



Aug 2018

Study on reasonableness of
cost incurred and capitalized
by BIAL during the first control
period

Evaluation Report



RITES LIMITED

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Abbreviations

AERA	Airports Economic Regulatory Authority of India
AAI	Airports Authority of India
ATM	Air Traffic Movement
Gol	Government of India
BIAL	Bangalore International Airport Limited
IMG	Inter-Ministerial Group
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IRA	Independent Regulatory Authority
LOS	Level of Service
MARS	Multiple Aircraft Ramp System
MoCA	Ministry of Civil Aviation
MPPA/mppa	Million Passenger per Annum
Mn	million
MYTP	Multi-Year Tariff Proposal
PPP	Public Private Participation
PHP	Peak Hour Passenger
TRB	Transport Research Board
UDF	User Development Fee
WPI	Whole sale price Index

1. INTRODUCTION

1.1. Background

Development of new greenfield international airport at Bangalore through PPP was awarded to Bangalore International Airport Limited (BIAL) and the concession agreement was signed between BIAL and the Ministry of Civil Aviation (MoCA) on 05th July 2004.

At the time of Financial closure and commencement of construction, the Initial Phase of the Bengaluru International Airport (renamed as Kempe Gowda International Airport on 17th July 2013) was designed for handling about 4.5 million passengers per annum and the project cost was Rs. 1411.79 crore. However, owing to significant increase in aviation traffic, BIAL redesigned the initial phase midway through the implementation of the project, increasing the capacity of the Airport to 11.4 million passengers per annum and the project cost to Rs. 1930.29 crore, so that the Airport, at the Airport Opening Date (AOD), had the requisite capacity to handle the aviation traffic at the required/ prescribed service levels. Subsequently, certain project extension works were taken up with supplemental expenditure budget of Rs. 540 crores taking the total project budget to Rs. 2470.29 crores. The airport commenced the operations on 24th May 2008.

Salient features of the concession agreement relevant to this report are highlighted below:

Nature of Agreement - Concession agreement for Development, Construction, Operation and Maintenance of Bangalore International Airport between Ministry of Civil Aviation - Government of India and Bangalore International Airport Limited

Concession

Gol grants BIAL the exclusive right and privilege to carry out the development, design, financing, construction, commissioning, maintenance, operation and management of the Airport (excluding the right to carry out the Reserved Activities and to provide communication and navigation surveillance / air traffic management services which are required to be provided by AAI)

•**Scope of the Project:** Development and Construction of the Airport on the site in accordance with the provisions of the agreement, Operation and maintenance of the airport and performance of the Airport Activities and Non-Airport Activities in accordance with the provisions of the agreement, performance and fulfilment of all obligations of BIAL in accordance with the provisions of the agreement

• **Fee:** BIAL shall, in consideration for the grant by Gol of the Concession pursuant to Article 3.1, pay to Gol a fee amounting to four per cent (4%) of Gross Revenue annually on the terms specified.

•**Charges:** The Airport Charges specified in Schedule 6 (Regulated Charges) shall be consistent with ICAO (International Civil Aviation Organization) Policies. The Regulated charges set out in Schedule 6 shall be indicative charges. Prior to Airport Opening BIAL shall seek approval from the Ministry of Civil Aviation for the Regulated Charges, which shall be based on the final audited project cost. From the date the Independent Regulatory Authority (IRA) has the power to approve the Regulated Charges, BIAL shall be required to obtain approval thereof from the IRA.

•**Term:**30 years

The shareholding pattern of Bangalore International Airport Limited as of 31 March 2018 is as under:

Fairfax India	-	48%
Siemens	-	26%
Airports Authority of India	-	13%
Government of Karnataka	-	13%

1.2. Scope of Services

Expansion of the airport terminal building including expansion of Airside Apron, West New VVIP Block, New Energy Center, Expansion of chiller plant and utilities, Kerbside improvement on airside and landside and Terminal Forecourt improvement at Bangalore International Airport was proposed by BIAL to be undertaken during the First Control period. The project consists of Civil, Electrical, Equipment, Air-Conditioning etc. BIAL has submitted their capital cost proposal amounting to Rs. 1479 Crores to AERA for the control period (01/04/2011 to 31/03/2016). Rites has been appointed for post facto examination of the same.

