BIRGANJ SUB-METROPOLITAN CITY
SECONDARY TOWNS INTEGRATED URBAN ENVIRONMENTAL IMPROVEMENT PROJECT (STIUEIP)
PROJECT IMPLEMENTATION UNIT (PIU)
BIRGANJ, PARSA, NEPAL

Ref.no. : 266/070/071 Date : 31Dec, 201

To,
Mr.Mani Ram Gelal
Project Director
Project Coordination office
Babarmahal, Kathmandu

Sub:- Regarding Submission of Final Report on Roads and Lanes , Birgunj

Dear sir,

PIU has received the Final Report on Roads and Lanes, Birgunj submitted by th consultants (SMEC & Associates). While we are reviewing the report, a copy of report ha been sent to PCO for review and perusal.

Encls:

- Final Report on Roads and Lanes, Birgunj,(Main report vol-3A) – 3 copies
- Final Report on Roads and Lanes, Birgunj,(Final drawing vol-3B) – 3 copies
- Clarification notes on Draft Final report- 3 copies

Regards

Shailendra Shresth
Project Manager
Project Manag

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E-mail:stiueip.birganj@gmail.com Website : www.birganj.gov.np

Design & Supervision Consultant for Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP)
Birganj Sub-metropolitan City, Nepal

SMEC In Association with BRISBANE CITY ENTERPRISES PTY LTD BDA CEMAT

Ref. No. – STI -161/070/71

Dates: 24 December, 2013.

TO,

Mr. Shailendra Shrestha.
The Project Manager, STIUEIP
Project Implementation Unit,
Birgunj Sub-Metropolitan City, Birgunj

Sub: - **Submission of Final Report on Roads and Lanes.**

Dear Sir,

We are glad to submit five copies of Final Report on Roads and Lanes for STIUEI Birgunj for your kind review and approval incorporating all the comments given on Draft Final Report. The repot has been submitted in two volumes as mentioned below;

1. Main Report Volume - 3A
2. Final Drawings Volume - 3B

Five copies of Clarification Notes has also been enclosed along with the Final Reports. We will highly appreciate your kind cooperation in this regard.

Sincerely yours,

Nagendra Jha
Team Leader, DSC
STIUEIP,Birgunj
SMEC in association with
DCI/BDA/CEMAT

Birgunj Sub-Metropolitan City
STIUEIP
Birgunj
Reg. No. 250/060/069
Date: 2060/8/9

in association with

Brisbane City Enterprise Pty Ltd – Australia
Building Design Authority – Nepal
CEMAT Consultants – Nepal

Final Report: Roads and Lanes
Main Report Volume -3A

Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP), Birgunj, Nepal

Birgunj Sub Metropolitan City, Nepal

September 2013

AUSTRALIA | ASIA | MIDDLE EAST | AFRICA | PACIFIC

in association with

Brisbane City Enterprise Pty Ltd – Australia
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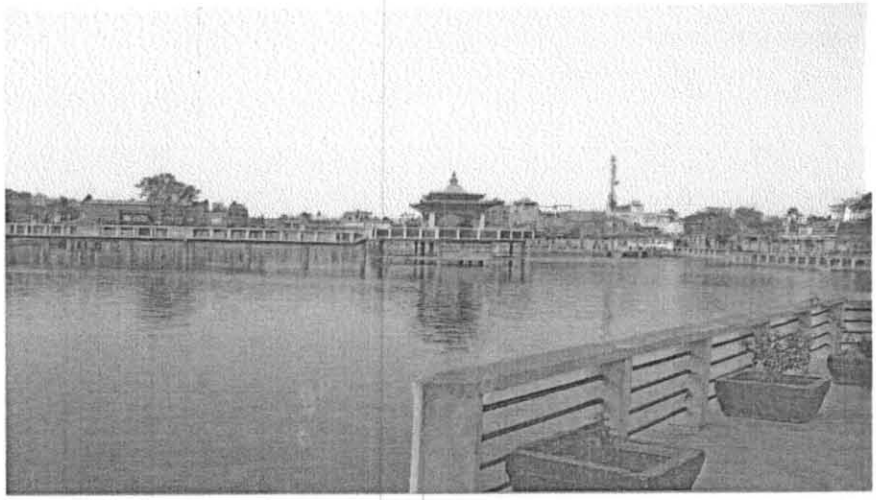
Final Report: Roads and Lanes
Main Report Volume -3A
Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP), Birgunj, Nepal



Birgunj Sub Metropolitan City, Nepal

September 2013

AUSTRALIA | ASIA | MIDDLE EAST | AFRICA | PACIFIC

Project Name:	Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP), Birgunj, Nepal
Project Number:	5064023
Report for:	Birgunj Sub metropolitan City, Birgunj, Nepal

PREPARATION, REVIEW AND AUTHORISATION

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
	September 2013	N Jha, Team Leader C M Ghimire, Roads Specialist.	Pramod Kumar Mafuzur R Khan	

ISSUE REGISTER

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Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP), Birgunj, Nepal

ADB-2650-NEP (SF)

For: Birgunj Sub metropolitan City, Birgunj, Nepal

SEPTEMBER 2013

ACRONYMS

ADB	Asian Development Bank
APs	Affected Persons
BoQ	Bill of Quantities
CBS	Central Bureau of Statistics
CDP	Community Development Plan
CDTA	Capacity Development Technical Assistance
DDC	District Development Committee
DSC	Design and Supervision Consultant
DUDBC	Department of Urban Development and Building Construction
EIA	Environmental Impact Assessment
GESI	Gender Equality and Social Inclusion
GIS	Geographic Information System
GoN	Government of Nepal
IEE	Initial Environmental Examination
MIS	Management Information System
MPPW	Ministry of Physical Planning and Works
MoE	Ministry of Environment
NGO	Non-Governmental Organization
NLSS	Nepal Living Standards Survey
O&M	Operation and Maintenance
PCO	Project Coordination Office
PIU	Project Implementation Unit
pph	people per hectare
PPTA	Project Preparatory Technical Assistance
QA&QC	Quality Assurance and Quality Control
3R	Reduce, Reuse and Recycle
STIUEIP	Secondary Towns Integrated Urban Environmental Improvement Project
SWM	Solid Waste Management
TDF	Town Development Fund
ToR	Terms of Reference
UEIP	Urban Environmental Improvement Project
UNDP	United Nations Development Programme
VDC	Village Development Committee
WWSP	Waste Water Stabilization Ponds

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1 INTORDUCTION

Urban roads and lanes are the infrastructure connecting various parts of a town for the sake to provide the smooth transportation facilities for the people and goods within and outside the town. The main objective of the Urban Roads Design is to reduce the total street length rather than its width. The objective of this report is to present the draft detail design of the road improvement works proposed under Birgunj Sub- Metropolitan City. Within the Birgunj city, many roads and lanes/streets are in existence in blacked topped, graveled and in earthen road. The consultant has designed those roads for their improvement that entails reinstatement, rehabilitation and upgrading on case to case basis. Four roads are designed for new construction for which the details are provided under the topics of new roads.

