

RESTRICTED

CHAPTER 3

BAILEY BRIDGE

SECTION 4

DESIGN CALCULATION OF BAILEY BRIDGE

0401. **Introduction.** Only a proper design can ensure economic use of time and manpower during execution. Design is the foremost part of any construction. A sound design brings into a successful execution of work. An engineer officer must be thorough in designing a Baily Bridge basing on the ground configurations and know how to overcome the eventualities.

0402. **Sequence.** The calculation is done in the following sequence:

- a. **Step -1.** Length of Baily Bridge and Type of construction.
- b. **Step -2.** Launching Nose and Position of Launching Link.
- c. **Step -3.** Roller Layout.
- d. **Step -4.** Grillage.
- e. **Step -5.** Jack.
- f. **Step -6.** Launching Calculation.
- g. **Step -7.** Store Calculation and Requirement of Vehicle.

0403. **Step 1: Length of Baily Bridge and Type of Construction.**

- a. Length of Baily Bridge = Distance between Launching Roller (LR) and Landing Roller (LdR) + Distance between long range and base plate + Distance between Landing Roller (LdR) and base plate.
- b. Type of Construction = SS, DS, DD or DT.
 - (1) Normally constructed bridges (subject to confirmation by test).

Class	Maximum Spans in Feet			
	S/S	D/S	D/D	D/T
9	90	150	180	230
12	80	140	180	220
18	60	110	160	200
24	60	110	150	200
30	50	100	140	190
40	30*	80	130	180
50	*S/S can be 50 feet Class 40 in emergency	60	110	160
60		50	100	130
70		40	90	120

- (b) Normally constructed bridges (subject to confirmation by test).

Class	Maximum Spans in Feet					
	9	12	18	24	30	40
S/S	90	80	40	20	20	-
D/S	150	140	100	90	80	60

(Auth: ERPB-1964, Section 16; Para 6, Table 1) Page-69

0404. **Step 2: Launching Nose and Position of Launching Link.**

- a. $\text{Length of Nose} = \frac{\text{Length of Baily Bridge} + 10'}{2}$
 $= \text{Next higher multiple of } 10'$

(Authorization: ME Volume III, Part III, Section 7, Para 1), Page-30

- b. Type of Construction= 5 bays SS and 2 bays DS etc.
(Authorization: ME Volume III, Part III, Figure 33, 34, 35 or 36). Page 149-152
- c. Position of Launching Link = $\frac{\text{Sag} + \text{Allowance}}{13.5}$

[Auth: ME Volume III, Part III, Section 8, Para 3a (Page-33) and Figure 34, 35 or 36] Page 149-152

0405. **Step 3: Roller Layout.**

- a. Construction Space = Length of Nose +27'.
- b. Position of Construction Roller = At a Distance of 27', 52', 77', and 102' back from the line of bank seat rollers.
(Auth: ERPB, Section 16, Para 4c), Page-67
- c. **No of Construction Rollers on Each Side.**

- (1) At 27ft : 01
- (2) At 52 ft : 02
- (3) At 77ft : 02
- (4) At 102ft: 02

(Auth: ERPB Section 16 Para 4c, Page-67; ME Volume III, Part III, Section 6, Para-4Page-30)

- d. $\text{No of LR} = \frac{\text{Weight of Bridge} + \text{Weight of Nose}}{\text{Load Carr Capacity of Rocking Roller}}$

[Auth: ME Volume III, Part III, Annex A (Page-132) and Section 4, Para 1 (Page-29), Section 6, Para 2 & ERPB Section 16 Para 2 (Page-66)]

- e. No of LdR= $\frac{\frac{1}{2} \text{ Weight of Bridge} + \text{Weight of Nose}}{\text{Load Carr Capacity of Rocking/Plain Roller}}$

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f. **Total Reqr of Rollers.**

- (1) Rocking Rollers = LR + LdR.
- (2) Plane Rollers = No of Construction Rollers.

0406. **Step 4: Grillage.**

- a. Find maximum base plate reaction consulting ESPB.

