

A study of the economic value of high-rise office buildings

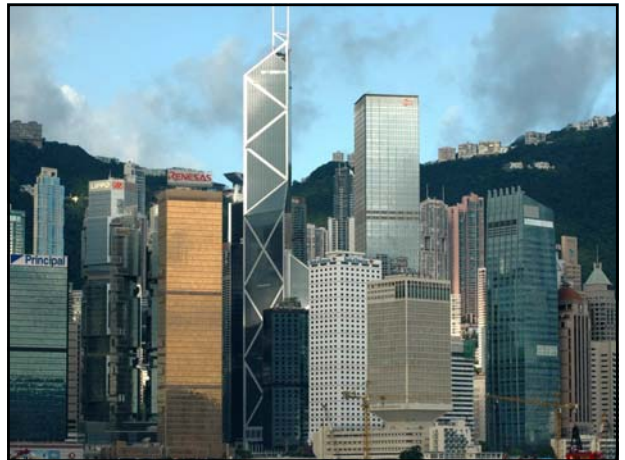
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FIG Work Week 2007



Quantity surveyors' role in project costing

- Economists take a forward-looking view
- Accountants take a backward-looking view
- Quantity surveyors, acting as building economists and building accountants, take both views
 - Forecasting project costs at the planning and design stage
 - Analyse and use historical cost data for forecasting



Forecasting the total project cost

Three components:

- Rental value of office space
- Building construction costs according to the height and the number of storeys of office buildings
- Maintenance cost

Effect of cost on the number of storeys and the height of the buildings

- Cost items fall as the number of storeys increases, e.g. roofs, foundation.
- Cost items rise as the number of storeys increases, e.g. lift installation, fire services.
- Cost items fall initially and then rise as the number of storeys increases, e.g. curtain walling.
- Cost items unaffected by height, e.g. floor finishes, doors.

(Flanagan and Norman, 1999)

Vertical transportation cost

- Labour and materials requires extra time for traveling to a particular height
- Time increases as the building goes higher and labour productivity turns lower
- To save time for traveling vertically, labourer's tea time are 'served' by the foreman

Factors affecting the no. of storeys and heights:

- Statutory regulations, e.g. plot ratio, daylight effect on neighbouring buildings
- Land costs
- Cost effect of different technical considerations
 - Foundation support
 - Structural steel or reinforced concrete frame structure
 - The envelop enclosing the frame
 - Lift cost, increased speed or transit floor
 - Pressurized system for water flow

Cost analysis of seven office buildings in Hong Kong

- Hypothesis – when a tall building reaches certain height, the construction cost display a staggered line in stead of a straight line
- Selected buildings are of heights ranging from 22 to 68 storeys, constructed and completed in different years

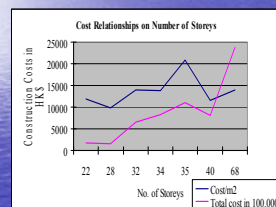
Method

- Updating all building costs to the same time level for comparison
 Costs are updated to the 4h quarter of 2006 (DLS Index 990)
- Calculate the distribution of the elemental costs of the buildings
- Work out the cost effect of the number of storeys on construction floor area (CFA) Work out the cost effect of the building elements of a high-rise building

Cost Effect of Area and Height on Number of Storeys

Building	No. of Storeys	Area	Height	Storey Ht.	Area/St.No
1	22	13,967	118	5.36	635
2	28	15,810	134	4.79	565
3	32	46,762	126	3.94	1,461
4	34	59,121	179	5.26	1,739
5	35	52,964	149	4.26	1,513
6	40	70,442	160	4.00	1,761
7	68	170,000	300	4.41	2,500

- Cost to no. of storeys



- Construction floor area to height

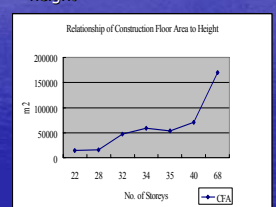
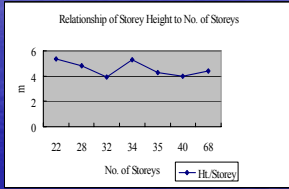
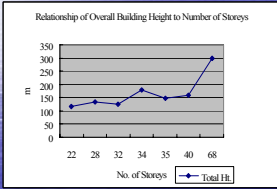