The scope of services assigned to RITES include

- To assess the need for and reasonableness of expenditure incurred and specification adopted for terminal-1 expansion and other related work at Kempegowda International Airport, Bengaluru.
- To assist AERA in case any litigation arises in future in connection with the reasonableness of the cost estimates
- To perform any other duties as may be deemed necessary and specified in the award letter

1.3. The Study Team

The following team has been formed by RITES to undertake the assignment:

Table 1 RITES team for the assignment

SN	Name	Designation
1.	Mr.Pawan Chowdhry	Group General Manager/Airports
2.	Mr.N.Ganesh Babu	Jt.General Manager/Airports
3.	Mr.Vivek Kumar	Assistant Manager/Airports
4.	Mr.Saurabh Pareek	Assistant Manager/Airports

1.4. Data Collection

The following data has been collected and studied:

- Bengaluru International Airport Terminal 1 Expansion Program Brief (2011) submitted by Bangalore International Airport Limited
- Bengaluru International Airport Terminal 1 Expansion works Preliminary Cost Estimate, Jan 2011
- Clarifications provided BIAL in response to queries by AERA

1.5. Report

Based on the study of data provided by AERA, this draft report is prepared and submitted to AERA.

This report sets out the findings by RITES of the need for expansion of existing infrastructure and capital cost thereof at Bangalore International Airport fait accompli on behalf of AERA.

The remainder of this report is structured as follows. Section Two describes briefly the proposal submitted by BIAL; Section Three analysis of the Air Traffic; Section Four the governing parameters; Section Five the Evaluation of the proposal and Section Six the Findings.

2. PROPOSAL BY BIAL

2.1. Expansion Proposal

The submission made by BIAL has been forwarded to RITES by AERA. The major components of the proposed capital expenses included the following:

- Passenger Terminal Building Expansion and Modifications
- Airside Apron Expansion
- West New VVIP block
- New energy centre
- Expansion of chiller plant and utilities
- Kerbside improvements on airside and landside
- Terminal forecourt improvements

2.1.1. Terminal Expansion

The area of Passenger Terminal Building prior to expansion was approximately 73,437sqm. Against the originally forecasted growth of approximately 10 mppa by the year 2010, the traffic had already reached approximately 11 mppa by the same period. Therefore, an expansion of the facility was planned to be completed in tandem to improvements in the existing facility to enhance and balance various functions.

The expanded terminal building was initially designed for 2014/15 passenger levels, forecast to reach approximately 17.2 mppa which was further enhanced to cater 20 Mppa. The total floor area was planned to increase to approximately 150,556 sqm. The actual area post expansion works was 1,58,500 sqm.

2.1.2. Airside Apron Expansion

To match the increase in terminal capacity, it was proposed to expand the existing terminal apron. The East pier extension was proposed for increasing the number of more efficient contact positions. Consequently, existing Ground Service Equipment (GSE) areas would be affected and thus relocated. Previously the GSE areas were located on either side of the terminal and new areas needed to be built to accommodate GSE equipment and parking.

It was proposed to expand the apron to the east where an additional pier is proposed in the Terminal building expansion enable to accommodate an additional 7 Code C or 3 Code E and 1 Code F aircrafts.

2.1.3. West VVIP Block

Previously, the existing VVIP complex on eastern side of the terminal building was within the footprint of the proposed terminal expansion. Therefore, the previous facility was demolished, and the new facility was proposed with total area of 850 sqm.

2.1.4. New Energy Centre and Other Utilities

To cater to the increased power demand, a new energy centre was proposed. The new energy centre was to provide additional service to the T1 and associated facilities. The proposed facility is 1,600 sqm.

2.1.5. Kerbside and Forecourt Improvements

Due to the expansion of the terminal building and enhancement of facilities for passengers improvements in the landside of the terminal, the access road on the land side and the bus routes on the airside were proposed due to change in traffic pattern and increased vehicular traffic anticipated with the airport's growth.

Airside kerb modifications include additional roadways, parking for busses and additional airside support vehicle traffic.

2.2. Capital Cost Proposal

As per the initial proposal submitted by BIAL, the total capital cost for expansion of the airport during the first control period was estimated by BIAL at Rs. 1479 Crores inclusive of terminal design and enabling works, contingency, pre-operative expenditure & Financing costs as per the break up given below in Table-1.