Table 118 - Construction Data For Class 40 and 70

Ser	Span (feet)	Type	Bay in Nose			Launching Weight (Tons)	Sag(in)	Max base plate reaction (Tons)	Notes that apply
			S/S	D/S	D/D				
1.	30	S/S	2	-	-	7	3	20.8	
2.	40	S/S	3	-	-	10	4	21.8	
3.	40	D/S	2	-	-	11	21	22.2	
4.	50	D/S	3	-	-	15	41	23.3	
5.	60	D/S	4	-	-	18	71	24.2	
6.	70	D/S	4	-	-	20	11	25.1	
7.	80	D/S	5	-	-	24	15	25.9	*CI 70 decking System
8.	90*	D/D	6	-	-	41	14	30.7	
9.	100*	D/D	6	-	-	45	17	32.9	
10.	110*	D/D	7	-	-	46	21	35.3	
11.	120	D/D	7	-	-	48	25	37.6	
12.	130	D/D	8	2	-	53	30	39.9	
13.	140*	D/T	6	3	-	81	27	47.5	Launch complete except 8 bays chesses and foot walk except all chesses and foot walk
14.	150*	D/T	6	3	-	78	36	49.4	
15.	160*	D/T	6	3	-	84	39	51.2	
16.	170	D/T	6	4	-	84	49	53.1	
17.	180	D/T	6	4	-	84	56	55.6	Except all chesses f walk and stringer
18.	40	D/S	2	-	-	13	$2\frac{1}{2}$	39.4	
19.	50	D/D	3	-	-	21.2	$4\frac{1}{2}$	41.51	

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Ser	Span (feet)	Type	Bay in Nose			Launching Weight (Tons)	Sag (in)	Max base plate reaction (Tons)	Notes that apply
			S/S	D/S	D/D				
20.	60	D/D	4	-	-	24.54	$7\frac{1}{2}$	42.32	
21.	70	D/D	4	-	-	28.13	11	43.65	
22.	80	D/D	5	-	-	32.47	12	44.42	
23.	90	D/D	6	-	-	36.81	14	45.53	
24.	100	D/T	6	-	-	55.40	16	50.32	
25.	110	D/T	6	-	-	61.82	$17\frac{1}{2}$	52	
26.	120	D/T	5	-	-	69	19	61.8	

(Auth: ESPB, Table 118) Page-257

- b. Find out type of grillage consulting ERPB.

Detail of Bolt & Washer Plate

Type of Grillage	Maximum Loads for the following Safe Ground Pressures						No of Trusses in Bridge or Crib
	1 Ton/sequence feet		2 Tons/sequence feet		3 Tons/sequence feet		
	Baseplate	Template	Baseplate	Template	Baseplate	Template	
Baseplate & Template only	13	8	26	16	39	24	S D T
A	15.5	13.5	31	27	-	-	S D T
B	23	18	46	33*	-	-	D T
C	33	22.5	66	45	-	-	D T
D	41	27	82	54	-	-	D T
E	46	35	92	36	-	-	D T Q
F	69	51	100*	88*	-	-	D T Q

Limited by strength of grillage.

(Auth: ERPB, Section 16, table under para 13) (Page-83)

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0407. **Step 5: Jacks.**

- a. Weight on Jack = $\frac{1}{2}$ x Weight of Bridge.
- b. No of Jacks = $\frac{1/2 \text{ x Weight of Bridge}}{\text{Capacity of Each Jack}}$
 = Next Higher Even No.
 (Auth: ME Volume III part III, Section 15, Para 1) (Page-42)

0408. **Step 6: Launching Calculation.**

- a. **Launching Plane.** Considering the launching plane through 6" above the tail end:
- (1) Height of tail end at launching plane.
 - (2) Height of tip of LR at launching plane.
- b. Slope of Bridge = $\frac{\text{Vertical Lift}}{\text{Horizontal Dstn}}$
 Which is allowable (Within 1: 30)
 (Auth: ME Volume III, Part III, Section 1)

0409. **Excavation/ Filling at Different Part.**

Serial	Considerations	Rollers at Various Part						Remarks
		-77'	-52'	-27'	-3.5'	0	73'	
1.	Rise at							
2.	Rise of bottom chord at tail (+ 6")							
3. (1+2)	Level at the tip of rollers over existing ground (inch)							
4.	Height of rollers on template							
5.	Height of the ground (above datum level)							
6.	Height of grillage (inch)							
7. (4+5+6)	Total height (inch)							
8. (3-7)	Excavation/Filling or packing Require (inch)							+ve=Excavate -ve=Fill

0410. **Step: 7: Store Calculation and Requirement of Vehicles.**

a. **Store List.**

Serial	Items	Require	10% Res	Total Require	Remarks
--------	-------	---------	---------	---------------	---------

(Auth: ME Volume III part III, Annex E) Page-140

Note:

- (1) End bay at the head of the bridge.
- (2) Intermediate bays.
- (3) End bay at the tail of the bridge.
- (4) Bays of the nose.