2 CLASSIFICATIOIN OF URBAN ROADS, LANES AND EXISTING SYSTEM

Urban Roads are classified according to their functions in the movement of people and goods in a particular urban area. Urban roads include through-traffic arteries, freeways, parkways, intersections and interchanges. All together there is about 280km length of roads in Birgunj city. In the context of Nepal, urban roads are basically classified under the following categories:

i) Arterial Roads:

Arterial Roads are differentiated as per the volume of traffic they serve, high or low. Under prevailing condition, traffic volume in Birgunj is relatively high compared to other cities in Tarai. Birgunj Municipality has relatively good internal road network in the west part of Main Bypass road whereas, the road network in the east of Main Bypass road is in the process of rapid growth in commensurate with the increase of settlement. The road network extension as of now is being carried by the Birgunj Municipality with its own resources. Arterial Road can be categorized as major and minor arterials. In case of Birgunj, Tribhuvan Rajpath (TRP) and other parallel north-south road which is named as Main Bypass Road serve as major and minor arterial. The Main Bypass starts at Gandak Chowk in the North and ends at Rajat Jayanti Chowk in the south. Padam Road which is the part of Postal Road is minor arterial or secondary Urban Road in Birgunj.

ii) Connector Roads:

Connector Roads are also known as collector roads and these roads are designed to flow the traffic from residential streets to the arterial roads. There are many connector roads in Birgunj Municipality. Typical examples of connector roads in Birgunj are Railway Road, Ghantaghar Link Road, Bypass Link Road and Haji Ali Road. Apart from that Inerwa Link Road which passes through proposed Solid Waste Management Site and traverse further east of Bara district, TRP to Chhapkyiya and few others are the typical examples of Connector Roads. In fact the municipal roads other than Arterial and Access are connector roads.

iii) Access Roads:

Residential feeder roads are known as access roads. The traffic from access roads is fed to the connector road except for in few cases when the traffic from access roads may be connected directly to the arterials road. In case of Birgunj there are several access roads traversing east to west and north to south of the city that connect the residences with arterial or connector roads.

The main objective of urban road design is to reduce the total street length rather than its width. But in case of Birgunj Municipality, almost all urban roads and lanes/streets are in existence and the consultant has to design for reinstatement, rehabilitation and upgrading of existing roads and lanes rather than planning of new roads. However, there are two roads which are planned to be newly constructed under the scope of STIUEIP during PPTA study. They are Second Bypass Road and Canal Road. These are recommended for construction by DSC too. Apart from that a new access road to STP site is also under consideration

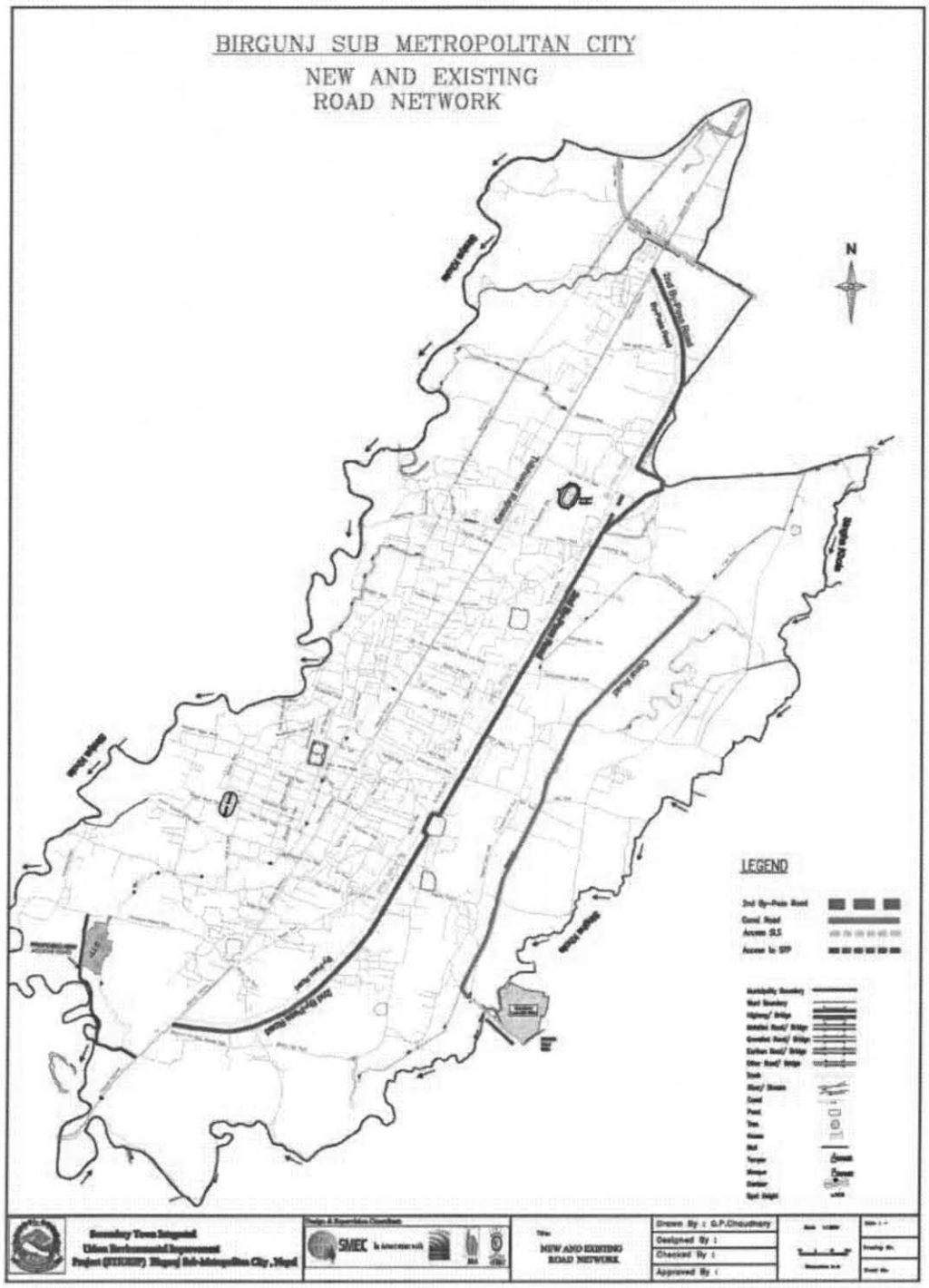


Figure 2 - 1: New and Existing Road Network in Birgunj

3 PROPOSED NEW ROADS IN BIRGUNJ

Two new roads were proposed in the PPTA Report for Birgunj under the scope of STIUEIP. These two roads are also recommended by DSC. Apart from these two roads, during site visit by the DSC, it was observed that the existing access road to the proposed STP site is too narrow and passes through the congested poor settlement of Chhapkaiya. Therefore, it was suggested to seek a new alternative access to STP site. The new roads in Birgunj under the scope of STIUEP including the alternative access to STP site are:

1. Second Bypass Road,
2. Canal Road
3. Access Road to Sanitary Landfill Site and
4. Alternative Access Road to STP Site.

3.1 Second Bypass Road

Second Bypass Road is planned to construct next to the existing Bypass Road in 40 m east parallel to the existing Bypass Road. This road is the inner road designated for local access during land development by the Town Development Committee with the RoW of 12m. The Town Development Committee allocated this space for the access to the developed plots on both sides, but could not complete the road construction work. At present stage, this width is encroached at some locations which need to be cleared. The road, except for few hundred meters is not constructed. During rainy season these road space works as drainage canal. The drains Div 12 and Div 13 are planned for the evacuation of the storm water in this area underneath this road. Therefore a two-lane road is proposed under this project with the Category III Access Road R1 as per the MSUD Urban Road Standard. The total length of this road during PPTA was considered only 4.42 km linking Pratima Chowk in the north to Inarwa Road in the south. During site visit it was noted that the road was required parallel to the existing Bypass from Gandak Chowk to Janajagrirti Chowk which is 7.645 km in length. It is proposed that a parallel storm water gutter type surface drain would follow in each side of the road along side of the footpath and a pipe drain in the middle of the road which will receive the storm water from the road through water inlets provided on each side of the road at frequent intervals. There was no need to study the alternative routes for this road since the DSC has to finalize the design along the predefined alignment. A typical section of Second bypass road is attached in the volume of Drawings.