Table 2 Proposed Total Capital cost for expansion

Sr. No	Items	Estimated Cost (in Cr)
	Terminal Expansion	
1	Terminal	798
2	Canopy	104
3	Airside / Apron works	42
	Sub Total	945
4	Employers Supplied Equipment	115
5	Non EPC works in Terminal include (Furniture, Art work, Internal Landscaping etc.,) excluded in EPC scope	40
	Sub Total	1,100
6	Terminal Design (Up to DD and PMC) and Enabling works such as Utilities works Relocation/ GSE/ VIP Terminal Internal/ Terminal modification and Enabling works not covered under EPC Scope (Not Part of EPC)	110
7	Landscaping	25
8	Contingency	60
9	External Service / Consultancy - For Master Plan	25
	Pre-operative Expenditure & Financing costs	
10	Personnel cost, office cost & other administrative costs	33
11	Interest and funding cost	126
	Grand total	1,479

The distribution of the base cost is depicted as shown in the Figure-1 below and the contribution of various infrastructures to the total cost has been noted as given below:

Passenger Terminal	-	54%
Canopy	-	7%
Airside/Apron works	-	3%
Employers supplied equipment	-	8%
Non-EPC works	-	3%
Terminal design (DD and PMC and enabling works	-	7%
Landscaping	-	2%
Contingency	-	4%
External service/Consultancy – For Master Plan	-	2%
Personal cost, office cost & admn. Costs	-	2%
Interest and funding cost	-	9%

