	22.67d.
Pan (grab)	41,923	2,732 17 10	15.64d.
Poseidon (suction)	304,700	3,265 14 7	2.57d.
Triton (suction)	548,500	5,738 13 1	2.51d.
Nereus (bucket)	147,450	5,585 18 1	9.09d.
Duplex (double grab)	117,480	3,797 11 5	7.84d.
Hercules (bucket)	634,300	10,677 19 5	4.11d.
15-ton crane	23,130	1,796 6 6	18.63d.

(Extract from S.H.T. Commissioners' 16th Report, for year ending 30th June, 1916.)

The prices of dredging at the Panama Canal are especially noteworthy, covering, as they do, a long period of time, with an immense quantity of material dredged.

PANAMA CANAL WORK.

	Cu. yards.
Ladder Dredgers, No. 1	7.82
No. 2	13.65
(Limited to a depth of 36ft., and used for dredging a channel for the sea-going dredgers, which completed the cut.)	
Sea-going Suction Dredgers, No. 1	3.87
No. 2	3.51
Dipper Dredgers, No. 1	13.87
No. 2	14.02
Pipe-line Dredgers, No. 1	6.97
No. 2	7.02
(These were used for pumping impervious material into the bore of the Gatan Dam.)	

5.—SUBAQUEOUS ROCK REMOVAL.

The cost of this class of work, of course, varies to a considerable extent, being greatly dependent upon the means adopted to effect the removal, and the nature of the rock.

In Sydney Harbour the contract price for crushing with subaqueous steam hammer, ready for dredging, equals 20/- per yard cube. Holes drilled for piles by the Sydney Harbour Trust cost approx. average £4 each for 4 ft. deep, 15 in. diameter to take toe of pile.

Many present undoubtedly recall to mind the removal of the Lytton Rocks in the Brisbane River in 1897, and a few notes in reference to that work are of interest.

Removal of Lytton Rocks, Brisbane River.

This work consisted of the removal of a ridge of dolorite rock, 750 ft. long, thus increasing the navigable depth from 15½ ft. to 20 ft.

Two Ingersoll-Sergeant drills were employed, and blasting gelatine was used, the net quantity of rock removed (measured on the solid from cross sections) being 27,310 cu. yards.

The quantity of blasting gelatine used was 9,750 lbs., equalling .36 lbs. per cu. yard.

The cost of drilling and blasting equalled 4/4 per yard cube (exclusive of plant).

Total cost, including drilling and blasting, dredging and conveyance from site, 8/2 per yard cube.

Other interesting prices for similar work are as follows:—

	Cu. yard. s.	d.
St. Lawrence Ship Canal, through Galops Rapids, Ontario (hard limestone)	15	6
Blyth (drilling and blasting and removal)	6	2.2
Using 2 Lobnitz rock breakers	3	11.6
Entrance to Hamilton Graving Docks, Malta (cost of breaking up rock ready for removal; using Lobnitz cutters)	6	4.4

6.—HARBOURS.

As Dover Harbour has to a considerable extent been much in evidence lately, a brief paragraph in reference to its construction is appended:—

ADMIRALTY HARBOUR AT DOVER.

Constructed 1897/1909.

Consists of—(a) Reclamation, 22 acres ground.
(b) Construction 2 new breakwaters.
(c) Extension of Admiralty Pier 9154 ft.
(d) Dredging.

Cost £3,500,000.

Walls of 6-1 concrete.

Blocks of up to 42 tons weight.

Exterior blocks faced with granite.

In the light of recent happenings it cannot be denied that real value has been obtained for this expenditure.

7.—LIGHTHOUSES.

	Total cost.	Cubic Ft.	Cost per Cubic Ft.
Eddystone (Smeaton) ..	£40,000	13,343	£2 19 11½
,, (Douglas) 1877	59,255	65,198	0 18 2
Bell Rock	55,620	28,530	1 19 0
Skerry Vore	72,200	58,580	1 4 7¾

Others ranging from 18/5 to 34/6 per cubic foot.

The Beachy Head Lighthouse, which was constructed in 1900-1902, and which a number of us have seen when passing down the English Channel, cost £56,000.

8.—DOCKS.

This matter is of ever-increasing importance, and a brief outline of the construction of the larger of the two docks at Cockatoo Island (now known as the Sutherland Dock, but formerly called the "Biloela" Dock) is of particular interest just now. Should anyone present wish to obtain fuller particulars as to this dock, he is referred to the paper thereon in Minutes of Proceedings of Inst. C.E., Vol. CXI., by Edward William Young, M.I.C.E., from which paper these particulars are extracted.

BILOELA GRAVING DOCK, COCKATOO ISLAND.

Designed by J. B. MacKenzie, Esq., M.I.C.E. under the instructions of E. C. Moriarty, Esq., M.I.C.E., late Chief Engr. for Harbours and Rivers).

Dimensions—	ft.
Extreme length from outer quoin to head of dock at coping level	638
Length of floor	580
Width at coping level	108
Depth of Cill below L.W.S. tides	26

Date of Work.—Entire work from February, 1883 to March, 1890 (7 years).

Engineers.—Messrs. E. C. Moriarty, M.I.C.E., Engr. in Chief till he retired; then C. W. Darley, M.I.C.E. (absent on leave till March, 1889), R. R. Hickson, M.I.C.E., Acting Chief Engr.