3.2 Canal Road

Considering the other two drains in priority in the municipality i.e. Div 12 A and Div 13A, a 4-lane road was proposed along the existing disused irrigation canal. It was expected that this road would further attract new development in Birgunj and reduce sprawl in other parts of the city. The canal has its present RoW 12m in average. To accommodate 4-lane road (i.e. 20 m wide) additional land needed to be contributed by the neighbouring land owners. Five meter width of land was expected from the land owners of either side of the road during PPTA study, which would boost the value of land compensating the contribution. It was proposed that this road would be of Category II Connector Road C2 as per the Municipality Services and Urban Development (MSUD) Urban Road Standard. With the funding limitations, it will not be possible to construct the entire length of the road. Therefore, it was proposed to construct central part of the road starting parallel to Pratima Chowk and ending at Inarwa and By-Pass Road junction. Total length proposed for construction by PPTA was 6.34 km but due to the budget limitation further reduction was made during detail design and only 3.564km length is considered by the

DSC for this phase of study. Also, presently it has been learnt that the locals are not ready to donate the land and the Municipality is not in position to acquire the land by providing compensation. Therefore, it has been compromised to make a new road of exactly the same section like proposed Second Bypass Road. For Canal road the option study for the alignment was not necessary since the consultant have to design the road on the predefined alignment of defunct canal.

3.3 Access Road to SLS

This road starts from the end of the canal roads and ends at eastern extreme point of Sanitary Landfill Site (SLS) at another canal road. The length of this road is 576m. In fact this road is upgrading of earthen road to bituminous standard in some portion where as in some portion totally new road will have to be constructed. Since this road in entire length has to be widened, raised to overcome the inundation problem and also new alignment in some portion is required due to social problems hence, it has been categorised as new construction. This road has been designed as 2 lane road with gravel shoulder of 1.5 m on either side.

During detail design phase when preliminary design was completed the DSC after the complaint from the locals and subsequent request of the PIU to revisited the survey and design in the vicinity of existing bridge, it was learnt with the help of the municipality land surveyor (amin) that the existing alignment in the vicinity of the bridge over Singaha river falls on the private property. The land acquired for the road is on north side of the existing alignment. Design of the road was revised based on the joint field verification and subsequent revised detail topographical survey of the spot. The alignment of access road to SLS follows the existing road. The design had been completed accordingly.

Later, after completion of design PIU informed that the existing alignment in the vicinity of Singha River falls on private land. So the road should be shifted towards north and constructed new culvert about 15m upstream of existing culvert. However, PIU until finalization of this report have not identified the exact route meant for new road construction. Therefore, it has been decided to shift the road alignment once the PIU identifies the exact land which has already been acquired for the road. The detail design is presented in separate volume of drawings.

3.4 Access Road to STP from TRP at Customs Office

This road was not envisaged during PPTA study. During the DSC's first site visit it was observed that the existing access road leading to STP was traversing through the heavily crowded village of poor community. Possibility of widening the existing road was not there due to the number of houses to be demolished along the road side. Also the geometry of the road was not up to the marks for the movement of construction vehicles during construction and post construction phases. Therefore, it was suggested that the client should consider alternative possible route routes.

Following the suggestion by the consultant, the Client advised to study the alternative new Access Road to STP from the west side of Main Nala MD1) from Customs Office Chowk. The DSC visited the site and prepared 4 possible options prior to discussing with the client to finalize the alignment. All four options follow the same route from Bhansar to MD1 and from south-west corner of STP to Chhapkaiya-Sitapur Road. The alignment has been studied dividing in four options. Brief description of all 4 options studied is as follows:

- **Option I:** The alignment after crossing MD1 heads towards west about 200m along the existing earthen road until Sirsiya River Bank and heads further west along the bank of the river another about 400m and takes a right turn towards north and traverses through cultivated land to reach the south-west corner of the STP. From there on the alignment traverses from the west side of STP abutting to it to meet the Chhapkaiya-Sitapur Road.

- **Option II:** The alignment after crossing MD1 heads towards west about 200m along the existing earthen road until Sirsiya River Bank and takes a turn towards north and traverses through cultivated land to reach the south-east corner of the STP. From there the alignment turns towards west to meet option I at south-west corner of the STP.
- **Option III:** The alignment after crossing MD1 follows the right bank of MD1 Nala and reaches south-east corner of the STP. Then after the alignment will follow the alignment of option II. This alignment is serpentine shape until it reaches south –east corner of STP hence not desirable.
- **Option IV:** The alignment after crossing MD1 traversed diagonally nor-west to reach south-east corner of STP. While following this alignment, the land plots which are in north-south and east –west grid system gets divided diagonally and the left over land will not useful for house construction in future. Therefore, this option is also not recommendable.

Out of all above 4 options, option I seems to be most appropriate from geometric, social and environmental points of view. But this alignment in some portion around in 400m is close to the Indian border. There might be trans-border problem during construction. Therefore, the road has been designed along the alignment of both options I & II so that in case if the road construction along *option I* is not possible due to border problem then option II could be used. Being more length and construction quantity in option II, it has been considered for construction at this time. During implementation, if there are no any problems to adopt option I, it will be constructed since it is the best option from every point of view.