0411. **Vehicle Require.**

- a. Lorry for Panels = $\frac{\text{No of Panels}}{12}$
- b. Lorry for Decking = $\frac{\text{No of Bay} \times 1.1}{2}$
- c. Ramps = 2 x Lorry
- d. Grillage = $\frac{\text{No of Grillage}}{2}$
- e. Accessories = Carried by Lorry of a, b, c, d.
- f. Total Lorry = (a + b + c + d).

0412. **Sample Calculation**

a. **Given Data.**

- (1) Water gap 73 feet.
- (2) Met condition : Actual
- (3) First Light : 0530 hours
- (4) Last Light : 1830 hours
- (5) Soil Bearing Capacity : 2 ton/ sq feet.

b. **Requirement.**

- (1) Class of the BB.
- (2) Dimension of BB.
- (3) Length of BB.
- (4) Length of nose.
- (5) Position of nose link.
- (6) Construction space for Roller.
- (7) Position of Construction roller.
- (8) No of Construction roller.
- (9) No of landing roller.
- (10) No of launching roller.
- (11) Total no of roller.
- (12) No of Jack.
- (13) Transport reqr.
- (14) Manpower reqr.
- (15) Time reqr.
- (16) Store reqr.

0413. **Detail Calculation.**

a. **Class of the Baily Bridge.** For medium tank a Class 40 Baily Bridge needs to be constructed.

b. **Dimension.** A double truss single storey Baily Bridge will be constructed to cross medium tank.

c. **Length of the Baily Bridge.**

Length = Distance between landing roller to launching roller +
launching roller to base plate + landing roller to base plate.

$$= (73' + 3 \frac{1}{2}' + 3 \frac{1}{2}') \text{ feet}$$

$$= 80 \text{ feet}$$

d. **Length of the Nose.**

$$\text{Length} = \frac{\text{Length of BB}}{2} + 1 \text{ Bay}/10'.$$

$$= \frac{80'}{2} + 10'$$

$$= 50' \text{ or } 5 \text{ Bay}.$$

e. **Position of Nose Link.**

$$\begin{aligned}
 \text{Position} &= \frac{\text{Sag} + 6''}{13.5''} [\text{Sag for 50' is 15''}] \\
 &= \frac{15'' + 6''}{13.5''} \\
 &= 1.55 \\
 &\cong 2
 \end{aligned}$$

That is after 2 Bays

f. **Construction Space.**

$$\begin{aligned}
 \text{Space} &= \text{Nose} + 27' \\
 &= 50' + 27' \\
 &= 77'
 \end{aligned}$$

Therefore, 77' space require behind the launching roller.

g. **Position of Construction Roller.** Behind 27', 52' and 77'

[Auth: ERPB, Section 16, Para 4(c)]

h. **Number of Construction Roller.**

- (1) At 27' - 2
- (2) At 52' - 2
- (3) At 77' - 2

Total Construction roller is 6.

j. **Number of Launching Roller.**

$$\begin{aligned}
 \text{No} &= \frac{\text{Weight of Bridge} + \text{Weight of Nose}}{\text{Capacity of Launching Roller}} \\
 &= \frac{8 \times 2.01 + .75 \times 5}{15} \quad \begin{array}{ll} \text{[Weight of one bay} & = 2.61 \text{ Ton} \\ \text{Weight of one bay of nose} & = .75 \text{ Ton}] \end{array} \\
 &= 1.642 \\
 &\cong 2 \quad \quad \quad \text{[Bay for br is 8 Bay for nose 5]}
 \end{aligned}$$

The rollers will be used in pair.

