



DETAILED FEASIBILITY REPORT ON CONSTRUCTION MATERIALS

Part 1

For
DEPARTMENT OF INDUSTRIES
MINISTRY OF ECONOMIC AFFAIRS
ROYAL GOVERNMENT OF BHUTAN

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Executive Summary



EXECUTIVE SUMMARY

Part I - Review of the construction materials scenario and identification of potential projects

1. Bhutan is passing through fast growing phase of development. Starting in early 1960, Bhutan embarked on planned economic development through successive five-year plans. Over the years, ever-increasing generation of electricity by installation of new hydropower projects has facilitated the establishment of new industries within the broad framework of sustainable and environmental friendly development. As power, transport and other infrastructure are the basic requirements for economic growth, the development of infrastructure has also been in the focus of developmental programmes. Over the years a number of power projects, roads, bridges, hospitals, schools and commercial and residential buildings have been built. This has resulted in a rapidly growing construction industry.
2. The main sectors of the emphasis in the development of infrastructure have been hydro-electric power, roads and bridges, urban infrastructure & buildings and this has given a boost to the construction industry resulting in higher demands of construction materials. The establishment of new power projects will involve a large number of construction activities including buildings at the project site and consequently huge quantity of building construction materials would be required. Further, with the planned hydropower projects for the 10th plan, many of which lie in the interior parts of the country, the present width and capacity of highways, roads and bridges could prove a bottleneck for effective transportation of large hydro plants and equipments and construction materials to the sites of these hydropower projects. The facilitation of accelerated development of hydropower will therefore require new roads to the constructed and existing highways and roads to be resurfaced, realigned and widened.
3. A large hydroelectric power project with capacity of 1100 MW in the first phase and 1000 MW in the second phase in being setup at Lobeyisa in Wangdue. The work on the project has already started. There is a provision for constructing a residential colony with around 700 residential units for the project personnel. A general hospital, building for office complex and a club building is also planned to be constructed. Besides there would be lot of construction activities in private sector due to setting up of the hydroelectric power project. Besides cement and steel there would be a large demand for stone aggregates, stone dust and cement products.
4. With the acceleration in the process of urbanization, and consequently, the rapid growth in urban population, the urban infrastructure and public amenities need to be strengthened to address the emerging urban requirement. There are urban plans for setting up 31 towns of which implementation plans of 17 are in various



stages of finalization. Similarly, there are ambitious targets for strengthening road and bridges sector. This scenario will result in providing a boost to construction industry.

5. It is estimated that the construction sector accounts for nearly 25 per cent contribution to Bhutan GDP. The fact remains that in a developing economy like Bhutan, the construction becomes the major activity in various spheres of developments be it power, road, urban infrastructure and housing, education health, communication, etc. The construction industry covers a wide range of sectors of economy, the most important in the context of Bhutan being hydroelectric power generation and distribution, roads and bridges, urban infrastructure development, housing, government and private building complexes, expansion of health and education facilities viz. construction of hospitals and schools. With such a base of the construction industry sector, it is desirable to have assessment of the current and future scenario of development of the construction intensive sector of the economy in order to visualize the emerging scenario of construction industry in Bhutan and resultant demand of construction materials.
6. With a view to cut down the cost of raw materials in construction industries and also to accelerate the pace of industrialization in Bhutan, the government is keen to promote industrial units for manufacture of construction materials. Setting up of such industries would help in easy availability of construction materials at economic prices, generation of employment opportunities, optimum use of natural and human resources and above all accelerating the pace of industrialization in the country.
7. In view of the above, it has been decided to undertake detailed feasibility studies of the construction materials with a view to identify the viable projects in this field and to develop detailed information on the identified project. The concept is that such detailed information would be made available to entrepreneurs to help them in taking investment decision. Accordingly, the project on detailed feasibility studies in the field of construction materials has been assigned to IDRG consultancy services. The objective of the project is to identify viable projects in the field of construction materials and carry out detailed feasibility analysis of the identified project.
8. The requirement and type of construction materials depends on the type of construction project e.g. in power projects, cement, steel and stone aggregates constitute the major requirement, in road construction project, bitumen and stone aggregates happen to be major requirements, while the construction of buildings require a wide range of other materials besides cement, steel, stone aggregates and bricks. The construction materials encompass a wide range of materials and products, viz. steel in different forms, cement and cement products, wooden items, metal hard wares and other products, plastic pipes and other chemical products. In the context of this study, it appears to be more logical to classify the



building materials based on their raw material of manufacture or their utilization in the construction industry.

9. Keeping in view, the estimates of the demand level for various items of construction materials, analysis of market scenario, 14 different products were identified having potential for production in Bhutan. Further, based on various parameters viz estimated current demand level, potential for growth in demand, existing manufacturing facilities in Bhutan, availability of raw materials, technology and machines, possibilities of adaptation of manufacturing technology, advantages of other factor inputs, two viable projects for detailed feasibility studies were selected. These included cement based products and roto moulded plastic containers and other products. These feasibility studies are given in part II and III of the report.
10. Though there is a boom in the construction industry in Bhutan, keeping in view the size of population, the demand for individual items would not be sufficient for setting up an economically viable unit. In the circumstances, the best option would be to study the feasibility for a group of products involving similar technology in order to set up viable indigenous production units. Based on this consideration, the feasibility studies for various cement based products and a range of roto moulded plastic products has been included in the study.
11. A cluster approach for developing similar product based units has also been recommended for accelerating the pace of industrialization in Bhutan. Cluster for production of cement based products, gypsum based products, steel and aluminium products, plastic products cluster, could be the possible examples. In these clusters products and operations could be divided among the units along with a provision for capital intensive common facility services. This would help in bringing down the production cost, improve quality and also help in better access to the market. The cluster approach would also enable to develop cost effective pollution control mechanism through setting up of common effluent treatment plants (CETP's) wherever needed. It is important to mention that world over, specially in case of SMEs, cluster approach is considered to be the most effective for promoting industrialization and this need to be kept in view while developing industrial units in Bhutan also.



Part II – Detailed Feasibility Analysis on Cement based products

1. The objective of the project is to carry out the Detailed Feasibility Analysis on **cement based products**. The project envisages the manufacture of various types of cement based products viz cement concrete bricks, solid blocks, hollow blocks, paver blocks, cement concrete tiles and mosaic flooring tiles.

2. Location of the proposed unit should preferably be in the vicinity of the major sites of construction as well as sources of raw materials. Thimphu, Phuentsholing, Punakha, Wangdue, Gelephu, Samdrup and Paro happen to be the main towns and would constitute the major sites of construction. Besides, Wangdue being the site of biggest ongoing power projects has also tremendous potential for construction activities. In past also, a cement brick unit was setup near to the site of Taala power project. The units for the manufacture of main raw materials viz stone aggregates and sand also need to be promoted near the proposed project. Cement, in any case, has to be transported from the cement factories. Keeping in view, the various parameters, these sites have been short listed in the order of preference. Based on the analysis of various parameters, it is recommended that to begin with a project be setup at Wangdue. Similar projects, however, need to be setup near to major cities viz Thimphu, Phuentsholing, Gelephu, Paro and Samdrup which would constitute the major construction sites.

3. Cement based products proposed to be manufactured by the unit are the basic building blocks of any construction project and on an average, they account for nearly 10% of the estimated cost of the building. The cost of transport of raw materials and finished goods has to be kept at minimum level so as to make the products competitive. Normally, the construction projects whether big or small, prefer to buy these products from nearest sources and therefore, vicinity to major sites of construction would be an important parameter for healthy functioning of the unit. As the cost of red bricks is very high in Bhutan due to heavy transport cost, there exists a good market for cement bricks. There is already one unit manufacturing such products in Thimphu and the proposed unit in Punakha, near Wangdue Power Project site has bright prospects of success owing to future growth in the construction activities in an around Punakha and Wangdue.

4. The Annual Production Capacity recommended is as follows: -

Solid blocks	-	2,00,000 nos
Hollow blocks	-	2,00,000 nos
Paver blocks	-	6,00,000 nos
Grey mosaic tiles	-	6,00,000 nos
Colored tiles	-	2,00,000 nos



5. The Land and Building Requirement is as follows: -

Plot up area – 6000 sq. mts
Built up area – 208 sq mts
Industrial shed – 900 sq. mts

6. The Power requirement for the project is around 45 KWH.

7. The Main machinery for the project is given below: -

Hydraulic system
Mould vibrator
Ram vibrator
Pallet feeder
Mix feeder
Mix feeder bin
Cavity block ram & mould
Pallet stacker
Pan mixer
Water dosing pump
Wheel barrows
Skip loader
Color mixer

8. The Man power requirement for the project is as below: -

Manager	– 1 no
Plant supervisor	– 2 nos
Office staff	– 2 nos
Laboratory technician and assistant	– 2 nos
Machine operators	– 4 nos
Unskilled workers	– 15 nos

9. The Total cost of the project is Rs. 127.46 lacs.

10. The time period of Project Implementation is around 11-12 months.

11. The details of Means of Finance is furnished below: -

Debt -	89.22 lacs (70%)
Equity -	38.24 lacs (30%)



12. The Break up of cost of project is as below; -

Machinery	-	44.68 lacs
Construction Cost	-	45.13 lacs
Misc. Fixed Assets	-	3.00 lacs
Pre-operative exp.	-	5.00 lacs
Training Expenses	-	0.45 lacs
Interest	-	11.79 lacs
Working Capital	-	17.41 lacs
Total	-	127.46 lacs

13. The annual Sales turnover is around Rs. 250 lacs.

14. The details of Financial Analysis for the project is furnished below: -

IRR – 27% on equity
IRR – 18% on investment
NPV – 42.28 lacs (12% discount rate)
Pay back period – 4 Years 6 months
Project Break-Even – 66%



Part III – Detailed Feasibility Analysis on roto-moulded plastic containers and other products.