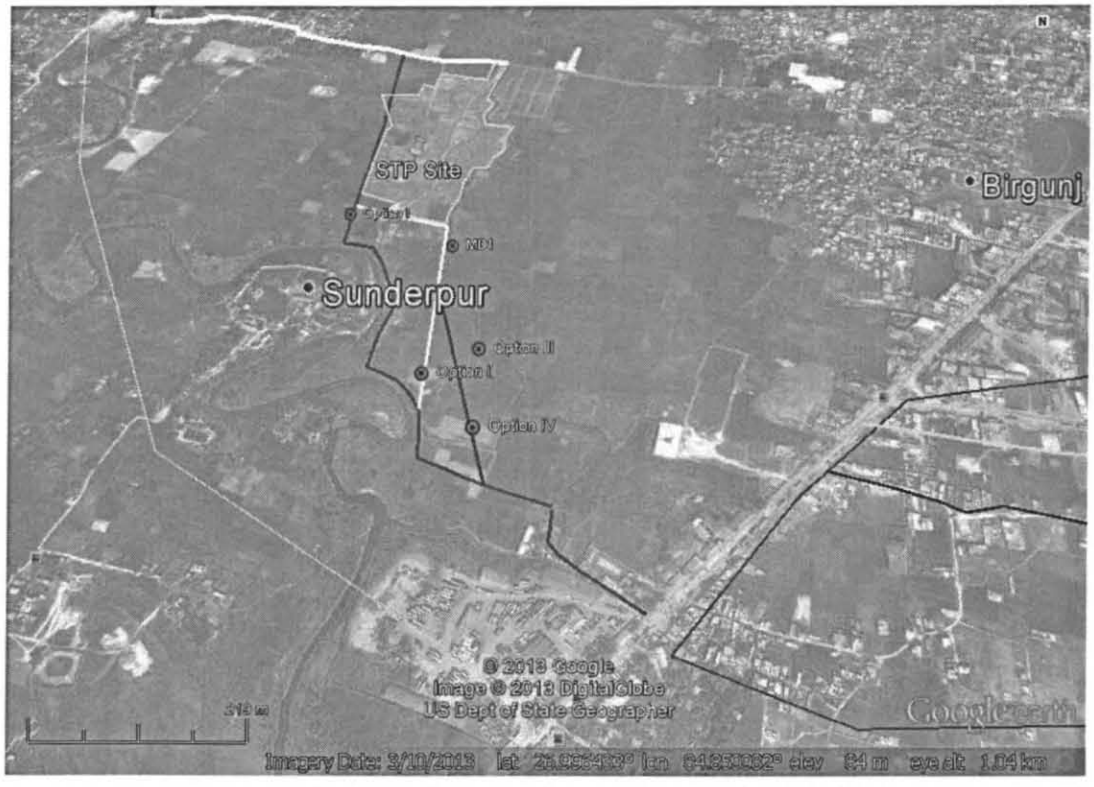


Figure 3 - 1: Option Study for Access to STP in Google Map

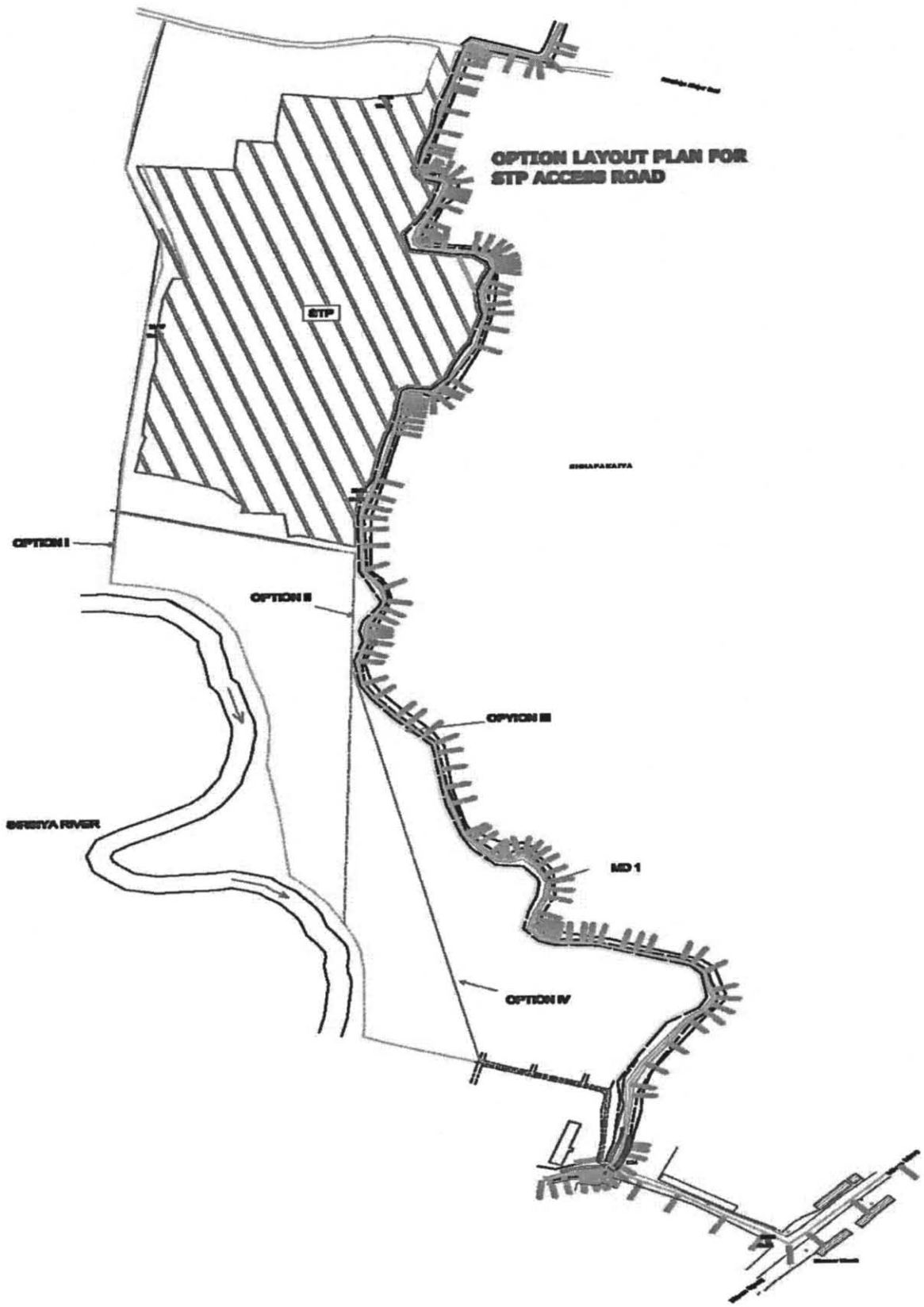


Figure 3 - 2: Options of Access Road to STP

Figure 3 - 3: Proposed new Roads in Birgunj

4 SCOPE OF WORKS

Among others improvement of Urban Roads and lanes in Birgunj Town/Municipality is one of the major components of consultant's scope of works under STIUEIP.

The scope of the consulting services under improvements of Urban Roads and Lanes is:

1. *Survey conditions of pavement and assess adequacy of drainage system for the identified roads and lanes, including detail conditions of bridges and other cross drainage structures, if any.*
2. *Carry out traffic analysis and provide 10 year forecast for pavement design; and*
3. *Ensure that road safety issues identified during design stage are properly addressed during construction and ensure that a road safety audit is undertaken on completion of works.*

4.1 Survey conditions of pavement and assess adequacy of drainage system for the identified roads and lanes, including detail conditions of bridges and other cross drainage structures, if any.

The following studies were carried to assess the condition of existing roads, drains and other structures so that accurate and optimum design could be carried out for new construction of a few roads, reinstatement, improvement and upgrading of existing roads following the construction of sewer lines and storm drains so that overall environment of Birgunj Municipality is improved. The study under this scope also includes detail topographical survey and inventory of roads and structures. The feedback of these studies is incorporated in detail design.

4.1.1 Desk Study

The consultants from the beginning of the project collected the previous study documents and studied to be familiarized with them. The main previous study documents were the PPTA and other documents/information related to the roads of Birgunj prepared by Birgunj Municipality and other organizations. Apart from that the DSC also collected the topographical map of the city and studied them. During the course of desk study the DSC approached to various offices from where the feedback for the design could be obtained. Coordination with various offices was important because it helped in getting information regarding their planning to carry out any physical construction activities in the city. It helped the DSC to finalize the design so that there was no duplication in design or missing of any important construction which is very important for a complete and comprehensive design of roads in Birgunj Municipality.

During desk study the DSC identified the roads and lanes to be improved or upgraded in Birgunj Municipality under the scope of STIUEIP. The scope of works under improvement of roads and lanes in Birgunj is mainly to construct a few new roads as mentioned above, upgrade certain section of gravel roads, reinstate the roads (asphalt, gravel or concrete) damaged during construction of Sewer/or storm drains and upgrading of lanes in poor settlements.

The desk study which was done in coordination with Sewer and Drainage Engineer has shown that about 10 km collector sewer, 37 km branch and lateral sewer in central part of Birgunj (in core area) and about 87 km of storm drains would be the scope of STIUEIP. If the length of sewer or storm drains is increased, more road works would be required. Therefore, the cost of new road construction, reinstatement, improvement and upgrading is dependent on the scope of sewer and storm drains. Only one road which is leading to STP is planned to construct where there is no sewer. However, the road side drain/storm water drain is required for this road too.