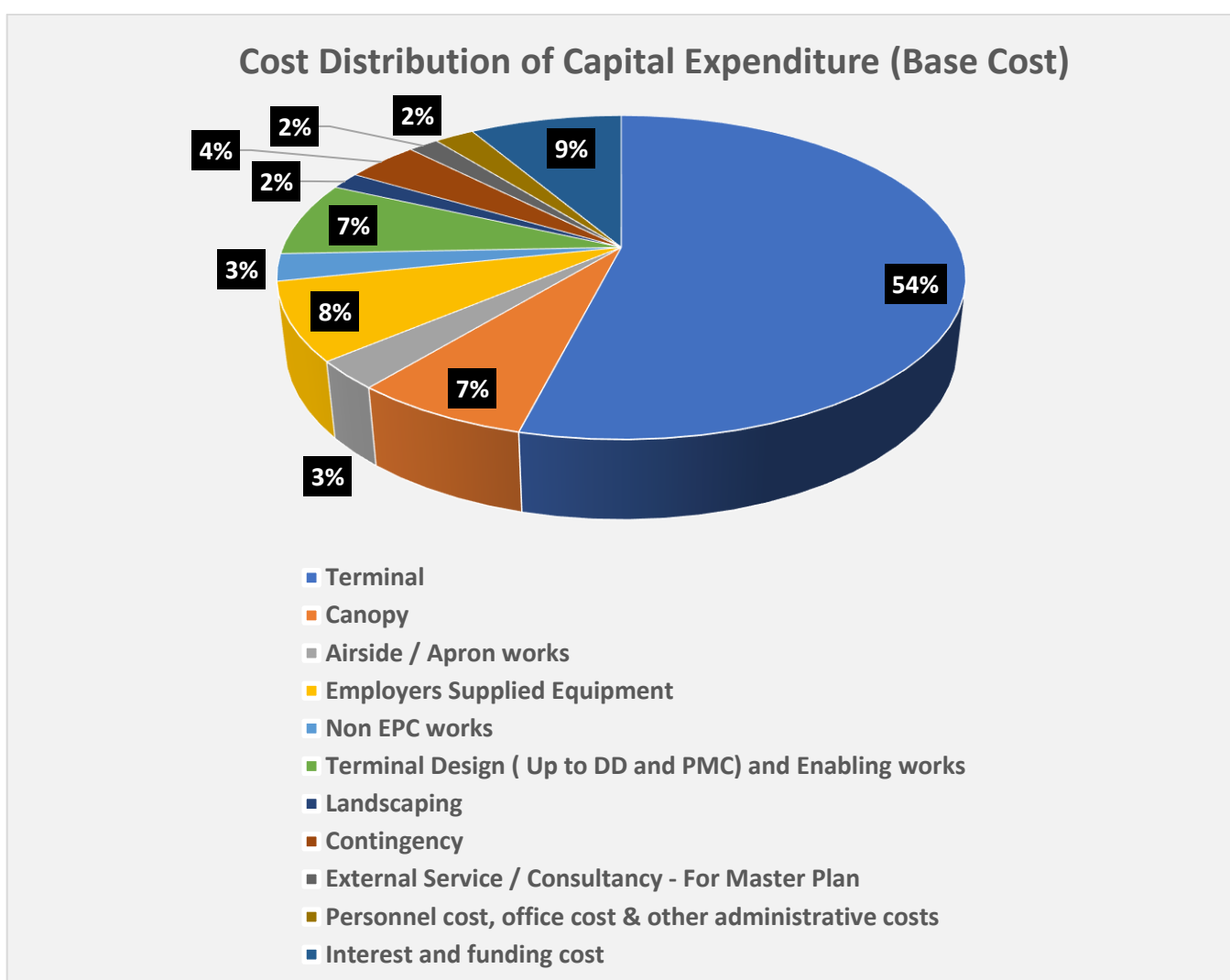


Figure 1 Cost distribution of Capital Expenditure (Base Cost)

3. TRAFFIC REVIEW

3.1. Traffic Projections

The passenger traffic forecast update was undertaken by BIAL through the consultants.

- The passenger traffic at KIA in 2009-10 was 10.1 MPPA, with projected traffic of 17.6 MPPA by the end of 2015-16
- The existing runway is designed for Code E aircraft with 4000 m in length and 45 m width. The runway is connected by a full length parallel taxiway complying with Code E, along with three Rapid Exit Taxiways and one perpendicular link taxiway.
- Existing passenger Terminal 1 was commenced in the year 2008 with a capacity of 11.40 MPPA,
- Airport T1, previously had total built up area of 73,437sqm.
- The objective of proposed KIAB airport development has been to enhance the terminal capacity to 20 million annual passengers.

3.2. Air Traffic Forecast by Landrum & Brown

BIAL entrusted M/s Landrum & Brown to develop Air Traffic Forecast in the year 2010.

Passengers

The plot of passenger forecast as given in 2010 report is as shown in the figure given below.

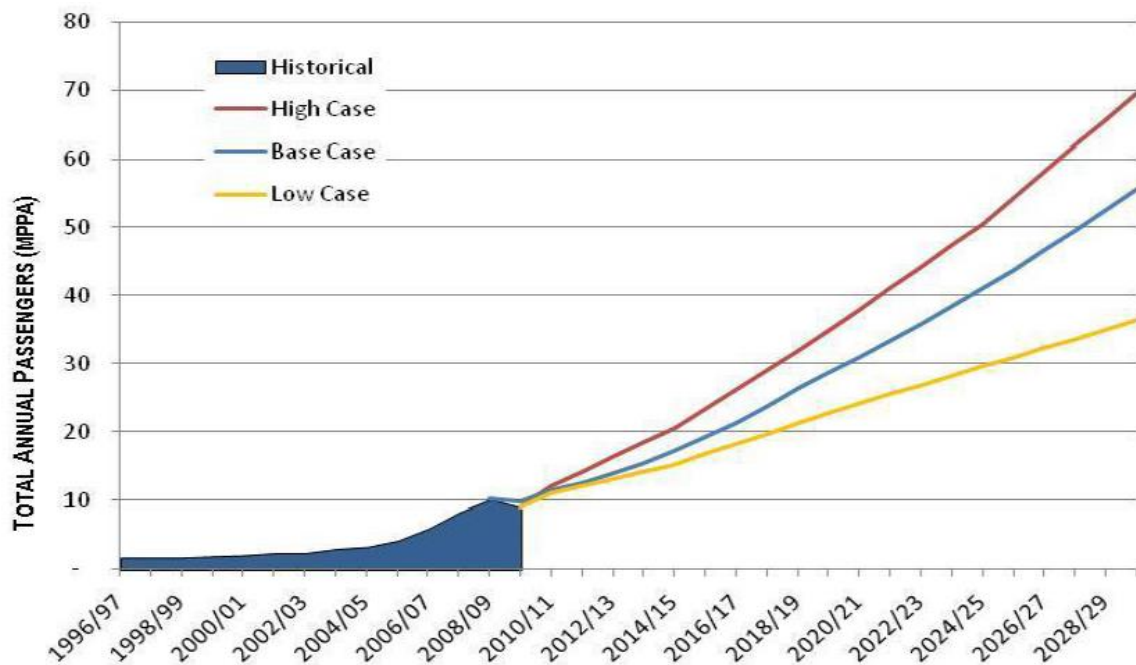


Figure 1 Passenger traffic Projections

- In the year ending March 2010, the actual traffic handled by Bangalore International Airport stood at 10.1 million. As per the forecast it could be inferred that the total passenger traffic at BIAL would surpass the design capacity and the total traffic will reach somewhere in between 17 to 20 MPPA by the end of the control period.
- The traffic forecast was revised in 2013 by Landrum Brown and the comparison for the forecasted traffic for the end of 2016-17 is reproduced below:

Table 2 Comparison of Forecast versus Actual passenger

Passenger Traffic handled 2016-17	Forecast as per 2010 report (for 2016-17)	Forecast as per 2013 report (for 2016-17)
Domestic pax	16,804,900	14,313,400
International Pax	4,507,900	3,631,200
Total	21,312,800	17,944,600

- It can be seen that in both the cases the projected traffic indicates that there has been a definite need for expansion of the terminal facility as the saturation capacity of the existing terminal was already surpassed. Hence the need for expansion of the terminal building to handle 20 MPPA can be considered justified.

4. GOVERNING PARAMETERS

4.1. Report of the Inter-Ministerial Group (IMG) on Norms & Standards for Capacity of Airport Terminals (2009)

IMG has deliberated in detail on various key issues and made following recommendations:

A Growth Rate for Traffic Projections

Keeping in view the trend in air traffic in last few years, a span of five years be adopted for the projects planned during the current five-year plan period, i.e., up to 2011-12. Thereafter, as the growth rate stabilizes, the span for making projections should be increased to 7 years for a more realistic assessment.

B Target year for Capacity Creation (Design Year)

Following norms could be adopted for capacity creation:

- Smaller airports (< 5.0 mppa) – 10th year from Planning year.
- Bigger airports (> 5.0 mppa) – 7th year from Planning year.

C Peak Hour Projections

Methodology given in ICAO Manual on Air Traffic Forecasting by finding ratios from historical data and recent studies be adopted. As per ICAO Manual, forecasts of peak period passengers are to be obtained from annual forecasts by applying ratios of busy period traffic to annual traffic derived from actual data at various airports.

Actual data for the past five years should be analyzed to determine the Peak Hour Traffic and the trend growth thereof. Projections for the Design Year should be made based on the trend growth in the past. AAI should make arrangements for data collection of Peak Hour Traffic in respect of all non-metro Airports, so that same is available at the time of planning expansion of these Airports.

In absence of actual data, the Peak Hour Traffic may be estimated based on ratios given in Table-5 below.

Table 3 Ratio based Peak Hour Traffic for estimation

SL. No	Traffic (in mppa)	Ratio for International Terminal	Ratios for Domestic Terminal
		PH/PD	PH/PD
1	1.0 - 5.0	0.30000	0.250000
2	0.5 – 1.0	0.3500	0.3500
3	Less than 0.5	0.4500	0.4500

In the event that requisite data is not available for airports with traffic above 5 million passengers per annum, the above ratio-based norms may be considered in the interim.

D Level of Services in Target Year

Level of Services 'C' as per IATA Airport Development Reference Manual (Jan 2004) denotes good service at a reasonable cost. Therefore, this level could be used for design for target demand in the design year. The unit area specified in paragraph E below represents Level of Service 'C'. Net impact of this norm would be that in the initial years, the passengers may experience LOS 'A' or 'B' and as the traffic increases LOS 'C' would be achieved.

E Unit Area Norms

Overall space/area norm should be such as to provide a reasonable level of service for all components required in a Terminal Building. Commercial or Retail area providing amenities like food & beverages, book shops, counters for car rental, vending machines, public rest rooms etc., normally require 8-12 percent of the overall area, and should be planned and provided accordingly. In bigger airports, i.e., with annual passenger traffic exceeding 10 million, commercial area could be up to 20 per cent of overall area. Keeping in view the IATA norms and discussion above, the norms as given in Table- 6, are considered appropriate for Indian Airports.

Table 4 Area Norms for type of airports

SL. No	Nature of Terminal	Area Norm – Sqm/php
1	Domestic Terminals	
	a) Traffic up to 100 php	12
	b) Traffic between 100 -150 php	15
	c) Traffic between 150 – 1000 php	18
	d) Traffic above 1000 php	20
2	Integrated terminal for handling both domestic and international	25
3	International Terminals	27.5

F Unit Cost of Construction

IMG recommended that the Appraisal Committee should specify the ceiling unit cost and the architects/engineers of AAI should plan and implement the project within the ceiling, subject to revision on account of increase in WPI.