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k. **Number of Landing Roller.**

$$\begin{aligned}
 \text{No} &= \frac{\frac{1}{2} \times \text{Weight of Bridge} + \text{Weight of Nose}}{\text{Capability of Landing roller}} \\
 &= \frac{1/2 \times 2.61 \times 8 + .75 \times 5}{15} \text{ [Earlier Ref]} \\
 &= 0.946 \\
 &\cong 1
 \end{aligned}$$

The rollers will be used in pair.

l. **Total Number of Roller.**

- | | | |
|----|----------------|-------|
| a. | Rocking Roller | - 04. |
| b. | Plain Roller | - 06. |
| c. | Total | - 10. |

m. **Number of Jack.**

$$\begin{aligned}
 \text{No} &= \frac{\frac{1}{2} \times \text{Wt of Br}}{\text{Cap of Jack}} \\
 &= \frac{\frac{1}{2} \times 8 \times 2.61}{7.5} \text{ [Earlier Ref]} \\
 &= 1.392. \\
 &\cong 2.
 \end{aligned}$$

Therefore, 2 Jacks will be used.

n. **Transport Requirement.**

- (1) Total Panel = $\{(8 \times 4) + (5 \times 2)\} = 42$
 3 ton lorry = $(42 \div 12)$
 = 3.5
 $\cong 4$.
- (2) Deck = Total Bay $\div 2 = 8 \div 2 = 4$
- (3) Ramp = 2 x 3 ton lorry.
- (4) Other Items = 3x 3ton lorry.
- (5) Total = $4+4+2+3 = 13$ x 3 ton lorry.
 [Auth: ERPB, Page 70, Para 10 & 11]

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p. **Manpower Requirement.**

- (1) LH Girder 10 Persons
- (2) RH Girder 10 Persons
- (3) Center of Bridge 10 Person
- (4) Decking 10 Person
- (5) Total 40 Person or 4 Engineer Sec or 1x Engineer Platoon.

q. **Time Required.**

- (1) 3 1/2 - 4 hours by day.
- (2) 8 hours by night.

r. **Store Required.**

- | | | |
|------|---------------|--------|
| (1) | Base plate | - 04. |
| (2) | Bearing plate | - 08. |
| (3) | Panel | - 42. |
| (4) | Transom | - 23. |
| (5) | Raker | - 22. |
| (6) | Sway Brace | - 25. |
| (7) | Bracing frame | - 16. |
| (8) | End Post | - 08. |
| (9) | Panel Pin | - 100. |
| (10) | Transom clamp | - 50. |
| (11) | Stringer | - 10. |
| (12) | Chassis | - 200. |
| (13) | Bracing Bolt | - 150. |

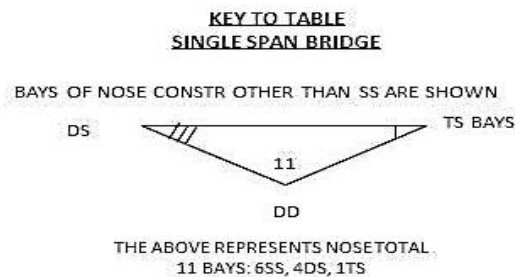
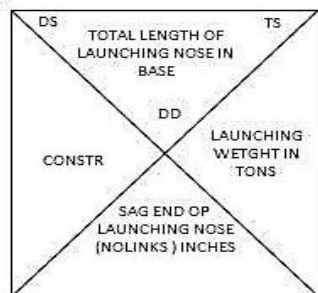
s. **Detail Planning.**

- (1) Mark the br center line.
- (2) Sitting launching roller on the home bank and landing roller on the far bank.
- (3) Construction of nose
- (4) Construction of subsequent bays.
- (5) Dismantling the nose.
- (6) Jacking down the br.
- (7) Fixing the end posts.
- (8) Fixing stringers and chassis.
- (9) Construction of foot way.

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LAUNCHING DATA FOR BAILEY BRIDGE