4.1.2 Reconnaissance Survey

After completion of preliminary level desk study the consultant's team comprising various experts made the reconnaissance level field visit in February and March 2012. During these site visits the consultant's team met with the project officials and conducted various meetings. During meetings and several other occasions, the team was apprised with many important information/issues of the project by the project officials.

Besides meeting with project officials , the consultant met with various stakeholders like Birgunj Municipality, DoR Division Office, ward offices and informed them about the purpose of our visit and also requested all the concerned to provide the project related information and cooperate the DSC in producing the optimum design for the Improvement of environment in Birgunj Municipality.

After meeting with the project officials and other stakeholders, the consultant's team made the preliminary level site visit to visualize and assess the existing infrastructures in the city, took the photographs of various structures, roads, drains and collected the relevant information to the extent possible. Based on the output of desk study and reconnaissance level field visit assessment, the DSC prepared the Inception Report. The inception report was prepared and submitted to the client for their review, comments and suggestions as per schedule on 15th April 2012 and presentation of Inception Report was also made in PIU, Birgunj.

4.1.3 Detail Field Visit Survey

After submission of Inception report the DSC again carried out the vigorous study of previous study reports, drawings and other secondary data related to the project area, visited the site and gathered more information related to the project. The consultant based on the outcome of those studies and field visit observations prepared the design criteria and catchment conceptual plan on various dates and presented the Catchment Concept plan in PCO, Babarmahal Kathmandu.

4.1.4 Detail Topographical Survey

Initially DSC had planned to start the detail topographical survey immediately upon completion of the submission of Inception Report. Unfortunately, due to some administrative problems commencement of detail survey was delayed by several months from targeted schedule. Moreover, nationwide strikes, closures and unrest obstructed to prepare the prerequisite documents for survey works for about two weeks. Monsoon had already started before finalizing all the administrative procedures related to the survey works and it could virtually started after monsoon and that too was disturbed due to the festivals. Survey works could be carried smoothly only after festivals, i.e. from mid November 2012. The delay in survey work has affected the entire schedule of design and consequently the submission of reports. The methodology of detail survey is as mentioned below:

Methodology of Detail Topographical Survey:

Based on the knowledge and experiences gained during desk study, field reconnaissance survey, discussion and meeting with the project officials, the DSC have prepared detailed methodology for undertaking further task for the detail topographical survey and design of various infrastructures in Birgunj Municipality to improve the environment, which are as follows:

Topographic Survey:

Though the Municipal road networks consist of about 200 km road length, in initial stage it has been agreed to carry out the detail survey not exceeding 90 km road length. Following the understandings reached between the PIU (Client) and DSC, the consultant had mobilized four

survey teams consisting of senior surveyors along with required numbers of assistant surveyors. The road survey consists of a strip survey along the selected road alignment covering road corridor, whereas the detail survey for treatment plant sites, solid waste management site and outlets of storm drainages cover the entire areas where the infrastructures will be constructed as well as some additional areas that might require producing a complete design.

The detail topographic survey among others consists of the Bench mark survey, base line survey and detail topographical survey along the roads where sewer and storm drains are proposed for the production of Digitized Terrain Model (DTM). The survey work includes establishment of base line stations, horizontal and vertical control points and permanent reference beacons. Permanent Benchmarks are established in entire project area maximum at 500m intervals so that further Benchmark survey is not required should the scope of works increased later. Adequate numbers of base line station are established at certain intervals so that these could be used during construction as well. Mapping of the road corridor are also being completed during the same operation to enable the design/construction quantity to be calculated and structures acquisition requirement to be identified.

All survey works are carried out using national grid point and national datum point established by the Department of Survey. This ensures that the topographic maps are in the same projection system as maps produced by the Department of survey including the grid sheet based cadastral map.

The topographical survey has collected adequate data to show the following details in the subsequent topographical map:

i) Topography with details such as: trees, water bodies, high-flood level
ii) Existing road details such as: formation width, paved area, access roads, bus bays, footpath, parking places, traffic signs, islands, signals and ROW limits
iii) Existing cross-drainage details such as: pier, abutment, railing, river training works
iv) Existing power line details such as: high-tension poles, low-tension poles, transformers, manholes
v) Existing telecommunication details such as: poles, man-holes, cabinets, OFC routes
vi) Existing water supply line details such as: supply mains, valves, valve chambers, hydrants
vii) Existing sewer line details, if any such as: trunk sewers, manholes
viii) Existing buildings such as: religious shrines, governmental building, residential building, compound walls
ix) Production of a map of road corridor in 1:1000 scale and with 0.2m contour interval
x) Acquisition of coordinate point from the Department of Surveys and referencing of all the survey coordinates to that obtained from the Department of Survey
xi) Establishing bench-marks at a maximum distance of every 500m or at suitable intervals along the road and other places like in solid waste management site and STP site.
xii) Establishing base line stations at an appropriate distance so that at least base line stations are intervisible along the road alignment.
xiii) Collect data and prepare D-Card Report.

Despite delay start and frequent disturbances, the DSC by the time of preparing this report has completed the detail topographic survey for all the agreed roads and drainage alignments. During the progress of survey works, PIU (the Client) was informed that the decision/instruction for further survey works, if required, was given prior to demobilizing the survey groups so that additional financial burden due to demobilization and remobilization of the same could be

avoided. The instruction for additional survey has not been made till the time of this report preparation.

4.1.5 Inventory of Existing Roads and Structures:

A preliminary level inventory of roads and structures within the project area was carried during the various site visits. Photographs were taken during site visit observation of the roads and structures. During preliminary site visit observation it was noted that surface of most of the bituminous roads are damaged and attempts for repair and maintenance were not made by the Municipality and Department of Roads, apparently due to the project being in pipe line. The internal storm drain networks in core city area found provided adequately but most of these drains found filled with debris and maintenance crews are not deployed. Routine maintenance of roads and drainages is lacking. Due to poor or no routine maintenance the existing drains are not functional. Apart from providing the new drains, it was noted that the existing drains need to be cleaned to make the entire drainage system functional.

A detail inventory of roads, drains, bridges, culverts and other structures were carried in later stage prior to finalizing the design and this report. As mentioned earlier, bituminous road surface is badly damaged and they will get further damaged during construction of sewer and storm drains.

Where possible it is suggested that the sewer and storm drains are constructed away from the asphalt carriageway so that damage of the same is not happened. This is possible in entire length of bypass road and some portion of TRP, especially from Gandak Chowk to Ghantaghar where the road width is enough to accommodate the sewer and storm drains on either side of the road. In other roads, sewer should be placed below the main carriageway.

From the inventory of site visit assessment it is concluded that apart from the reinstatement of damaged portion due to construction of sewer and storm drain a layer of minimum thick asphalt overlay in entire road width is recommended so that the life of road pavement is increased thereby reducing the ingress of surface water into the pavement layer and preventing the breakage of pavement from the joints of old and new asphalt. Minimum thickness of asphalt overlay is recommended 25mm for minor roads and 40-50mm for major roads like TRP and bypass roads.

Two major cross drainage structures will be required to construct In Birgunj under the scope of the Project. One is over Singaha River along access road to landfill site and the other is above MD1 in the west of Bhansar along the proposed new road leading to STP. The existing bridge over Singaha River is very old and is in dilapidated condition. The alignment of new road to landfill site will be shifted some 10-15 meter north of the existing bridge site and the bridge location will also be shifted towards north due to the present alignment falling on private land. Either 8-10 m span bridge or 2x5m span slab culvert is required above Singaha River.