1. The objective of the project is to carry out the Detailed Feasibility Analysis on **roto-moulded plastic containers and other products**. The project envisages the manufacture of overhead water storage tanks and various other containers in plastics by roto moulding process.

2. Overhead water storage tanks are required for all new buildings as well as for replacement in the old buildings. The plastic tanks have a variety of applications like septic tanks, storage bins, drum and barrels, etc. Location of the proposed unit should preferably in the vicinity of the major sites of construction as well as sources of raw materials. Thimphu, Phuentsholing, Punakha, Wangdue, Gelephu, Samdrup and Paro happen to be the main towns and would constitute the major sites of construction and consequently would constitute a major market for plastic tanks. Besides, Wangdue being the site of biggest ongoing power projects has also tremendous potential for construction activities. In Wangdue power project, there is a provision for construction of a residential colony, a general hospital, building for office complex and a club building. Besides, there would be lot of construction activities in the private sector due to setting up of the hydro electric power project. The per unit cost of the transport of overhead water tanks and containers is quite high in view of the high weight to volume ratio. It would therefore be desirable if the proposed unit is setup at a location central to major towns. Keeping in view, the various parameters, these sites have been short listed in the order of preference and it is observed that Punakha would be the most preferred location for the project followed by Thimphu. It is further recommended that the unit be setup at Punakha as a part of the cluster for units for the manufacture of construction materials.

3. Based on the detailed study on the construction sector, the water storage tanks are widely used in the buildings due to their light weight, ease of handling and long term durability. Beside, there are a number of other products viz septic tanks, trash bins, drums, barrels, etc. which could be manufactured by the unit and have good market potential in Bhutan. Presently, the entire requirement of these tanks is being met through imports and this involves heavy transport cost. Indigenous production is likely to result in heavy cost reductions and advantage to the consumers. Besides water storage tanks, the unit has to concentrate on a wide range of products viz septic tanks, storage bins, trash bins and various other roto moulded products to achieve economy in the production.

4. The Annual Production Capacity is around 120 lac litres of overhead water containers in various sizes.



5. The requirement of Land and Building is furnished below; -

Plot up area – 3000 sq mts
Built up area – 250 sq mt
Industrial shed – 800 sq mt

6. The requirement of Power is around 172 KWH.

7. The Main machinery required for the project is Three Arm Carousel Rotational Moulding Machine, Pulverizer, Extrusion Unit, Turbo mixer & Scrap grinder.

8. The requirement of Man power for the project is given below: -

Manager	– 1 no
Engineer / Production Incharge	– 1 no
Marketing Executive	– 2 nos
Office staff	– 2 nos
Operators/skilled workers	– 6 nos
Unskilled workers	– 14 nos

9. The Total cost of the project is around Rs. 254.64 lacs.

10. The time duration of the Project Implementation is around 11-12 months.

11. The details of Means of Finance is furnished below: -

Debt	-	178.25 lacs (70%)
Equity	-	76.39 lacs (30%)

12. The Break up of cost of the project is as under: -

Machinery	-	137.24 lacs
Construction Cost	-	43.00 lacs
Misc. Fixed Assets	-	5.00 lacs
Pre-operative exp.	-	7.00 lacs
Training Expenses	-	1.37 lacs
Interest	-	23.23 lacs
Working Capital	-	37.79 lacs
Total	-	254.64 lacs



13. The annual Sales Turnover is around Rs. 5.40 crores.

14. The details of Financial Analysis of the project is as given under: -

IRR – 35% on equity
IRR – 23% on investment
NPV – 162.20 lacs (12% discount rate)
Pay back period – 3 years
Project Break-Even – 51%



CHAPTER - I

INTRODUCTION



1. Economic Development in Bhutan

1.1 Bhutan, during last four decades has undergone a major transformation. The country's economy is no longer one in the past that was entirely dependent on subsistence production. In the past decades its economy has grown at an annual rate of nearly 7 per cent, more than twice the annual rate of population growth and a rate matched by few other Least Developed Countries (LDC's). Bhutan cautiously opened its doors to the forces of change and modernization in 1960's. Prior to this, country possessed very little infrastructure which is today associated with modern State of Bhutan. The key factors to the economic growth of Bhutan have been harnessing of natural resource potential viz hydroelectric power, mineral & forest resources, emphasis on development of infrastructure, promotion of industrialization & indigenous production both for domestic consumption and exports.

1.2 The story of Bhutan's development is one of the broad based progresses from the most modest beginning. The per capita GDP of Bhutan in 1961 was estimated to be at US\$ 51, then the lowest in the world. In the year 2000 the per capita GDP stood at US\$551, one of the highest in South East Asia. The human Development Index (HDI) of 0.510 places Bhutan in the UNDP medium human development category of countries. Bhutan is one of the very few Least Developed Countries placed in this category.

1.3 It is pertinent to observe that Bhutan is passing through fast growing phase of development. Starting in early 1960, Bhutan embarked on planned economic development through successive five-year plans. Over the years, ever increasing generation of electricity by installation of new hydro power projects has facilitated the establishment of new industries within the broad framework of sustainable and environmental friendly development. As power, transport and other infrastructure are the basic requirements for economic growth, the development of infrastructure has also been in the focus of developmental programmes. Over the years a number of power projects, roads, bridges, hospitals, schools and Commercial and residential buildings have been built. This has resulted in a fast growing construction industry.

2. Infrastructure- Focus Sector for Development

2.1 As mentioned above the main sectors of the emphasis in the development of infrastructure have been hydro-electric power, roads and bridges, urban infrastructure, buildings and this has given a flip to the construction industry resulting in higher demands of higher demands of construction materials. In construction industry the activities are going on both in the public sector as well as private sector. Keeping in view future growth projections in the infrastructure development, the construction industry is likely to grow at a very fast pace.

2.2 In public sector, apart from other buildings, some major buildings such as Secretariat Complex for housing ten ministries and Supreme Court building are the



major construction projects planned to be taken up shortly. Presently construction projects of 38 schools are in various stages of implementation by the government. A number of other construction projects in the public sector would be taken up in the coming years. In the Tenth Five Year Plan the government is actively considering the proposal for construction of residential houses on government land and allotting them to citizens on hire-purchase basis. Similarly it is expected that in private sector also the construction activities would grow at a very fast in coming years. A number of commercial complexes housing complexes and schools are expected to come up in the private sector and the trend is likely to continue in coming years.

2.3 In the road construction sector, a twenty-year (2007-2027) Master Plan has been finalized by the Ministry of Works and Human Settlement Government of Bhutan. The road sector Master Plan (RSMP) is a twenty year programme, which includes Road network expansion, road realignment, tunneling roads for inter-dzongkhag connectivity and second East-West highway. Total construction of 2654.4km of feeder roads, 794km of second East-West highway, 537km of highways for inter-dzongkhag connectivity and tunnels have been envisaged in the RSMP. Besides the government is contemplating to build few additional hydroelectric power generation projects in the coming years.

2.4 It would be seen from the above that a lot of construction activities are either in the process of implementation or planned to be taken up in the future both in public and private sector. With the growing pace of development in infrastructure sector and increasing trend of urbanization in Bhutan, the construction activities are likely to gain further big momentum. This scenario has led to heavy increase in the demand of construction materials. Presently majority of the construction are being imported from neighboring countries.

3. Justification of the Project

3.1 With a view to cut down the cost of raw materials in construction industries and also to accelerate the pace of industrialization in Bhutan, the government is keen to promote industrial units for the manufacture of construction materials. Setting up of such industries would help in easy availability of construction materials at economic prices, generation of employment opportunities, optimum use of natural and human resources and above all accelerating the pace of industrialization in the country.

3.2 The Department of Industries, Ministry of Economic Affairs who are responsible for promotion and development of industries in Bhutan have decided to undertake detailed feasibility studies of the construction materials with a view to identify the viable projects in this field and to develop detailed information on the identified project. The concept is that such detailed information would be made available to entrepreneurs to help them in taking investment decision.