Figure 1

Figure 2

• Building ht. to no. of storeys

• Storey ht. to no. of storeys



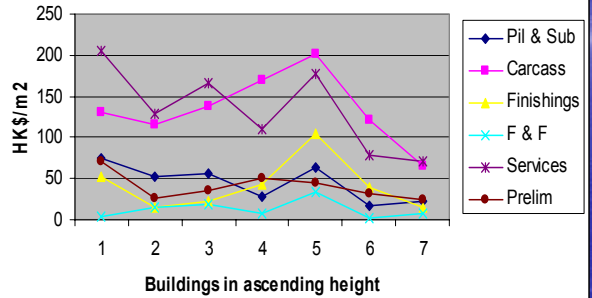
Cost Distribution of Office Buildings vs Number of Storeys

Case	No. of Storey	Cost per m ² HK\$	Pil & Sub	Carcass	Finishings	F & F	Services	Prelim
1	22	11,813	1,637	2,876	1,168	65	4,526	1,541
2	28	9,870	1,460	3,232	418	418	3,606	736
3	32	14,007	1,812	4,412	726	624	5,288	1,145
4	34	13,866	959	5,766	1,475	230	3,723	1,712
5	35	20,788	2,195	7,021	3,677	1,166	6,180	1,559
6	40	11,546	638	4,867	1,584	61	3,114	1,282
7	68	13,982	1,531	4,491	1,062	458	4,807	1,633

Cost Effect per Number of Storeys

Building	No. of Storeys	Cost per m ² in HK\$ per storey	Pil & Sub	Carcass	Finishings	F & F	Services	Prelim
1	22	537	74	131	53	3	206	70
2	28	353	52	115	15	15	129	26
3	32	438	57	138	23	20	165	36
4	34	408	28	170	43	7	110	50
5	35	594	63	201	105	33	177	45
6	40	289	16	122	40	2	78	32
7	68	206	23	66	16	7	71	24

Elemental cost per no. of storeys



Elemental Cost Distribution of Tall Buildings

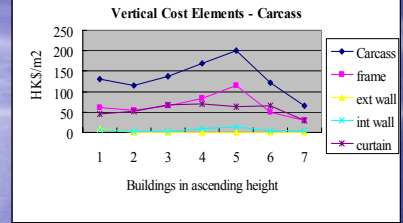
Building Elements	Elemental Cost Distribution Percentage						
	B1	B2	B3	B4	B5	B6	B7
Pilings and substructure	6	7	14	15	11	11	13
Carcass	42	32	24	34	34	32	31
Finishings	14	10	10	13	13	8	5
Furniture and fittings	1	2	1	3	6	3	4
Services	27	33	38	30	30	34	38
Preliminaries	11	12	13	7	7	12	8
	100	100	100	100	100	100	100

Elemental Costs of Carcass and Services of Tall Buildings

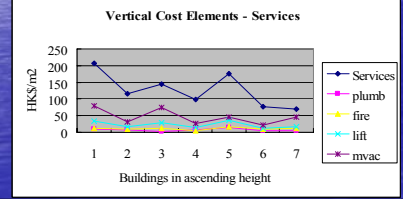
Elemental Costs per Number of Storey for Carcass and Services							HK\$ / m ²
Carcass total	131	115	138	170	201	122	66
Frame & slab	61	54	66	84	116	50	29
Ext. wall	8	1	0	0	0	0	0
Int. wall	7	1	2	8	13	4	5
Curtain walling	46	51	66	70	64	66	30
Services total	206	116	145	98	177	78	71
Plumbing & disposal	10	8	3	6	13	5	6
Fire services	11	9	12	5	16	10	2
Lifts	35	18	28	15	35	13	18
MVAC	80	32	75	27	46	23	27

Percentage Significance of Elemental Costs for Carcass and Services

Building Elements	Cost percentage within group per number of storey						
	B1	B2	B3	B4	B5	B6	B7
Carcass							
Frame and slab	46%	46%	47%	49%	57%	40%	43%
External wall	6%	1%	0%	0%	0%	0%	0%
Internal wall	5%	1%	1%	5%	6%	3%	8%
Curtain wall	35%	44%	47%	41%	31%	54%	45%
Services							
Plumbing and disposal	5%	7%	2%	6%	7%	6%	8%
Fire services	5%	8%	8%	5%	9%	13%	17%
Lifts	17%	16%	19%	15%	20%	17%	25%
MVAC	39%	28%	52%	28%	26%	29%	38%



Graph 6



Graph 7

Conclusion

- The carcass and services group constitute higher cost weightings
- Vertical cost items (services) display a staggered line (Graph 7), whereas area-storey and height-storey display a straight line based on the scatter diagram
- The frame and the mechanical ventilation system need detail examination in considering the design variables
- Lifts and fire protection require further analysis
- Client's preference and the statutory requirements should be considered in addition to economic value of tall buildings