There is a very narrow culvert above MD1 in the west of Bhansar along the proposed new road to STP. The size of the culvert is too narrow and structurally it is weak to withstand the construction and other traffic in future. Apart from that the culvert is not located in proper position so that it could be incorporated in the new road. Hence a new culvert of about 5-6 m span will be required to construct a few meter north of the existing slab culvert. The other existing minor cross drainage structures in the city will be checked by the drainage team for their capacity and strength. The existing cross drainages will be improved or provided new as required.

The existing roadside drains and culvers are in good condition but are filled with garbage and therefore not functional. They need to be cleaned and improved if required. To improve the drainage system in Birgunj, the drainage design team has carried detail inventory, detailed survey and completed the design of drainage networks in Birgunj to make the city relatively

inundation free. However, there might be inundation for some time during rainy season particularly when there is incessant rainfall. Birgunj being located in lowland area and having inadequate outlets, inundation is inevitable during heavy rainfall. Therefore, this needs to be informed to all stakeholders prior to the construction of the drainage works so that every one would know what can be expected from the project after its completion.

4.2 Carry out traffic analysis and provide 10 year forecast for pavement design

Present traffic analysis is required to forecast, work out and establish the design traffic for pavement design of estimated design period. In our case we have to analyze and forecast the traffic for 10 years design period. Traffic analysis is also required for urban planning. DSC opines that the scope of study under this heading is not only limited to forecast traffic but also to carry out detail engineering design; both geometric and pavement. The consultant have carried the detail geometric design, pavement design, produced the drawings, appropriate BOQ and have incorporated in bidding documents. To carry out the abovementioned activities the consultant after completing the detailed survey and inventory prepared the Standard Design Criteria and carried the geometric and pavement design as mentioned in the following chapters.

4.2.1 Standard Design Criteria for Urban Roads

Standard Design Criteria for Urban Roads are worked out based on the parameters provided in various literatures like; Design Manual for Urban Roads, Nepal Roads Standard, Design Standard for Feeder Roads, Transport Research Laboratory (TRL, UK) publications, best practices being used in Urban Roads Design and other relevant documents. These standard criteria can be complied providing the required space is available for improvement/upgrading/new construction. Otherwise, we shall have to improve the roads on available road width. In Birgunj Municipality most of the roads are already opened and the Row is fixed. Possibility of widening the existing roads to meet the standard of Urban Roads requirement in this stage is very slim. Nevertheless, maximum efforts will be made to improve the existing roads and lanes during upgrading/reinstatement where possible. Where new roads are planned to construct the below mentioned standard design criteria for urban roads shall be adopted.

Table 4 - 1: Standard Design Criteria for Urban Roads

Urban Roads in Birgunj				
Design Parameter	**Arterial Roads**	**Connector Roads**	**Access Roads**	**Reference**
Design Speed (km/h)	50	30	25	Urban Roads
Lane Width (m)	4	4	3	Urban Roads
Maximum gradient (%)	3	3	3	NRS
Minimum horizontal curve radius (m)	90	35	25	NRS
Minimum length of vertical curve in (m)	NA	NA	NA	NRS
Stopping sight distance (m.)	65	30	25	NRS
Super Elevation (%) (max)	7	7	7	NRS
Cross fall (%)	2.5	2.5	2.5	Urban Roads
Maximum extra widening (m)	1.0	1.50	2.50	NRS
Minimum culvert size (mm	600	600	600	NRS
Parking Width (m)	3	3	3	Urban Roads

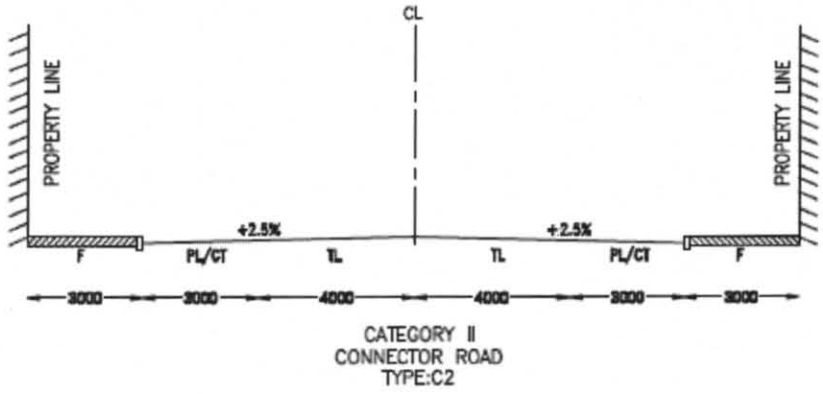
Urban Roads in Birgunj				
Design Parameter	**Arterial Roads**	**Connector Roads**	**Access Roads**	**Reference**
Median Strips (m)				
a). Arterial Road Type A1& Connector Road Type C1	4	4	NA	Urban Roads
b). Arterial Type A2&Connector Type C2	4	NA	NA	
c). Arterial Type A3	NA	NA	NA	
Footpath (m)	3	3	2	Urban Roads
Intersection Design	At Grade	At Grade	At Grade	
Traffic Control at Junctions*	Using Traffic Signs	Using Traffic Signs	Using Traffic Signs	Traffic Signs Manual
Pedestrian Crossings**	At Grade	At Grade	At Grade	
Pavement Design in combination of	Sub grade CBR &Traffic Class	Sub grade CBR &Traffic Class	Sub grade CBR &Traffic Class	TRL Overseas Road Note 31
Safety Design				Traffic Signs, other standards and practices

* Signalized Traffic control at junctions can also be considered.

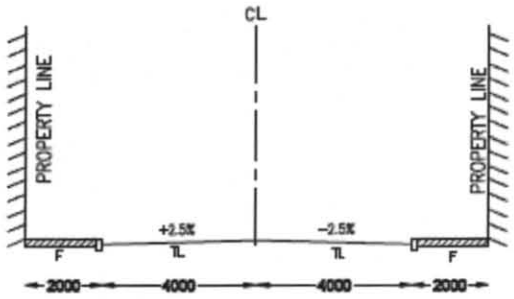
** Flyovers can also be considered budget permitting.

The above mentioned planning and design are the principle of urban road development. These planning and design are relevant in case of new town planning and construction of new urban infrastructures. In case of Birgunj Municipality environment improvement, fulfillment of above requirement is hardly possible and we will have to compromise with the available road widths, geometry and other features. Where possible the above principles of urban road have been applied during finalization of the design. Moreover, it is to be noted that there are only 4 new roads under the scope of STIUEIP viz., Second Bypass Road, Canal Road, Access Road to SLFS and Access Road to STP. The standard design criteria will be used to design these roads. For the improvement or reinstatement of other existing roads we will have to compromise with various parameters and adoption of above design standard is not possible.

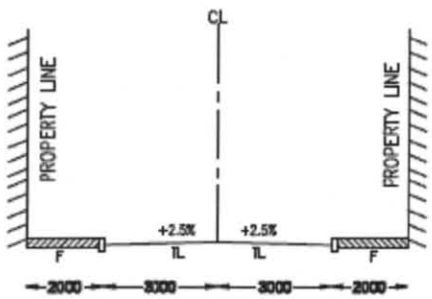
Some typical sections adopted/to be adopted as the design criteria/basis for roads design in Birgunj are shown below. However, as mentioned above the below shown standard typical sections are also modified to match with the specific site conditions.