3.3 Accordingly, the project on detailed feasibility studies in the field of construction materials has been assigned to IDRG consultancy services. The objective of the project is to identify viable projects in the field of construction materials and carry out detailed feasibility analysis of the identified project.

4. Approach to Work

4.1 The terms of reference envisage that the study would be conducted in two phases, the first will be the preliminary studies to identify the viable project in the field of construction materials, identify project with maximum potential for development and the second phase would be to carry out detailed feasibility studies for the selected projects. Accordingly, during the study on the project and formulation of feasibility report, following were attempted at:

- Review and examine the current construction scenario, future policies and programmes in various sectors of economy.
- Review the available literature, information, and statistics about the requirement of construction materials, the policies and prevailing practices for their procurement.
- Assessment of the current demand level for various items of the construction materials and make future demand projections.
- Shortlist the items/group of items, which can be taken up for production in Bhutan.
- Select the projects with maximum potential.
- Study the selected project(s) for preparing detailed feasibility report.
- Preparation of detailed feasibility report on construction material.

5. Methodology

5.1 The methodology comprised of collecting and collating information from Government authorities, private business and other stake holders in construction sector about various items of construction materials, prevailing practices of supplies, current demand level and future demand projections. The Consultants further attempted to:

- Review the data on current and future demand projections of various items of the construction materials and prepare a list of items with substantial recurring demand.



- Assess the technical viability of manufacture of this items/group of items.
- Draw upon a list of projects in construction materials which are considered viable.
- Select project(s) with maximum potential in consultation with the Department of Industry, Ministry of Economic Affairs.
- Carry out detailed feasibility studies of the selected project(s) as per terms of reference.
- Submission of the final report.



CHAPTER II

Consultation & Review of the Literature & Information



1. Consultation & Review

1.1 IDR team initiated the work on the project on 28th April, 2008 with a briefing meeting with the Chief Industries Officer & Project Officer in the Department of Industries, Ministry of Economic Affairs. Subsequent to briefing meeting IDR team had meetings and discussions with various take holders in Construction sector including Government authorities, schools, private sector business & industrial units.

1.2 The Consultancy team had extensive meetings at Thimphu, Phuentsholing, Punakha and Wangdue power project site with several government officials and the private sector. IDR team had a meeting with Director, Dudes and Officiating Secretary General, Construction Association of Bhutan. The team also had a meeting with Chairman-cum-Managing Director, Bhutan Engineering Company Pvt. Ltd.

1.3 IDR team had a detailed meeting with Director, Department of Roads, Ministry of Works and Human Settlement with a view to ascertain the details of road construction scenario in Bhutan and future plans for development of road network.

1.4 The team had a meeting with Director, National Statistics Bureau with a view to have the statistics about education sector. The Statistical Year of Bhutan 2007 relating to statistics of year 2006 was made available to the team.

1.5 The team also had meeting with Joint Director, Department of Revenue and Customs for ascertaining the level of imports of construction materials as also the countries of origin.

1.6 IDR team also had a meeting with Secretary General, Bhutan Chamber of Commerce & Industry (BCCI) to have their perspective on industrial development in Bhutan and the problem areas.

2. Discussions with representatives of industrial units.

2.1 There are not many industrial units manufacturing items of construction materials in Bhutan. However, the team had meetings with a number of industrial units at Phuentsholing, Pasakha and Bjenina Industrial Estate Thimphu in the field of wood products, plastic product, cement products, GRC products, stone aggregates and stone dust as well as traded channels in the field of construction material. The discussion with industrial units provided an insight about the problems being faced by the entrepreneurs as also the suggested remedial majors to accelerate the pace of industrialization in Bhutan. A brief account of the discussions with industrial units is given below:-

2.2 M/s. Phuntsho Timber Industry, Industrial Estate, Phuentsholing- The unit is manufacturing sawn timber and furniture. They also have wood seasoning unit. The shed is on rent-basis. The worker's strength is around 20 nos. The important points mentioned are as under:



- They purchase the wood, their raw material from Forest Development Corporation through auction
- There has been some hike around 5% in the reserve price of wood recently
- Facing problem of marketing due to ceiling on prices of sawn timber by the Govt.
- Problem of high transport cost in marketing of furniture. Composite furniture with steel & aluminium in CKD condition is the viable option.
- Saw dust and waste wood chips being sold as fuel.
- Broom handles being explored from Bhutan

2.3 M/s. Bhutan Board Products Pvt. Ltd. Phuentsholing and Pasakha- The unit manufactures particleboard and value added products viz furniture. Their particleboard unit is at Gedu and the value added products unit is at Pasakha. The total worker's strength is around 500. The main observations are as under.

- The unit is using lops & tops for the manufacture of particleboard.
- M/s. BBPL has been allotted certain forest areas on lease basis by National Resource Development Corporation (NRDCL)
- A forestation is a precondition for cutting the forest.
- They use lops & tops and the main trunk - the prime wood is to be given back to (NRDCL)
- It was informed that the other unit at Gedu manufacturing ply board is not working due to non availability of good quality wood ply.
- Heavy increase in prices; transport cost is a major constraining factor. The landed cost of lops and tops has risen from Nu.650 to Nu.1800 in last few years.
- Similarly the cost of decorative paper resins & chemicals have also increased substantially.
- According to M/s. BBPL, there is no scope for another particle board unit in Bhutan.



- At their Pasakha unit they are manufacturing CKD furniture doors & window frames, wooden flooring & wall panels.
- They have not yet supplied furniture to schools.
- There are possibilities of supplying composite furniture with steel/ aluminum and wood to schools.

2.4 M/s. Yarab Pvt. Ltd. Phuentsholing- M/s Yarab Pvt. Ltd. is having the production facilities for Copper Wire Drawing, PVC Insulated Cables & PVC Pipes. The main points of discussions/ observations are as under:

- They have a GKN – Windsor PVC Pipe Unit.
- The unit produces PVC Pipes up to 110mm dia, mainly for rainwater and sewage applications.
- The pipe fittings are being procured from outside
- They produce multi core cables for household wiring.

2.5 M/s. Bhutan Polythene Co. Ltd. Phuentsholing- The unit is manufacturing black polythene pipes mainly for water supply. They have two extrusion lines – one for extrusion of pipes up to 110mm dia and another for 110mm – 225mm dia pipes. The second extrusion line is being utilized only partially. The pipes are mostly for domestic market however they have also supplied some high pressure pipes in Gujarat India for use in Gas Pipe Lines. Their sale in India is through marketing agents.

2.6 M/s. Bhutan Marbles & Minerals Pvt. Ltd. Phuentsholing- The company has following two manufacturing units. Besides the company is planning to set up a gypsum board unit. They are also exporting lime stone powder to Bangladesh for use in poultry feed.

- Unit for manufacturing marble tiles from imported & local marble slabs
- HDPE tape & mono filament

2.7 M/s. Bhutan Bricks Pvt. Ltd. Pasakha- Automatic brick making plant. Cylindrical autoclave for brick firing in the process of installation. Unit in trial production stage. Heavy Alumina/ Calcium Silicate Bricks possibly for use as fire clay bricks.

2.8 M/s SINGYE and Sand Factory, Bjemina, Thimphu – The unit is manufacturing stone aggregates and stone dust. They have three manufacturing lines with each line



having three crushers for manufacture of stone aggregates and stone dust. They are also planning to set up a unit at Wangdue, the site for hydroelectric power project.

2.9 M/s Dorji Metal Fabrications Bjemina Industrial Estate, Thimphu- a small fabrication unit engaged in the fabrication of steel door frames, window frames, grills and various other metal fabricated items.

2.10 M/s Bhutan Concrete Bricks Bjemina Industrial Estate, Thimphu - the unit is engaged in the manufacture of hollow and solid cement concrete bricks and blocks. They have installed an imported Chinese machines for the manufacture of these products.

2.11 M/s Bhutan GRC Bjemina Industrial Estate, Thimphu - the unit is manufacturing glass fiber reinforced cement (GRC) products. The unit is supplying its products mainly for use in schools through SPBD. They are also various other items for sales in the market.

2.12 M/s Lakhi General Store, Thimphu- The team had detailed discussions with the representatives of Lakhi Store about the type and quantum of various metal and other hardware used in the construction of building. It was revealed during the discussion that there is a good demand of PVC pipes, PE pipes, overhead water tanks, cables, nails and screws, powder pigments etc.

3. Visit to PUNATSHANGCHHU- Hydroelectric Power Project, Wangdue

A large hydroelectric power project with capacity of 1,100 MW in the first phase and 1000 MW in the second phase is being set up at Lobeysa in Wangdue. The work on the project has already started. The team had a visit to the site of the hydroelectric power project with a view to assess the requirement of various construction materials required for the project. The team had detailed discussions with the officials of M/s WAPCOS Ltd., the main implementing agency for the project. It was revealed during the discussions that there is a provision for constructing a residential colony with around 700 residential units for the project personnel. A general hospital, building for office complex and a club building is also planned to be constructed. In addition these buildings a large quantity of construction materials would be needed for developing the infrastructure viz. roads, bridges, water supplies, sewage and disposal system at the site of the project. Besides there would be lot of construction activities in private sector due to setting up of the hydroelectric power project. Besides cement and steel there would be a large demand for stone aggregates, stone dust, cement products viz. bricks, hollow blocks etc. metal and plastic hardware items, electric wires and cables and various other items used in the construction of the project.