G Airports developed through Public Private Partnerships

In the case of airports developed through Public Private Partnerships, the project authorities may adopt a case by case approach with respect to norms relating to unit area and unit costs. Based on the judicious consideration of international best practices and financial viability, the norms may be specified in each case prior to inviting bids for private participation.

5. EVALUATION OF THE PROPOSAL

5.1. Capacity Constraints

As per the traffic projections, the airport was anticipated to handle at least 18 million passengers per annum by the end of 2016-17. The existing facilities were just adequate to handle the projected traffic up to the year 2011. To cater to the future requirement for the next 5 years i.e. 2016, expansion of the existing terminal as proposed by BIAL was a necessity. As per IMG norms, the target year for capacity creation in the case of bigger airports (>5 mppa) could be 7th year from Planning year.

The design Capacity for the expanded terminal was set as 20 MPPA and the total area proposed for expansion at 83,272 sqm, was increased to 87,483 sqm to accommodate the air handling units of the expanded portion.

As per the ratio recommended for working out the Peak hour passengers as per the IMG norms, the Peak hour traffic comes out to be 6000 pax as against the peak hour projections of 6540 made by BIAL based on the traffic forecast. The total area thus required works to approximately 163,500 @ 25 sqm/php for integrated terminal building.

Table 5 Peak hour passengers for Domestic, International/enplaned and deplaned

Peak Hour Passengers	Target combined Demand (MPPA)	Target segregated Demand (MPPA)
Combined Departures	3150	
Int. departures	600	1305
Dom Departures	2550	2906
Combined Arrivals	3390	
Int. Arrivals	683	1149
Dom Arrivals	2708	2708
Total PHP	6540	

The individual peaks viz. domestic departure, arrival and international departure and arrival have been used to work out the process Area by BIAL.

The overall Terminal area as per the IMG Norms with 6540 PHP works out to be 163,500. Thus, the total area proposed by the BIAL falls well within the design standards recommended by the IMG report.

In terms of IMG norms, the area proposed by BIAL is within the IMG norms of 25 sqm/php for integrated terminal and hence the area proposed is considered justified. Due to expansion of the terminal building to cater 20 MPPA, augmentation of kerbside capacities as proposed by BIAL has also become essential. The specifications of finishes adopted for the expansion of the terminal building has been matching with the existing Terminal Building and hence considered to be in order.

5.1.1. Expansion of Apron

To match the increase in terminal capacity, it was proposed by BIAL to expand the existing terminal apron.

The existing apron facility had the total area of 5,48,880 sqm with the total number of 66 Code C stands. The proposed extension of the East Apron would have increased the total Apron area by 33,000 sqm and the total no of Code C stand by 2 making the total stands as 68. Under the proposed expansion the apron would be extended to the east to accommodate an additional 7 Code C or 3 Code E and 1 Code F positions in a Multi Aircraft Range Stand (MARS) configuration

However, the total area added under the expansion plan was 38,240 sqm, including the apron taxi lane area.

Keeping in view of the extension of terminal building and provision of additional contact stands, the need for expansion of the apron as proposed by BIAL is considered justified.

5.2. The Capital Cost Proposal

5.2.1. Estimated Cost

It has been observed that BIAL appointed a consultant to prepare the initial estimate for the expansion works. The consultants submitted an estimate of Rs. 1046.42 Crores in Jan 2011 which included the terminal works, canopy works and airside expansion and General & Preliminary items but excluded PMC and contingencies.

BIAL revised the cost estimates to Rs. 1,479 Crores vide the program brief submitted to AERA. BIAL indicated that BIAL awarded the works to Larsen & Toubro through an EPC contract following a tender process for a contract amount of Rs. 945 Crores. BIAL further added the following costs to the revised estimate which were not covered in the EPC contract.

SN	Description of item	Rs. Cr
1	Employers supplied equipment	115
2	Non-EPC works in Terminal (excluded in EPC scope)	40
3	Terminal Design (upto Detailed design and PMC) and Enabling works	110
4	Landscaping	25
5	Contingency	60
6	External Service/Consultancy for Master Plan	25
7	Personnel cost, office cost & other administrative costs	33
	Interest and funding cost	126
	Total	534

Thus, the revised estimated cost worked out to Rs. 1,479 Cr.