SPAN	40'	50'	60'	70'	80'	90'	100'	110'	120'	130'	140'	150'	160'	170'	180'	190'	200'
CONSTR	3 40T 40W 4	3 30 5.5	4 24 8	5 12 11	5 9 24												
DS	2 70W 70T 2 1/2	3 70T 60W 4 1/2	4 50W 60T 7 1/2	4 40W 52.2 10	5 40T 29.4 12	6 30 27.0 13.5	6 30 28.0 14.5	7 12 15.6 17.5	7 12 15.6 17.5	8 12 17.4 19	8 12 18.8 21	9 9 17.0 22					
TS		3 70W 70T 3 1/2	3 70W 70T 5 1/2	4 60W 70T 8 1/2	5 60T 42.0 15.5	5 30T 50W 12.9 17	6 40W 38.0 17.5	7 40T 33.3 19	7 30 31.6 20.5	8 24 27.3 22.5	8 24 28.8 24	9 12 21.6 26	10 12 22.8 28	10 9 21.5 29.5			
DD				4 70W 70T 10	5 70W 70T 12	6 70T 59.8 20.5	6 60W 50.0 22.5	7 50T 40.4 24.5	7 40T 36.1 24	8 40T 39.5 26.5	9 30 35.8 29	9 24 32.6 31	10 18 29.8 33	10 12 25.8 35	11 18 26.3 42		
TD						6 70T 70W 12	6 70W 56.0 27.5	7 70T 56.5 31.0	7 60T 50W 33.5	8 50T 45.5 26.5	8 40T 46.2 36	9 30 41.3 39	9 24 38.8 41.5	10 24 40.8 40	10 24 40.8 40	11 12 33.8 42	12 9 32.3 42
DT							5 70W 70T 12	7 70T 55.9 32.5	7 70T 58.5 34.5	7 50T 69.6 37.6	8 50T 53.1 40.5	9 50T 57.5 42	9 50T 59.7 42	10 40T 55.0 42	11 40T 57.0 42	11 30 53.4 42	11 12 37.2 42
TT							LAUNCHED AS TD BRIDGE										



PARTS OMITTED TO KEEP LAUNCHING WEIGHT DOWN TO 84 TONS

HORIZONTAL PUSH DEVELOPED BY DOZERS IN TONS

BAYS	SPAN									
	TRIPLE DOUBLE				DOUBLE TRIPLE					
	170	180	190	200	150	160	170	180	190	200
CHESSES	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
FOOT WALKS	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
STRINGERS	-	-	15	ALL	-	-	-	ALL	ALL	ALL
TOP STOREY	-	-	-	2	-	-	-	-	3	5

PUSH	SIZE	MAX
TON	4	3.5
TON	3	6.5
TON	2	9.5
TON	1	11.5

PUSH REQUIRED TO LAUNCH BRIDGE IS 1/15 OF LAUNCHING

LAUNCHED WITHOUT FOOT WALKS COUNTER WEIGHT UP TO 1 TON IS NEEDED

THE LAUNCHING OF BRIDGES OF OVER 200' SPAN OR OF 190' AND 200' TD OR OF 180' DT ALL OF WHICH NEED BALANCE BEAM ASSY AS ROLLERS IS DESCRIBED IN ME VOL-III, PART IV, PAMPHLET NO -1 LUNCHING OF TT BRIDGES

1. TT BRIDGES ARE LAUNCHED AS TD AND ADDITIONAL TOP OR BOTTOM STOREY ADDED AFTERWARDS.
2. CLASSIFICATION OF TT BRIDGES APPLY WHETHER ROAD AT 1/3 HEIGHT WITH SWAY BRACE AND ONE TRANSOM PER BAY IN LOWER STOREY, OR WHETHER ROAD POSITION NORMAL WITH OVER HEAD BRACING.
3. ONE BAY OF PANELS IS LEFT OFF FROM TOP OR BOTTOM STOREY ENDS WITHOUT ALTERING CLASSIFICATION.

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LUNCHING DATA FOR BAILEY BRIDGE

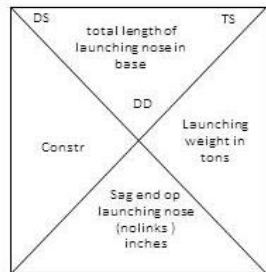
SPAN	30'	40'	50'	60'	70'	80'	90'	100'	110'	120'	130'	140'	150'	160'	170'	180'	190'	200'
CONSTR	SS								DS								DD	
Class 9																		
12																		
18																		
24																		
30																		
40																		
50																		
60																		
70																		