4. Presentation of Inception Report.

4.1 Based on the information from various stakeholders in construction sector, relevant literature and available data, IDRG submitted an inception report on the subject. At a meeting held on 22nd May, 2008 in the Ministry of Economic Affairs, wherein all stake holders were present, IDRG team made a presentation on the findings of the inception report on the detailed feasibility study on construction materials in Bhutan. During the presentation, it was suggested that the two main products out of the various items of construction materials, be studied for detailed feasibility analysis. IDRG team was advised to select these two items based on the various parameters and considerations relating to market demand, availability of raw materials, technology and skilled manpower, environmental consideration, etc. using matrix model. The comments and observations made during the meeting and subsequent written observations, if any, by the concerned authorities were also to be incorporated in the final report. Subsequently IDRG submitted the relevant information to Ministry of Economic Affairs and finalized the following two items of construction materials for detailed feasibility analysis:-

- Cement based products.
- Roto-moulded plastic containers and other products.

5. Organizations and Institutions contacted.

5.1 Subsequent to presentation of inception report, IDRG team had another round of meetings with concerned organizations and institutions in order to collect detailed information relating to identified projects and also the details on availability of land and other infrastructure, availability of finances, existing marketing channels, current prices scenario etc. Back in India, the team had extensive discussions and meetings with a large number of industrial units, concerned organizations, knowledgeable persons engaged in the manufacture of similar products, manufacturers of machinery and equipment, manufacturers and suppliers of raw materials in various parts of the country. Quotations and indicative prices of various items of machinery and equipments and raw materials were obtained from the concerned manufacturers through meetings and correspondence.

5.2 The team's endeavor has been to collect maximum possible information and details on construction materials. The list of the organizations visited and all the persons who were kind enough to spare their time for discussions with IDRG team during their visits to Bhutan is given in annexure I.

5.3 The list of industrial units, organizations and institutions visited in India through correspondence and meetings is quite extensive. The relevant names and addresses of the concerned organizations have been given along with the detailed feasibility analysis of the above stated two items of the construction materials in the list of machines and equipment suppliers and raw materials manufacturers and suppliers.



5.4 The information available during the discussions was further supplemented by review of the published literature and the information available on Internet in public domain. List of documents and articles consulted by the team is given in annexure II:



CHAPTER III

Economic Sectors with demand Potential for Construction Materials



1. Construction- A major activity

1.1 According to draft tenth plan document it is estimated that the **construction sector accounts for nearly 25 per cent contribution to Bhutan GDP**. The fact remains that in a developing economy like Bhutan, the construction becomes the major activity in various spheres of developments be it power, road, urban infrastructure and housing, education, health, communication etc. The construction industry covers a wide range of sectors of economy, the most important in the context of Bhutan being hydroelectric power generation and distribution, roads and bridges, urban infrastructure development, housing, government and private building complexes, expansion of health and education facilities viz. construction of hospitals and schools. With such a wider ways of the construction industry sector, it is desirable to have assessment of the current and future scenario of development of the construction intensive sector of the economy in order to visualize the emerging scenario of construction industry in Bhutan and resultant demand of construction materials. This would also provide an insight into the type of various construction materials required sector-wise and the growth pattern in the demand of construction materials. The three main sectors considered by the IDRG team include the following:-

2. Hydroelectric Power Generation & Distribution

2.1 Water is a natural resource that is in great abundance in Bhutan and the mountainous topography and climatic characteristics have endowed the country with a vast hydropower potential of around 30,000 MW. Of this, 23,760 MW is technically feasibly which translates into a mean annual energy production capacity of around 100,000 GWH. This tremendous comparative advantage for the country have been tapped effectively through a mutually beneficial and highly successful partnership with Government of India resulting in a win-win situation for both the countries. India has generously provided valuable financial and technical resources to undertake the implementation of power complexes and mega projects in addition to assuring purchase of surplus power generated. The availability of reliable electricity also serves India's growing needs for cheap power to continue growing rapidly and ensure its energy security. For Bhutan, the effective and sustainable utilization of its water resources has proved to be the key strategic success factor in furthering its sustainable developmental goals.

2.2 At the start of new millennium in 2000, the hydropower generation capacity in Bhutan stood at around 353.65 MW. By 2007, it has quadruplicated to 1,489 MW. This capacity is further expected double by the end of 10th plan and possibly reach 6000 MW by 2020 and 10000 MW by 2028. On an average, this represents adding capacity of around the size of CHUKHA annually, a substantial accomplishment considering the small size and limited absorptive capacity of the country's economy. The expansion of hydroelectric capacity has had an enormous impact as by the end of 9th plan, the energy sector contributed to around a quarter of GDP and 60 per cent of national revenues. It is important to state that these figures exclude the major contribution that hydropower infrastructure development makes to the construction sector, which accounts for another



quarter of GDP. With a further doubling of capacity as envisaged by the end of 11th plan in 2017 or by the year 2020, the energy sector will probably contribute close to half of GDP and account for around three-fourth of the total national revenue.

2.3 The energy sector thus strongly poised to continue leading and boosting growth in the future economic scenario and will greatly enhance the prospects of promoting higher living standards and reduce poverty levels in the country. Taking into consideration domestic consumption, the country would require the capacity addition of 4500 MW or an annual capacity addition of 346 MW, the size of CHUKHA hydropower project each year. A list of hydropower projects scheduled for construction in the 10th and 11th plan periods is as under:-

Hydropower projects scheduled for construction in the 10th and 11th plan periods

River Basin	Project Name	Installed Capacity (MW)	Construction Period
Punatsangchhu	Punatsangchhu IHEP	1095	2007-2014
Mangdechu	Mangdechu HEP	670	2009-2016
Punatsangchhu	Punatsangchhu IIHEP	990	2009-2016
Bumthangchhu	Chamkarchu-I	670	2014-2020
Bumthangchhu	Chamkarchu-II	570	2017-2022
Drangmechhu	Kholongchhu	485	2014-2020
Amochhu	Amochhu HEP	500	2010-2018
Nikachhu	Nikachhu HEP	210	2010-2018
	Routhpashong HEP	400	
	Dagachu CDM HEP	114	
	Sunkosh	4060	

Source : Department of Energy, MEA

2.4 The financial outlay for the energy sector is currently NU 5998.699 million. Evidently, the establishment of new power projects will involve a large number of construction activities including buildings at the project site and consequently huge quantity of building construction materials would be required. Further, with the planned hydropower projects for the 10th plan, many of which lie in the interior parts of the



country, the present width and capacity of highways, roads and bridges could prove a bottleneck for effective transportation of large hydro plants and equipments and construction materials to the sites of these hydropower projects. The facilitation of accelerated development of hydropower will therefore require new roads to the constructed and existing highways and roads to be resurfaced, realigned and widened. Besides, additional bridges to be build to accommodate 70 ton trucks.

2.5 It is evident from the above, that the envisaged development in the energy sector would result in the spurt in the demand for construction materials.

3. Roads & Bridges

3.1 Being land locked country, Bhutan is fully dependent on road network for transportation. Considering the country's mountainous terrain, provision of road services is extremely difficult and costly, nevertheless, major investment until now have been channeled into road and bridge infrastructure sector due to the fact that the national security and the socio economic development of the country largely depends on a safe, efficient and reliable road network. A well connected national highway and road system interlinked with rural feeder and farm roads would greatly help in reducing the regional imbalances. Additionally, the national road transport connection between regional growth centres, national cities and various small and medium towns would facilitate growth and development of urban areas and commercial hubs around the country.



3.2 In the last 25 years, tremendous achievements have been made through establishing 4,544.73 KMs of motorable roads and several motorable bridges. In the difficult areas where the construction of motorable roads has not been possible, suspension bridges provided the vital transport. Currently, there are 511 KMs of district roads, 1,247 KMs feeder roads, 440 suspension bridges and rudimentary mute – tracks



across the country. Despite these achievements, the existing road, rural road network in particular, is still remains inadequate in terms of both connectivity and coverage.



3.3 In the 10th five year plan, priority has been given to the construction of southern, east-west national highway, based on the decision of the 82nd session of the National Assembly and also in view of the Vision 2020 milestone to complete the construction of the second transnational highway by 2017. The major road sector targets are under:-

3.4 Road and Bridges Sector Targets

- Ensure that 75% of rural population lives within half days walk form the nearest road.
- Construction and upgradation of 247 KMs of southern east-west highway.
- Construction of 20 southern east-west highway bridges.
- Construction of 145 KMs of national highways.
- Construction of 20 national highway bridges.
- Double laning of 40 KMs national highways.
- Realignment of 51 KMs of national highways.
- New construction of 28 KMs and upgradation of 278 Kms of highways and roads to facilitate access of heavy transport, 170 trucks to hydropower project sites.