The capital cost proposal has been prepared by BIAL by adopting the following methodology:

Building, Canopy and Airside works

- Based on cost of EPC contract awarded to Larsen & Toubro.

Design Engineering & PMC Fees

- Design Engineering fee and Project Management fee of Rs.110 Cr. @approx.10% has been considered by BIAL on the cost of works (i.e.Rs. 945+115+40 = 1100 Cr)

Contingency

- Contingencies amounting to Rs.60 Cr (@ approx.6%) has been included in the Cost Estimate.

Pre-Operative Expenditure & Financing Costs

- Pre-operative costs of Rs.33 Cr and interest and funding cost of Rs. 126 Cr (@11.5%) has been considered in the Cost estimate.

Although, the cost catered towards detailed engineering & PMC, contingencies, pre-operative expenditure appear to be on the higher side, however, as the works have since been completed, the actual expenditure incurred on various sub-heads duly audited needs to be relied upon fait accompli.

5.2.2. Actual Cost of Construction

BIAL vide email dated 16th July has submitted the actual cost incurred versus the estimate as given under:

Sl No	DESCRIPTION	APPROVED COST (Rs. In Crores)	REVISED BUDGET (Rs. In Crores)	EPC	BIAL Softcost	Others	Post T1A Additions	Total	Variance
A	Terminal Building (expansion)	1,055.50	1,105.50	977.14	49.76	-	38.73	1,065.63	10.13
B	Enabling & terminal modifications	32.00	26.70	11.04	0.41	-	-	11.45	-20.55
C	External roof works	128.10	129.70	115.96	1.11	-	-	117.06	-11.04
D	Airside projects	42.00	48.25	42.88	2.83	-	-	45.71	3.71
E	Landside and landscape projects	25.00	16.90	25.65	4.86	-	-	30.51	5.51
F	New VVIP terminal	12.00	14.80	14.08	1.49	-	-	15.57	3.57
G	Master plan Projects	25.00	13.00	-	4.17	10.66	-	14.83	-10.17
H	IEDC & Administrative costs	159.40	192.50	-	-	202.16	-	202.16	42.76
	TOTAL Projects Cost	1,479.00	1,547.35	1,186.75	64.62	212.82	38.73	1,502.92	23.92

Overall Cost Increase w.r.t. Original Cost	1.6%
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The reasons for the deviation in the cost submitted by BIAL is at Annex-1.

It can be observed from the above that

- the cost of EPC works including terminal building expansion, enabling & modification works, external roof work, airside works, landscaping, VVIP terminal has remained at 1186.75 Cr. + 38.73 Cr = Rs.1225.48 Cr. The Cost of the expansion of terminal building works (Rs.977.14 Cr.+Rs.38.73 Cr.) worked out to apprx. 1,19,425 per sqm. (Rs.1015.87 Crores/85,063(158500-73437) sqm. which is comparable with the cost of Rs. 1,10,962/Sqm incurred by AAI for terminal building works at Kolkata.
- the external roof is peculiar structure covering huge spans with steel structure. The actual cost of Rs.115.96 crores incurred on construction of external roof works through EPC as against the initial estimated cost of Rs.131.02 Cr. and is considered reasonable.
- Although VVIP terminal costing Rs.15.57 crores appeared to be high in comparison with the cost per sqm of terminal building works, however, on scrutiny it has been observed that this is owing to provision of superior finishes and fittings, interior designs and artifacts being a ceremonial lounge to be used by high profile dignitaries. The higher cost is also due to integration of various functions of security, immigration & customs etc. at the building. The total cost is also inclusive of area development, landscaping and road pavements. The cost of the VVIP terminal is therefore can be considered reasonable.
- An amount of Rs. 10.66 Crores have been spent on Master Plan.
- The remaining cost of Rs. 266.78 crores is towards BIAL soft cost and Interest Expenditure During Construction (IEDC) & Administrative costs. Admissibility on this aspect may be looked into by AERA. The cost on this account has considerably increased (by 42.76Cr, 26.8%) probably due to delay in implementation of the project from 18 months to 30 months. Projects of this nature generally require 24 - 30 months for completion particularly when it is intended to be executed through EPC contract and the work is to be executed in operational airport environment. The delay, as brought out, is on account of technical challenges faced during the construction including additional field investigations, review of designs, additions, modifications etc. as given at Annexure – I.