LUNCHING DATA FOR BAILEY BRIDGE

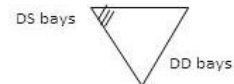
SPAN	30'	40'	50'	60'	70'	80'	90'	100'	110'	120'	130'	140'	150'	160'	170'	180'	190'	200'															
CONSTR	SS							DS							DD																		
CLASS																																	
9	2	3	3	4	5	5	5	6	7	7	8	8	9			11																	
12				55	17	55	19	22		35	38	42	44			75																	
18	55	55	55	12	11	16	6	24	35	47	58	62	70		10	66		11															
24		7	7	5	4	5	DS	27	DS			9	10		56		DT	84															
30		3	5 1/3	DS	DS	DS	20	20	25			43	50			11	DT	84															
40	3			7 1/3	11	15				7	8	9	9		10	84	72																
50	2	2	2	DS	DS			6	7	7	8	9	9		9	84	56																
60	55	7	DS	13	7 1/2			DD	45	21	DT	27	36		9	84																	
70	3	2 1/2				DD	12	6	17		7	7	9		9	84																	
	DS					DD				DT																							
<div><div>HORIZONTAL PUSH DEVELOPED BY DOZERS IN TONS</div><table><tr><td>SIZE</td><td>MAX</td><td>PUSH</td></tr><tr><td>4</td><td>3.5</td><td>10'</td></tr><tr><td>3</td><td>6.5</td><td>20'</td></tr><tr><td>2</td><td>9.5</td><td>30'</td></tr><tr><td>1</td><td>11.5</td><td>40'</td></tr></table></div>																			SIZE	MAX	PUSH	4	3.5	10'	3	6.5	20'	2	9.5	30'	1	11.5	40'
SIZE	MAX	PUSH																															
4	3.5	10'																															
3	6.5	20'																															
2	9.5	30'																															
1	11.5	40'																															

HORIZONTAL PUSH DEVELOPED BY DOZERS IN TONS

SIZE	MAX	PUSH
4	3.5	"
3	6.5	"
2	9.5	"
1	11.5	"

**KEY TO TABLE
SINGLE SPAN BRIDGE**

Bays of nose constr other than ss are shown



The above represents nose total 10 4DS (leaving 6 SS)

Parts omitted to keep launching weight down to 84 tons

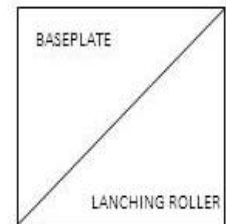
Bays of	SPAN					
	Double Triple					
	150	160	170	180	190	200
Chassesfoot	8	All	All	All	All	All
walk stringers	8	All	All	All	All	All
top stormy	-	-	-	All	All	All
	-	-	-	-	5	5

3 (Sec 40-ft and 50-ft SS column) maybe Class 40 in an emergency.
Launched without footwalks. Counterweight up to 1 ton is needed.

The launching of bridges of over 200ft span or of 180ft to 200ft DT, all of which need balance beam assemblies as rollers, is described in ME Vol III, Pt IV Chap 1.

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SPANS IN FEET																				
LOAD	SS							DS							DD		DT			
CLASS	30	40	50	60	70	80	90	100	110	120	130	140	150		180		210	220	230	
9	8.8 3.5	76 5	9.3 .6	9.0 7.5	3.6 8.5	10.1 9.5	10.0 11.0	13.2 14.5	14.3 10.5	15.6 17.5	16.5 19	17.3 21	18.2 22		26.1 57.5		27.5 50	39.1 52.5	40.0 51	
12	0-1 3.5	63 5	9.5 6	10.2 7.5	10.6 8.5	11.3 9.5	13.2 13.5	14.5 14.5	15.8 16.5	17.2 17.5	17.9 19	18.9 21		26.1 35	27.6 37.5		37.6 42	39.6 50	41.2 52.5	
18	11-7 3.5	12.5 6	13.3 6	14.0 7.5	15.4 10	16.2 12.0	17.0 13.6	16.7 14.5	20.2 16.5				33.5 31	35.0 33		42.2 42	44.3 42			
24	14-2 3.6	15.2 5	16.0 6	16.7 7.5	18.2 10	18.9 12.0	19.7 13.6	21.7 14.5	23.7 10.5				33.7 31		44.4 42	46.9 42	49.1 42			
30	17.7 3.5	17.7 5	18.6 6	20.6 10	20.6 10	21.4 12.0	22.3 16.6	21.7 14.5			33.6 26.5	35.6 29			48.4 42	51.7 42				
40	20.8 3.5	22.2 6.5	23.3 8.5	25.1 10	25.1 10	25.9 12.0				37.6 2.4	39.9 26.5			52.2 42	53.1 42	55.6 42				
50	23.8 5.0	27.3 6.5	28.6 8.5	29.5 10				29.0 22.5	42.2 24.5			55.1 40.5	57.7 42	60.3 42						
60	30.3 5.0	31.9 6.5	33.3 8.5				40.4 20.5	44.4 22.5			58.9 37.5									
70	34-6 6.0	36.5 6.5				43.6 18	45.3 20.5			61.8 34.5										
	DS						DD		DT				Not launched as Triple Storey							



0414-0500 Reserve.