3.5 The total financial outlay for the road and bridge sector is NU 10,158.75 million. Apparently, the above construction activities in the field of roads and bridges would give uplift to the construction industry and consequent upsurge in the demand of construction materials.



4. Urban Development

4.1 The process of urbanization in Bhutan is more than four decades old unlike many other countries, where establishment and growth of towns and cities have been influenced by economic potential, the development of towns in Bhutan has initially resulted from the establishment of administrative centres. Today, the urban population constitutes around 31% of the total population and by 2020 it is envisaged that more than 50% of the population will be living in urban areas. Some estimates put that the extend of urbanization in Bhutan by 2020 would be around 70%. With this rapidly growing trend in the urban population, there has been a huge strength on urban infrastructure, public amenities and services which require substantial human and financial resources to address the emerging urban requirements and issues.



4.2 Presently there are urban plans for 31 towns of which implementation plans of 17 towns are in the various stages of finalization. It is pertinent to mention that while basic rudimentary urban facilities exists in all the towns, they are inadequate and require improvement and expansion both in the field of urban infrastructure and housing. This task will be carried out in line with the national spatial planning policy and national urbanization strategy. Until now, piped and potable water supplies have been provided to 20 towns, piped sewage and treatment facilities to 2 towns and solid waste management and disposal to 13 towns. The major targets to be achieved for urban development during 10th plan period are as under:-

4.3 Urban Development Targets

- Improvement and consolidation of the urban infrastructure in the existing towns.
- Establishment of 2 national cities - Thimphu and Gelephu.
- Establishment of 5 regional growth centres and 16 DZONGKHAG centres.
- Establishment of 12 medium towns, 23 small towns/GEWOG centres and 4 corridors that link the cities and regional national centres.

4.4 The total capital outlay for urban development in the 10th plan is NU 5410.698 million. Needless to mention that the emphasis on infrastructure development during the 10th plan and implementation of ambitious targets in the field of energy, roads and bridges and urban development would provide much greater opportunities for the



construction industry. The growing demand of housing and the envisaged policy of the government to construct houses on the government land for allotment to public on higher purchase basis are also expected to spur the construction activities. Besides, a number of government buildings, commercial complexes, hospitals and school projects are in the process of implementation and this would give rise to additional construction activities. In fact, one could see lot of ongoing construction activities in and around major cities and towns viz. Paro, Thimphu, Phuentsholing and Pasakha. Based on this emerging scenario and various other relevant factors, the construction sector is projected to grow at an average of around 16-17% per annum. Consequently, there will be a huge spurt in the demand of construction materials and some of the items like steel, cement and cement products, metal hard wares, plastic products may be needed in huge quantities justifying setting up of the indigenous units for their manufacture in Bhutan.



CHAPTER IV

Construction Materials – Type & Requirement



1. Types of Construction Materials and Services

1.1 As mentioned previously, the development envisaged in various economic sectors would result in the huge spurt in the demand of construction materials in Bhutan. Like the construction sector, the construction materials also include an extensively wide range of materials and products viz. those required for basic structure, sewage and sanitation, water supply, telecommunication, construction of roads and bridges, electrification, interior and exterior finishing, etc. Besides, the construction industry needs various types of services viz. architects, construction contractors, RCC mixing plants, carpenters, electricians, plumbers pest control services, etc. Few of the service enterprises which could be considered in the context of this study include the following:-

- Consultancy services in architecture and structural designing.
- Construction contractors
- RCC mixing plant
- Bitumen, stone aggregate mixing plant
- Pest control services

1.2 The requirement and type of construction materials depends on the type of construction project e.g. in power projects, cement, steel and stone aggregates constitute the major requirement, in road construction project, bitumen and stone aggregates happened to be major requirements, while the construction of buildings require a wide range of other materials besides cement, steel, stone aggregates and bricks. The construction materials encompass a wide range of materials and products, viz. steel in different forms, cement and cement products, wooden items, metal hard wares and other products, plastic pipes and other chemical products. In the context of this study, it appears to be more logical to classify the building materials based on their raw material of manufacture or their utilization in the construction industry. The main construction material therefore be categorized as under:-

2. Cement & cement based products

2.1 Cement Plants: Limestone deposits are widespread and are found in good quantity near western and eastern extremities of southern Bhutan. There is ample possibility of setting up Mini Cement plants in west-south, central-south and east-south part of the country. Mini cement factories may also be located near Thimphu and Paro. Even a big cement manufacturing industry may be considered to be set up. Presently the country is self sufficient in production of cement and is also exporting it. Consumption of cement within the country is likely to go up with increase in construction activities primarily due to a few Hydro Power projects planned to be taken up in near future. There is good scope of exporting cement to India as well.



2.2 Cement Concrete Bricks: Solid and hollow cement concrete bricks are good alternative to clay bricks. It is envisaged that these types of bricks may generate considerable demand in hilly and difficult areas where good quality clay is not easily available. This also ensures good bricks of much better strength and uniform quality. Its shape being true, less mortar is required in constructing walls and ultimately use of this product may prove economical. Use of hollow bricks provides insulation in buildings thereby requiring less heat energy for keeping the building warm. Bricks can be moulded in different dimensions as per requirement. Technology is simple and may be available indigenously or could be imported from India.

Raw materials for this product include cement, sand and stone aggregates. All these materials are available in Bhutan. The process of manufacture is simple and quite suitable to start in rural and hilly areas especially where sand and stone material is cheap and manufacturing of good quality of clay bricks are very difficult due to non-availability of suitable clay and prohibitive cartage expenses of clay bricks. Once people understand its benefit, this product will get preference over clay bricks since the construction activity is ever increasing in Bhutan and the cost of clay bricks is quite high due to heavy transport cost involved in bringing these bricks from plain areas in India.

2.3 Cement Concrete, Tiles and Paving Blocks: Cement concrete tiles and paving blocks are plain or grooved in length and width wise on the surface making multiple square projections. Flooring with these tiles is cheaper and durable. Because of their sturdy and robust nature, these tiles are normally used in paving open areas, the footpaths provided on the sides of roads, pedestrian crossings, foot-over bridges on roads, parking places in big buildings, hotels, schools, marketing complexes etc. With development of cities, laying of footpaths and pavements besides roads and dwellings, the demand of this product is likely to increase manifold. With great upsurge in the constructional activities of public and private buildings and infrastructure, the demand of this product is likely to further increase. Technology required to set up this industry is quite simple and is easily available. Raw materials required are cement, sand and stone grit aggregate, which are indigenously available in Bhutan. In view of the above this product has a good potential for production in Bhutan. This industry may be developed in the form of clusters of various units manufacturing different items viz. cement bricks, cement blocks, pavement tiles, cement mosaic flooring tiles, cement paints, GRC products, cement poles and various other products in cement.

2.4 Cement Mosaic Flooring Tiles: Cement Mosaic tiles are used for flooring in buildings. With the rise of standard of living the people prefer using cement mosaic tiles. In construction of government buildings this product is being widely used. Technology requirement for this product is simple and is available in the country. Raw materials required are grey cement, white cement, mosaic chips and colour pigments. While grey cement is available in the country, white cement, mosaic chips and colour pigments are required to be imported. There is a good demand of this product in construction of public as well as private sector, residential and commercial buildings. This industry may also be set up as a part of cluster proposed for the development of cement based industrial units.



2.5 R.C.C. Spun pipe- Reinforced cement concrete pipes are made of a mixture of Portland cement. Sand and aggregate with steel wires as reinforcement material. These are manufactured in standard lengths, wall thickness and diameter. The R.C.C. pipes are used in irrigation, culverts construction, sewerage and drainage purposes for smooth disposal of affluent without seepage. Technology is simple and may be available either indigenously or may be imported from India. Raw materials for this product are cement, sand, stone aggregate and steel wires/bars. All these ingredients are available easily. This product is having ever increasing demand and therefore has good market potential.

2.6 Precast Prestressed Concrete Pole- Precast prestressed concrete poles are used for carrying electrical transmission lines. Presently in Bhutan hollow steel pipes are mostly being used for this purpose and are imported from India. Technology of prestressing is a bit complex one and its know how may have to be imported from India. Cement, sand, stone aggregate, steel bars and high tensile prestressing wires are required for manufacturing this product. High tensile prestressing wires have to be imported and rest raw materials are available in the country not seem to have good. This product is for exclusive use of carrying electrical transmission lines. Presently in Bhutan, hollow steel tubular pipes are being used for this purpose. Therefore this product does market potential.

2.7 Pre-cast Cement Jali- Cement jallies are pierced panels with a thickness of not less than 2.5 cm. used in construction of houses, buildings etc. as partition panels in walls and in ventilators. Technology is quite simple and is available indigenously. Raw material required is cement, sand, stone grit and steel wires. . All these materials are available in the country. The demand of cement jallies increases correspondingly with the increase of building activity, which is fast growing. Another factor to its demand is fascinating designs and functional qualities apart from low cost.