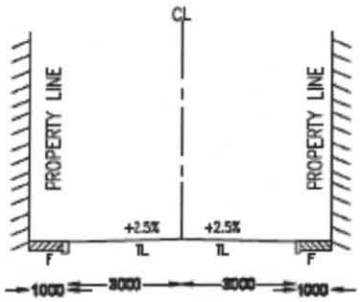
CATEGORY II
CONNECTOR ROAD
TYPE:C2



CATEGORY III
ACCESS ROAD
TYPE:R1



CATEGORY III
ACCESS ROAD
TYPE:R2



CATEGORY III
ACCESS ROAD
TYPE:R4

F: FOOTPATH
CT: CYCLE TRACK
PL: PARKING LANE
TL: TRAFFIC LANE

Cross Section of Road

Cross Section of Road

4.2.2 Detail Engineering Design of Roads in Birgunj

The detail engineering design consists of:

- Geometric Design
- Pavement Design

Geometric Design

Geometric design is the design of horizontal and vertical alignment of carriageway, roadside drains and footpaths along with median strips and parking lanes where applicable, intersections, junctions, roundabouts, pedestrian crossings etc. The geometric design will also consist of the design of roadside storm drainage and cross-drainage structures along the roads surveyed for reinstatement, improvement and upgrading.

The Roads Specialist along with the CAD Engineer is involved in detail engineering design of urban roads and lanes. They were also involved in supervising the topographic survey and other field investigation work required for the design of roads and lanes in Birgunj.

Geometric Design of Roads

The geometric design effectively superimposes a new, designed surface over the existing ground surface. The existing ground surface, modeled as a digital terrain model (DTM) is prepared from a detailed topographical survey carried out using accurate survey instruments such as Total Station, EDM and Level Machines. Geometric design is then prepared digitally, using the standard parameters of urban roads standard. The design parameters of urban roads are being adopted in finalizing the geometric design. The computer-aided design process then maps the design surface over the existing ground surface and evaluates quantities, profiles, and surface intersections, (fills, cuts etc) and produces design drawings and quantity estimates.

The design of road was prepared using AutoCAD and design software produced by Softwel Pvt. Ltd as follows:

- **SW_ DTM** for Digital Terrain Modelling
- **SW_ Road** for Highway Design

These soft ware **SW_DTM** and **SW_Road** are widely used in Nepal for the design of roads of all classes.

SW_DTM is software developed by Softwel Pvt. Ltd. and it provides complete package solution for Digital Terrain Modelling. This software has interactive module for plotting of survey points, triangulation and plotting of contours at any contour points at any contour interval. The program provides facilitation to extract data and draw plan, profile/cross-sections for any alignment and can be plotted in AutoCAD in any scale along with the data extraction as required by the designers/users.

Being the Terai urban roads, contours are being drawn in 0.25m intervals to prepare the DTM for design purposes. All the features like, roadside structures. Telephone poles, electric poles, transformers, tress, shrines, buildings etc are shown in the DTM.

SW_Road is road designing software which has been used for the design of existing Urban Roads for their improvement/upgrading. This software generates precise road design outputs considering all parameters of road design. It produces all plans, profiles and the cross-sections. The quantity calculation is done by the software and the output obtained in Excel format and drawings such as plans, profiles and cross-sections are produced in AutoCAD file format. The design inputs used in software is presented in **Annex I**

Methodology Adopted

Design will start from an accurate survey of existing roads and lanes and the design will be presented in two stages:

(a) A feasibility level design, which will offer design alternatives as possible solution to minimize construction cost and socio-environmental impacts and address safety concern. In addition to that at the core city areas of Birgunj Municipality, congestion prone locations will be identified, design option will be prepared for suitable works to alleviate congestion prone location and design options will be prepared for suitable work to alleviate congestion arising from motorized and non-motorized vehicles. Note that location/relocation of services based on information obtained from the service owners/providers will be initially addressed at the preliminary design phase.

(b) Following discussion with the client and inclusion of client's requirement a final and detail design will be completed. BOQ suitable for inclusion in bidding document will be prepared.

The major improvements recommended on urban roads of Birgunj are as follows:

- Raise the embankment to provide a minimum subgrade level of 0.5m or more above natural ground level or minimum 0.6m above highest flood level, to meet hydraulic requirements;
- Provide geometric parameters for the road to allow a minimum design speed of various types of urban roads
- Provide guard barriers at bridge and culvert approaches and where horizontal curves are sharp and where embankments are greater than 3m in height.
- Provide road signs, delineator posts, kilometer posts, etc. and additional signs where there is high pedestrian activity and a high possibility of accidents;
- Provide pedestrian crossings and speed controls at key locations outside schools, hospitals, junctions, settlement areas and in other places where there are high pedestrian movements;
- Provide RCC covered drain and paved footpaths at built-up areas;
- Provide New Jersey type concrete barrier to separate the main carriageway and service roads in case of Tribhuvan Rajpath and Bypass Road on where required basis;
- Provide parking bays between paved footpath and properties at built-up areas where the space is available;
- Improve existing intersection roads and provide additional intersections at appropriate locations to allow the vehicles to R-turn or U-turn.

Finalization of Geometric Design:

Various aspects are considered during the finalization of Geometric Design of Urban Roads in Birgunj. Geometric design is carried on existing road networks basically for their improvement which entails geometric improvement, upgrading from earthen/gravel to bituminous standard, reinstatement/rehabilitation of existing asphalt roads.

Geometric design for the roads where the alignment has to be followed along the acquired land has been done to improve the alignment as per the requirement of Urban Roads Standards. Where a new road has to be designed in virgin areas, different options were studied, discussed with the client and detail geometric design carried on the agreed alignments.

The width of the existing roads varies for different roads. Moreover, the width of the same road is also varies from place to place. To finalize the design in such difficult situation, the DSC had checked the width of the existing roads from place to place, checked the available width (width between the property lines) and also checked the minimum RoW width fixed by the Municipality for various roads where applicable. ROW has not been fixed by the Municipality for many roads. DSC will suggest Municipality to fix the ROW for some important roads.

During finalization of geometric design especially the width of carriageway, the DSC has taken into consideration of all above three parameters, i.e. RoW, Limit of Property Line and the road width/available width between existing drains, if there is no drain available width between the property lines.

Where the available width is equal to or more than RoW, the road including the footpath is designed to cover the entire RoW. If the available width is less than RoW but more than existing road width, the road including footpath is designed to cover the available width. In case if there are lined drains on both sides of the roads, it has been tried to incorporate them in new design and use them as much as possible. The remaining available width between the property lines is utilized by providing additional width of footpath so that there would be no chance of further encroachment and the Municipality in future could upgrade the road and footpath as per standard criteria. Apart from that if there is any space left without blacktop between the drains, it has been considered to blacktop from one end of drain to the other end.

During finalization of geometric design it has also been observed the inconsistent width of road between the drains. It was very difficult to design the road width different from one chainage to another. To avoid these difficulties the DSC during finalization of geometric design has checked the existing road width in many places and adopted one which represents majority sections. However, road improvement will be limited to one end of the drain to another end and the remaining space will be utilized as footpath. Where there is no lined drain entire available width will be utilized for the improvement of roads, footpaths and provision of drains.

During discussion with the officials of the Birgunj Municipality it was learnt that the ROW has been fixed for TRP, 2nd bypass and Postal Road which is also known as Padam Road in Birgunj City Area. Apart from that the ROW for 2nd bypass road has been fixed 12m and land has been acquired. During PPTA study Canal road was considered to be 20m anticipating voluntary donation of 5m land from the people of either side of the road. During detail design phase it was learnt that the ROW of defunct canal is only 12m and the people are not willing to donate the land to make a road of 20 m so the design has been accomplished to be 8m carriageway plus 2m footpath on either side same as 2nd by pass road.