6. FINDINGS

6.1 Findings

The findings of the exercise with reference to scope are summarized as under:

- a) *To assess the need for and reasonableness of expenditure incurred, and specification adopted for terminal-1 expansion and other related work*

The proposal for expansion of the Terminal building, Canopy and airside works as submitted by BIAL is justified in view of the growth in traffic witnessed at Bangalore airport as discussed in Chapter 3. The specifications of finishes adopted for expansion of the terminal building has been to match with the existing Terminal Building and hence considered to be in order. Since the costs submitted by BIAL are based on actual expenditure incurred, these may be admitted on production of certification of the completion cost by statutory auditors being fait accompli.

The cost incurred on expansion of the terminal building works is comparable with the cost of similar works undertaken at other airports in the country. The admissibility of the costs incurred by BIAL on soft costs and interest expenditure during construction may be reviewed by AERA.

TERMINAL 1 EXPANSION - BRIEF JUSTIFICATION FOR AERA (SUBMITTED BY BIAL)

Annexure - I

The original construction duration of the expansion project was 18 months, however based on the technical challenges faced during the execution of the project, the final completion duration for the project was 30 months.

1. Upon award of the EPC Contract, geotechnical studies were further carried out, during these investigation rocky strata was encountered, prior to the tendering of the contract based on the investigation done only soil condition were anticipated. Rock strata was encountered, rock breaking and excavation had to be carried out by mechanized operations as blasting was not allowed in the operational environment. Hence sub structure construction duration was significantly impacted due to the rock being encountered.
2. Foundation system of the east side was redesigned to suit the existing foundation, this led to major changes in the structural model for the east side, as a result of this more time was needed to check and approve the structural model. This led to delay in finalization of foundations on the east side.
3. The basement size was increased based on detail design to meet the MEP requirements, this increase in the basement size resulted in more work volume. The complete dismantling of the then existing huge fan rooms and construction of new fan rooms were impacted due to change in basement plan.
4. When single line diagram of MEP services were converted to 3D, clashes were detected in services and also additional space was required in basement to accommodate the MEP services, this led to redesign of basement to accommodate the MEP services and redesign of service and finger tunnels.
5. The interior designer appointed by EPC could not take forward the vision and the intent. Major short comings were noticed in detailing of drawings. Hence midway of the project, the consultant had to be terminated, this result in extended duration for interior design. This affected the completion time lines.
6. Additional Bus couplers were added by BIAL to enhance the regular maintenance of the panels.

7. Once the new interior designer was on board and the design was not in line with BIAL intent, further refinement of the interior design was carried out.
8. Peer reviews were carried out to ascertain the structural stability.
9. Additional cameras requirement for security led to increase in scope of work.
10. Additional works like baby care room facility, feature wall landscaping at the landside, concessionaire area screed works, epoxy painting work in East PTB basement, East pier corridor and AHU rooms were carried out.
11. Relocation of lift inside existing terminal was carried out which included dismantling existing staircase, service shaft and construction of new lift structure.
12. Installation and Integration of green data center work with existing data center in the terminal.
13. Modification of HVAC works at lounges, modification to carry out additional HVAC load from east pier and IT rooms in west.
14. It was required to undertake modification in certain specified areas within the existing terminal, it was also required to undertake development in following areas between grid 9-19 at level 0 and level 1 to integrate the new and expanded terminal with modification works.
15. Additional steel was required to support the skylight well cladding and led to increase in scope of work.
16. Additional design review by IOSTL for fuel hydrant system.
17. Extension and strengthening of perimeter road, wall and fencing as per design.
18. Specialized consultant effort was required for airside for vetting of design.
19. Art work in VVIP building, modifications of skylight, retaining wall modification due to deep excavation on the east side.
20. Enhancement of Interior works of VVIP building to match the high aesthetic look.
21. Access road beautification near VVIP building and at landside area of the terminal.
22. Considering the project of this nature, complexity in operational airport environment, considerable efforts were put into reducing cost. Overall cost increase is 1.6%.
23. Management had approached the BIAL board with increased cost approval, BIAL board has concurred and approved the cost escalation in the project.
24. Further the costs have been approved by Lenders engineers from Banks and the statutory auditors of BIAL.