2.8 Glass Reinforced Concrete (GRC)- Glass Reinforced Concrete (GRC) is a thin section of concrete that uses randomly dispersed alkali resistant glass fibers for reinforcement in place of traditional steel. The fact that the fibers will not rust like steel means that there is no real requirement for cover' and no problems associated with the lack of it. As such it is possible to lightweight elements that have impressive structural qualities. Intricate and fascinating deigns can be put in moulds and when GRC member sets and taken out of mould, the GRC member is ready with the designs. Reduced weight leads to lower transport and erection cost. It is almost maintenance free viz. no steel reinforcement to corrode. It may have improved surface detail and quality of finish. This is comparatively new building construction component. Technology for this is required to be imported. Raw materials required are cement, sand and glass fiber. Glass fiber will be imported whereas cement and sand are available in the country. An industrial unit has recently been set up at Bjemina Industrial Estate, Thimphu for the production of GRC products. Majority of its production is being supplied for construction of school. However the unit is in the process of developing a number of products for private construction and also other products used in buildings viz. flower pots and decorative sections and items.



2.9 Cement Paint- For making cement paint, colour is mixed with cement in such a way that a homogenous mixture is obtained. This is widely used in painting finished surface both exterior and interior. Technology is quite simple and can be obtained from India. Cement and colour are the raw materials required. Whereas cement is available in the country colour will be imported. It has very good market potential. With the growing activities in construction of buildings its demand will also continue to grow.

3. Limestone & Limestone Based Products

3.1 Stone Aggregates/Stone Metal Chips- Stone metal and chips of varying sizes is an indispensable item for use in the construction of building and roads and other similar activities where cement and concrete work are involved. As on today much construction work is going on in Bhutan. Presently stone metal/chips being produced in Bhutan fall well short of requirement causing great hindrance in timely completion of projects. Therefore, it is desirable that more units for producing stone metal/chips may be set up so that pace of construction work is not slowed down and full requirement is met. In fact the demand is that there is scope for setting a few more crushing units. There is enough reserve of stone quarry and many more crushing units may be set up. Technology for quarrying and crushing stone boulder for making metal and chips is well known. As already mentioned earlier, stone metal/chips are used in construction of buildings, roads, bridges, dams, hydropower projects etc. Therefore, this product will have very good market potential.

3.2 Lime- Lime which in other words are called as quick lime or unslaked lime is made out of limestone deposits are widespread through the country. Lime is used as mortar in the construction of low cost buildings by mixing with suitable proportion of sand and surkhee (burnt clay) as aggregate. As there is rapid development taking place in the construction of buildings under urban and rural areas, housing development programme throughout the country, there is good demand for lime. In view of this, there is very good scope for setting up units for producing lime in close proximity of deposits of lime stone.

4. Gypsum Based Products

4.1 Plaster of paris- Plaster of paris which is calciumsulphate with half molecule of water of crystallization. It acquires hygroscopic characteristics by duly calcining the raw material, Gypsum. It possesses outstanding property of setting and subsequent hardening when mixed with water. It is extensively used in washing finished plastered surface to smoothen it so that plastic paint or dry distemper may be applied on the the surface to have smooth surface and finish. Raw material required is Gypsum there is large mineral reserve of Gypsum in the country and therefore there is no dearth of raw material for producing this product. It has very good market potential. Apart from buildings it is also used in making dolls and statues.



4.2 Boards of Plaster of Paris- Plasterboards are made of plaster of paris with reinforcing materials such as hessian jute bags, coconut coir etc. These are made in the shape of panels in different sizes and are used for interior decoration and false ceiling in residential buildings, offices and other establishment as substitute to plywood due to their better appearance and thermal insulation properties. Raw material for this product is plaster of paris and jute or coconut fiber. These are easily available. In view of growing building constructional activities for residential buildings, offices and other commercial establishments, the demand of plasterboard is expected to be growing year by year. Since it is a low cost substitute for plyboard hard board, it has good market potential.

5. Wood Based Industries

5.1 Wood Seasoning Plant: About 72% of total area of Bhutan is covered with forest and as such wood reserves of the country are huge and there is ample scope of setting up of many wood based industries. For majority of fabrications the wood is required to be treated / seasoned before its conversion to wood products. Wood as cut from forest contains high quantity of moisture and hence is not suitable for use as building material or for manufacture of furniture. To enhance its quality and to make it suitable for use in building it requires seasoning. Wood seasoning is the process of removal of moisture from timber. This can also be termed as drying process of timber. In the seasoning process the moisture of wood is brought down in the range of 8 – 15% based on end application.

5.1.1 Following are the advantages of seasoning.

- Enhances overall strength of timber.
- Checks tendency of warping.
- No risk of fungal decay.
- Reduces weight.
- Improvement in strength properties.
- Increase in nail and screw holding capacity.
- Improves gluing capacity.
- Helps in preservative treatment.
- Wood exhibits better electrical and thermal insulation properties.

5.2 Doors and windows

Traditionally windows and doors of buildings in Bhutan are carved with intricate artistic designs. Windows and doors may be made in standard sizes. People may take these ready to fit windows and doors thereby reducing time of construction, also mass production will also result in cost reduction. Seasoned timber will be the only raw



material required for this. Artisans for making doors and windows with traditional intricate designs are present throughout the country. These products will have good market potential.

5.3 Plywood and board manufacturing industrial units: Plywood is extensively used in construction of buildings and manufacture of furniture throughout the world. The broad advantages of plywood include fast workability, Low cost, much less warpage and shrinkage. The various process operations involved in the manufacture of plywood include the following:

- A log is softened with steam and then mounted on a lathe.
- A long knife then peels off thin layers of wood in a continuous veneer. Once dried, a thin veneer sheet like this is very strong in one direction (along the grain) and very weak in other (across the grain).
- Several layers of veneer are layered together with the grain direction alternating between the different layers. Glue is used between layers.
- The stack is then heated and pressed to form a rigid panel.

5.3.1 Because grain direction of the layers of veneer alternate, the panel becomes strong in both directions. For making plywood, even soft wood with long veneer is good enough. Technology for this may easily be acquired. This product has very good market potential. For making **Wooden Boards**, much less expensive chips of wood are used instead of a continuous veneer. These chips are thin and fairly large and during manufacture they are lined up in different layers (oriented) so that the panel is strong in all directions this product is much cheaper than solid wooden planks. The boards may be manufactured in varying thickness and may also be laminated. Technology for its manufacturing may easily be acquired. The product has very good market potential.

6. Steel Bars & Metallic Hard Wares

6.1 Steel bars in different sizes constitute the basic construction material for any construction activity, be it power projects, bridges or the building construction. In Bhutan, a huge demand for steel bars exists and the demand level is likely to increase manifold. Bhutan with its immense availability of power at low cost offers a great potential for setting up of steel bar drawing units from the billets. It is understood that one unit is being set up at Pasakha for production of steel bars. The item is considered to have good potential for development in Bhutan and many more industries could be set up for this product in various parts of the country so as to reduce the cost of transport. Besides, steel bars a number of other metallic hard ware items in steel, brass, and aluminium are used in the construction industries. Some of the items which could be considered for indigenous production in Bhutan include the following:-



- Steel Rolling Mill
- Nails and fasteners
- Nuts and bolts
- Door and window hinges
- Door and window hedges
- Locks
- Bathroom and kitchen fittings
- Manhole covers

7. Plastic & Chemical Based Products

Plastic products find extensive applications in the modern system of constructions. A number of items which were hitherto based on cement, metal, etc. have been replaced by plastic based products. Keeping in view the fact that plastic processing industries could be easily located near to the centres of consumption, easy availability of technology and machines and minimal impact on environment and availability of power at economical cost at Bhutan, the plastic processing industry is ideally suited for a developing economy like Bhutan. In fact, some plastic units have already been set up in the country. The plastic products which could be considered for manufacture in the field of construction materials include the following:-

- PVC conduit pipes
- PVC pipes of higher dia for water supply, sewage and drainage system
- PVC pipe fittings
- Cables and wires
- PVC extruded sections
- PVC doors and windows
- Wide width polythene films
- PVC flooring tiles
- Overhead water tanks in PVC
- PVA emulsion based adheres
- Water proofing chemicals and binders
- Emulsion paints and finishes



8. Service Enterprises

As mentioned earlier also a number of service enterprises are needed in the construction sector. With the progress in construction sector, especially in the building construction sector, there exists good potential for setting up service based enterprises in the construction sector. These mainly include the following:-

- Consultancy services in architecture and structural designing.
- Construction contractors
- Plumbers
- RCC mixing plant
- Bitumen, stone aggregate mixing plant
- Pest control services
- Interior decoration



CHAPTER - V

Selection of Viable Projects - Issues and Approach



1. Issues and Approach

1.1 Once the different items of requirement in the construction section have been identified along with growth projection pattern for future demand, it is desirable to assess the techno-economic viability of their manufacture in Bhutan before finalizing the recommendations. The items suggested to be taken up for production, in the initial phase necessarily should necessarily be based on simple technology.

1.2 The items requiring single operation manufacturing process and where the machine suppliers would be able to help in technological aspects and operation their machines need to be preferred. To illustrate, the leading manufacturers of plastic processing machines provide on site technical and operational training for the production of plastic conversion products. Similarly in case of steel/aluminium/fabrications items the main operations are cutting, bending, welding and assembly, which are quite simple technology. For such fabrication based products critical components like wheel assembly, ball bearing etc. could be imported.

1.3 The products for which the raw materials are abundantly available at economical prices need to be preferred e.g. limestone based products, gypsum based products, etc. Further, it would be possible to manufacture those construction materials at competitive prices, wherein the power input cost is substantial e.g. steel bar drawing units, wire drawing units and plastic processing industry.

1.4 In case of certain products wherein raw materials need to be imported, still the economic factors would favour their indigenous production on account of saving in the transportation cost of the finished products. The examples in this context could be large diameter PVC pipes and overhead water storage tanks.

1.5 Though there is a boom in the construction industry in Bhutan, keeping in view the size of population, the demand for individual items would not be sufficient for setting up a economically viable unit. In the circumstances, the best option would be to study the feasibility for a group of products involving similar technology in order to set up viable indigenous production units.

2. Cluster approach for development

2.1 A cluster approach for developing similar product based units could also be adopted for accelerating the pace of industrialization in Bhutan. Cluster for production of cement based products, gypsum based products, steel and aluminium products, plastic products cluster, could be the possible examples. In these clusters products and operations could be divided among the units along with a provision for capital intensive common facility services. This would help in bringing down the production cost, improve quality and also help in better access to the market. The cluster approach would also enable to develop cost effective pollution control mechanism through setting up of common effluent treatment plants (CETP's) wherever needed. It is important to mention that world over, specially in case of SMEs, the cluster approach is considered to be the



most effective for promoting industrialization and this need to be kept in view while developing industrial units in Bhutan also.

2.2 The various cement-based products have a good potential for development of units through cluster approach. In the various cement based products cement, stone aggregate, stone dust, and sand happen to be the main raw materials and if these raw materials are made available at one site through bulk purchase, the cost of production for various items could be made quite competitive. This industry may be developed in the form of clusters of various units manufacturing different items viz. cement bricks, cement blocks, pavement tiles, cement mosaic flooring tiles, cement paints, GRC products, cement poles and various other products in cement.

2.3 In today's world when the markets have become global and outsourcing has become the order of the day, the brand has become an important factor for influencing the customer's preference and access to the new markets. In Bhutan also in the general market, the brand is an important factor for acceptance of a product. In case of certain construction materials viz. wires and cables, sanitary fittings, paints and finishes, the brand becomes of paramount importance. One of the suggested approaches to ensure the credibility and reliability aspects in certain products could be the production of accepted brand through franchising arrangements with the Indian/ other foreign company supplying this product in Bhutan. Such an arrangement, besides ensuring quality & performance credibility of the product, is also likely to facilitate the easy availability of finances, speedy implementation of the project and access to overseas markets.

3. Construction Materials – Identified Projects

3.1 Based on the demand level for various items of construction materials, analysis of market scenario as discussed in preceding paragraphs, IDRG team has identified the following projects for development in private sector / public private partnership in Bhutan in the field of construction materials.

- Cement based products
- Roto moulded plastic containers and other products.
- PVC pipes
- Limestone based products
- Gypsum based projects
- Cement concrete mixing plant
- Steel and Aluminum Pipes and Products
- Electrical fittings



- Supplies for Rural Electrification
- PVA emulsion based adhesives
- Metallic hard ware
- Wire and wire nails.
- Wood based products with doors, windows and frames
- Steel rolling mill.

3. Selection of projects for detailed feasibility analysis

3.1 Based on the studies of various aspects of construction materials, demand estimates, and supply chain system, IDRG team submitted an inception report on construction materials in Bhutan. A presentation was made on the findings of the inception report in a meeting held on 22nd May, 2008 in the Ministry of Economic Affairs wherein all stake holders were present. During the presentation, IDRG team presented the details of identified products as listed in para 3 above and suggested that the first two items be considered for detail feasibility analysis. It was decided that based on the various parameters viz. current demand level, potential for growth in demands, existing manufacturing facilities in Bhutan, availability of raw materials, technology and machines, possibilities for adaptation of manufacturing technology as also the parameters discussed above relating to issues and approach for selection of projects, IDRG team would make a selection of two viable projects for detailed feasibility study using matrix model. It was also decided that project profiles for three another potential items of construction materials be also included in the purview of the report.

3.2 Based on the discussion during presentation and subsequent interaction with stake holders the critical parameters were identified and the project ranked accordingly. While ranking the projects the aspect relating to possibility of developing a cluster of similar products has also been kept in view. The table No. VIII shows the ranking of the various projects.



Table VIII

Construction Materials – Ranking of Project based on various parameters

S. No.	Item	Existing Demand Level	Future growth prospects	Availability of Local raw material	Adaptability of Technology	Availability of skilled manpower	Employment potential	Saving in Transportation cost	Advantage due to insufficient of domestic	Export possibility	Environment friendly process	Total
1	Cement based products	9	9	8	7	8	9	9	5	5	9	78
2	Overhead water tanks	7	7	5	7	5	8	9	9	8	9	74
3	PVC pipes	7	7	4	5	5	8	8	4	7	9	64
4	Wire & wire nails	8	8	5	5	4	6	7	5	5	7	60
5	Gypsum based projects	7	7	8	5	5	5	4	5	5	5	56
6	Limestone based products	8	8	7	5	5	6	4	3	3	2	51
7	Cement concrete mixing plant	5	5	7	5	5	3	7	5	2	2	46
8	Steel and Aluminum pipes and products	5	5	4	4	6	5	4	3	2	5	43
9	Wood based products with doors, windows and frames	6	6	7	4	3	4	3	2	5	2	42
10	Supplies for Rural Electrification	4	3	2	3	4	7	3	6	3	5	40
11	Electrical fittings	4	3	2	2	4	4	3	6	5	5	38
12	PVA emulsion based adhesives	7	7	3	2	2	2	6	2	2	5	38
13	Steel rolling mill.	6	6	3	3	4	3	3	2	2	5	37
14	Metallic hardware	3	3	2	2	4	3	2	4	3	5	31



3.3 As would be seen from the matrix model presented in table No. VIII cement based products and roto-moulded plastic containers and other products were identified to be most viable projects. It was agreed that M/s IDRG Consultancy Services shall prepare two detailed feasibility reports on projects thus selected. In addition to this three project profiles shall also be prepared for the benefit of entrepreneurs. Accordingly, in construction materials sector the detailed feasibility analysis has been carried out for the following two projects:-

- Cement based products
- Roto moulded plastic container and other products.

The detailed feasibility analysis on cement based products & roto-moulded plastic containers and other products have been presented in part II and part III of the report respectively.

3.4 In addition to this the project profiles on following three items have also been included in the report.

- Wire & wire nails
- Gypsum based projects
- Limestone based products

The project profiles on above said three products are given in annexure III of this report.

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Annexures

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Annexure II

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3. Draft 10th Plan document – available on Internet
4. Statistical yearbook of Bhutan 2007
5. Bhutan Trade Statistics 2006, 2005 & 2004
6. Bhutan Private Sector Survey 2002
7. Innovative Ideas for Industrial Development in Bhutan
8. Bhutan Business Directory
9. Technical books and literature relevant to identified projects.
10. Relevant specifications by Bureau of Indian Standards (BIS).
11. Technical literature on various technologies and machines and raw materials available from raw material machine manufacturers.
12. Articles, write-ups, photographs, maps, etc. on the identified projects as available in public domain on Internet.



Annexure III

Project Profiles

1. WIRE NAILS

INTRODUCTION

The wire nails are known to most of the people as it is widely used for fastening purposes. It is used for industrial as well as for domestic purposes. It is made of mild steel hard Drawn Bright wire with a head at one end and is pointed at the other end. The head will help to drive the nail with a hammer or for the nail removal. The pointed end will help for driving the nail into the items to be fastened. The wire nails are required widely as stated above. They are great demand for any wooden fabrication like packing cases, boxes, partitions etc. These are generally sold directly to consumers and indirectly through hardware merchants. The demand for wire nails will always be increasing.

PROCESS OF MANUFACTURE

Coils of hard drawn bright wire is taken and fed to automatic wire making machines, which are fitted with the proper handling dies, grips and cutting tools. In the machine, cold heating of the wire nail, head, cutting of the nail are done automatically and finished wire nails are thrown out. These wire nails are put in polishing drum along with saw dust, lather pieces and similar items and rotated to get polish on the wire nail. Wire nails are then packed as required and dispatched.

The nails shall be machine made and may have die marks on the neck. These should be uniformly of round section, straight and shall have sharp points. The heads shall be properly formed and concentric with the shank.

PRODUCTION TARGET

It is proposed to manufacture 120 tons of wire nails of different gauges and different length per year.



LAND AND BUILDING

Covered area: 300 sq. meters

MACHINERY AND EQUIPMENT

- 1 Automatic wire nails making machine range of wire gauge 1 mm to 2 mm, length of nail ½" to 2" with 1 H.P. motor suitable for 3 phase 400 V/50cy. With all accessories.
- 2 Automatic wire making machine, 2 mm to 3.5 mm length of nail from 1" to 4" with 2 H.P. motor suitable for 3 phase, 400 volts and all accessories.
- 3 Automatic wire making machine, 2 mm to 2.5 mm length of nail ½" to 2" with 1 H.P. motor suitable for 3 phase 400 V/50cy. With all accessories.
- 4 Polishing barrel motorized with reduction gear arrangement.
- 5 Double-ended bench grinder wheel dia 6" with 1 H.P. motor.
- 6 Spare dies.
- 7 Work bench, hand tools, sqanners, screw driver weighing machine etc.

TOTAL CAPITAL INVESTMENT:

Fixed cost	--	Rs. 25,00,000
Working Capital cost for 2 months	--	Rs. 18,00,000
Total	--	Rs. 43,00,000

SALES TURN OVER - **Rs. 96,00,000**

RATE OF RETURN -- **21.8%**

BREAK EVEN POINT -- **42.1%**



LIME STONE BASED PRODUCTS –BURNT LIME

INTRODUCTION

Burnt Lime also called as quick lime is manufactured by burning of lime stone under control conditions. The burnt lime is extensively used as a mortar in the construction of building by mixing it with suitable proportion of sand and surkhee of burnt clay as aggregate. It is also used for white washing of houses and building. Iron and steel plants, and foundries also use lime as a fluxing agent in considerable quantity. Drugs and pharmaceuticals, paper industry, pesticides formulations and other chemical processing industries also use lime. There is rapid development taking pace in the construction of buildings in rural and urban areas due to various development programmes in Bhutan and industrialization activities throughout the country. Burnt lime has a good demand. The main applications of lime include its use mortar in the construction of building. Besides there would be a good demand for white washing of building and some industrial application.

PROCESS OF MANUFACTURE

The limestone mined from quarry should be free from all defects and impurities. These stone blocks are crushed manually or by jaw crusher in sizes of 3 to 6 inches. Oil fired vertical shaft kiln (VSK) with refractory lining inside portion having about 33 meter conical vertical chimney, is used for the firing or calcination of lime stone at a temperature of about 900^o C. The chimney of VSK is so arranged that the speed of exhaust gases and fumes in the chimney and travel @ 9 to 12m /sec. The diameter of chimney is so calculated that the lower/ bottom portion of chimney is one third of the total stack of chimney. Skip bucket with rope, which is driven by electric motor, is arranged for loading of stone pieces for firing of calcinations. These stone pieces are loaded from the top of kiln, this process is done regularly as per the requirement of stone calcinations. A cyclone or dust catcher is also arranged with a scrubber, which collect about 50 to 80% dust particles and removes with scrubber. Approx 4 kg. to 6 kg. sludge / hr is removed by this process which can be discharged to land fill. The firing is done with the help of burner. The firing is initiated from the bottom section of kiln and after a suitable interval the calcined lime is unloaded through the outlets provided at the bottom section of kiln. Properly calcined lime is sorted out in different grades like A, B and C grade. Semi burnt lime stone is charged again in the kiln for calcinations. The dust, clinkers ash and other harmful materials are removed from the finished product and properly sorted lime is packed for sale.

The Bureau of Indian Standards has formulated and published the following specification for the necessary guidance and maintenance for the quality of different types of lime products.



IS 1861:1961 Lime in vertical mixed feed type kilns and its manufacture.

IS 712:1973 Methods of testing for building lime

IS 1624:1974 Fields testing and building lime and mortars.

PRODUCTION CAPACITY (PER ANNUM)

The production capacity envisaged in this project is about 8,000 MT, valued at Rs. 2,40,00,000 per annum.

LAND AND BUILDING

Land area one acre

Office and work shed area 300 sq mtrs.

Store, Workshop, laboratory area about 100sq mtrs.

Boundary wall, MS Gate, vehicle's stand, time office etc.

MACHINERY AND EQUIPMENT

(A) PRODUCTION UNIT.

- 1 Oil fired vertical shaft kiln with Refractory lining inside portion of kiln having 33 meter height chimney made of steel Fabricated plate form type having all arrangement with skip bucket and burners etc. Capacity 30 Tonne per day.
- 2 Jaw crusher for crushing the stone or pebbles with 10 HP motor and starter etc.
- 3 Rotary self driven for sieving the lime having different mesh sizes with 1.5 HP motor and starter etc.
- 4 Wheel barrow for handling of raw material and finished product
- 5 Balance for weighing upto 500 kg
- 6 Overhead water tank; capacity 1000 litres. Water storage having well boring jet with 2 HP motor and starter and pipe line fitting etc.
- 7 Beg sewing machine
- 8 Generator set capacity 10 KVA
- 9 Other tool, fixtures, dies, hand tools, racks etc.

(B) TESTING EQUIPMENT



(C) POLLUTION CONTROL EQUIPMENTS

Exhaust Fan
Dust cotcher
Scrubber
Ducting
Fencing for Plantation
Hand gloves, eye goggles etc.

TOTAL CAPITAL INVESTMENT

Fixed capital	Rs. 26,33,000/-
Working capital for 3 months	Rs. 24,63,915/-
Total	Rs. 50,96,915/-

SALES TURN OVER **Rs. 2,40,00,000**

NET PROFIT RATIO (PER ANNUM) **20.3%**

RATE OF RETURN (PER ANNUM) **53.91%**

BREAK EVEN POINT **58%**



PLASTER OF PARIS (GYPSUM BASED)

INTRODUCTION

Plaster of Paris which is calcium sulphate with half molecule of water of crystallization ($\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$) possesses outstanding properties of setting and subsequent hardening when mixed with water. Plaster of paris is extensively used in ceramic industry for the preparation of models, moulds and toys. It is also used as a main raw material in the manufacture of toys and statues, chalk crayons, gypsum plaster boards, decorative picture frames, besides a wide rang of applications in the interior decoration of buildings and other establishments. Pharmaceutical grade plaster of paris is used in hospitals for orthopedic application. There is a growing industrial activity in the field of white ware, such as pottery, sanitary ware, chemical and electrical porcelains, requiring large quantities of plaster of paris for making moulds and preparation of moulds. The demand for the product is ever increasing. There is also considerable demand for the plaster of paris arising from a large number of shops and establishments engaged in making statues and interior decoration as well as decorative plaster boards for false ceiling etc., which is in turn creating a good scope for setting up new units.

PROCESS OF MANUFACTURE

The raw material gypsum is stored and washed with water for removal of sand and other impurities. The lumps thus obtained are then dried and powdered in pulveriser. The dried gypsum powder is calcined in a rotary drumcalciner using light diesel oil as fuel. The low pressure burner is used for calcinations at a temperature of 160°C to 180°C . The process of calcinations is done over a period of about 2 hours, so that one and half molecules of water is removed to convert the gypsum ($\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$) into plaster of paris ($\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$). After cooling the product (plaster of paris) is further pulverized to a fineness of 150 mesh and packed in air light polythene lined gunny bags to avoid the plaster of paris from absorption of moisture. For manufacture of surgical grade plaster of paris, a mineral silinite which is considered to be a purer variety of gypsum is used.

QUALITY CONTROL AND STANDARDS

The Bureau of Indian Standards has formulated and published the following specifications for maintaining quality of the product and testing purpose.

IS 2333:1992	Plaster of paris for ceramic industry
IS 1288:1982	Methods of tests for mineral gypsum
IS 4738: 1998	Bandage plaster of paris



IS 2547 (Part 1): 1976	Gypsum building plaster including premixed light weight plaster
IS 2547 (Part 2):1976	Gypsum building plaster including premixed light weight plaster

PRODUCTION CAPACITY (PER ANNUM)

Qty.	:	900 MTs.
Value	:	Rs. 45,00,000.

LAND AND BUILDING

Covered area; 2000 sq.ft. with provision for stores, office etc. with equal open area (Rented)

MACHINERY AND EQUIPMENT

1	Rotary cylindrical drum calciner capacity 2 MTs (Locally fabricated)
2	Attrition type disc pulveriser ½ MT/hour with motor and other accessories
3	Computer system, office furniture and equipment
4	Burner and other equipment

TOTAL CAPITAL INVESTMENT

Fixed capital	Rs. 12,50,000/-
Working capital for 3 month	Rs. 15,00,000/-
Total	Rs. 27,50,000/-

TURNOVER (PER ANNUM) - **Rs. 45,00,000**

NET PROFIT RATIO - **11.25%**

RATE OF RETURN - **37.83%**

BREAK EVEN POINT - **56.8%**