Birgunj Municipality has not fixed the ROW of other roads. House construction was and is being allowed leaving 1m set back from the edge of the existing roads. Municipality was advised to fix the ROW for each road like in other towns. During discussion, the Municipality officials and the Project Manager PIU had suggested the DSC to recommend the ROW for each road. Recommendation of ROW for all the roads of Birgunj Sub-Metropolitan City is not practical in this stage and also it is not covered under the scope of DSC. However, the Road Engineer of DSC in consultation with Urban Planner has prepared a list of ROW for some major roads of Birgunj Sub-Metropolitan City and presented in the table below. Apart from that it is also recommended that all internal residential roads are also improved to be minimum 6m wide in future.

Table 4 - 2: Recommended ROW for some Major Roads of Birgunj Sub Metropolitan City

Road No.	Road Name	ROW (m)	Remarks
1	TRP	50	Existing ROW is 28/20m. DOR are responsible for this road.
2	Bypass Road	33	Existing ROW is 33m. DOR are responsible for this road.
3	2nd Bypass Road	12	Current Design is based on 12m ROW
4	Canal Road	20	Current Design is based on 12m ROW
5	Access to Landfill Site	15	Current Design is based on 10m ROW
6	Access to STP	12	

Road No.	Road Name	ROW (m)	Remarks
7	Radhemai Road	20	
8	Daak Road	12	
9	Railway Road	20	
10	Padam Road	15	Existing ROW is15m. This road comes under the jurisdiction of Postal Road.
11	Bypass Link Road	12	
12	Laxmanuwa Road	12	
13	Kabi Shiromani Road	12	
14	Sahid Tej Bdr Amatay	12	
15	College Road	12	
16	Parsauni Road	12	
17	NMC Road	12	
18	Not known	12	
19	Not known	12	
20	Not known	12	
21	Not known	12	
22	Not known	12	
23	Not known	12	
24	Not known	12	
25	Link of Bypass and Padam	12	
26	Not known	12	
27	Not known	12	
28	Not known	12	
29	Not known	12	
30	Ghantaghar Road	20	This is a link road of TRP and Bypass
31	Not known	12	
32	Not known	12	
33	Not known	12	
34	Not known	12	
35	Not known	12	
36	Not known	12	
37	Not known	12	
38	Not known	12	
39	Not known	12	
40	Chhapkaiya Road	12	Link road of TRP & Sitapur west of Birgunj

Note: Above recommendation for ROW is purely consultant's view which was based on the assessment of present context and perspective of future development of Birgunj Sub Metropolitan City. However, it is the ultimate responsibility of the Municipality and DOR to fix the ROW. The existing ROW mentioned in the remarks column of respective roads is provided by the Municipality officials during interaction of DSC with them. Special documentation substantiating those information has not found.

Proposed Roads Alignment Plan shown in Figure: 4 -1

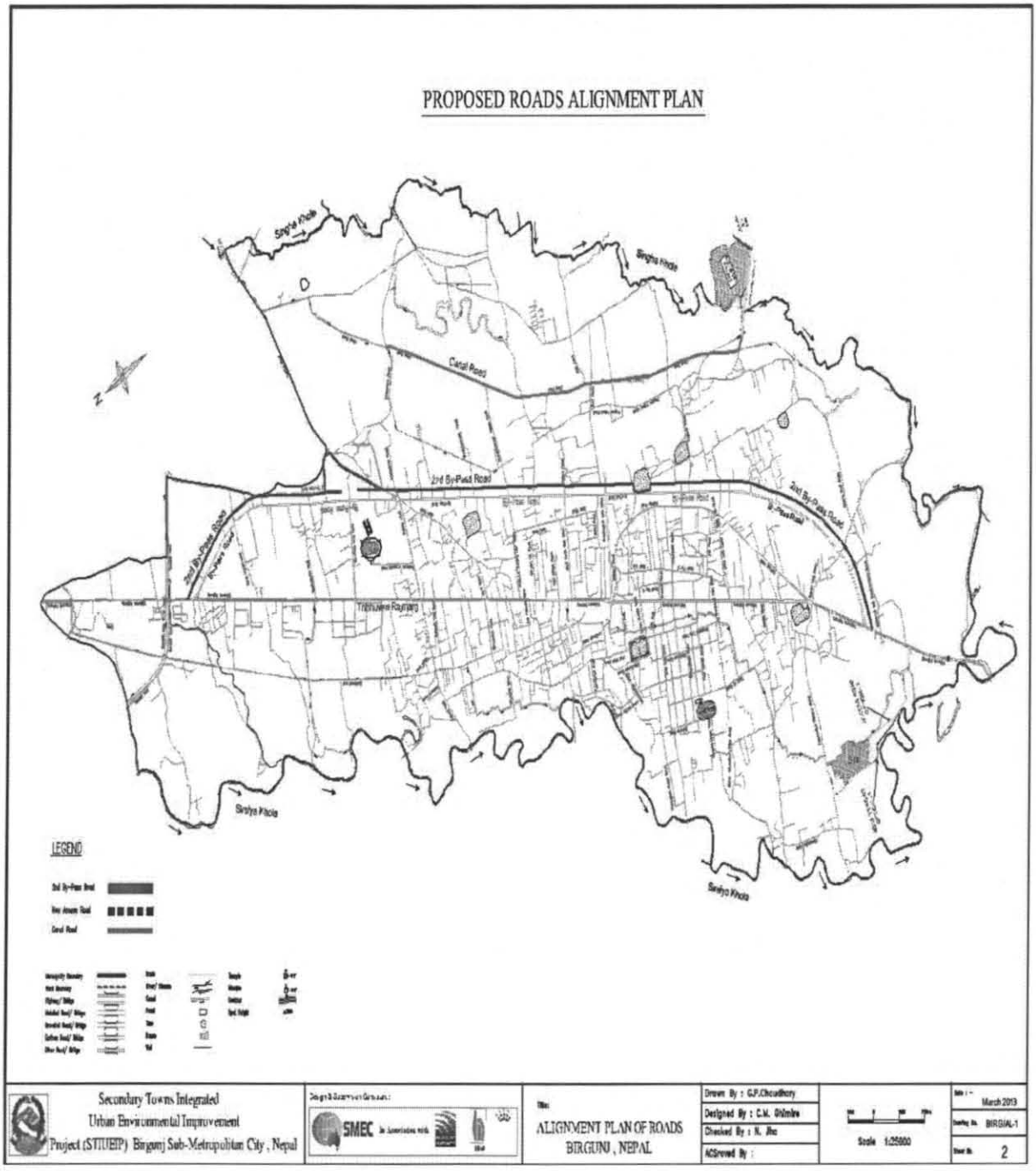


Figure 4- 1: Proposed Roads Alignment Plan

Some typical sections of proposed road in Birgunj are provided in the volume of Drawings.

4.2.3 Design of Intersections and Pedestrian Crossings

Design of Intersections

Introduction

Intersections are areas shared by two or more numbers of roads at a particular place. Such areas are designated for the vehicles to take turns to different directions of their choice. Its main function is to guide vehicles to their respective directions. Traffic locations are complex in the highways or in any roads. The complexity arises from the fact that vehicles moving in different directions want to occupy the same space at the same time. In addition to the vehicles, all sorts of traffic including pedestrians want to cross the road through the same space at the same time. This results in conflicts among the road users at the intersections. The number of conflicts depends on the number of roads meeting at the intersections. Drivers of vehicles and other users of the intersections have to make split second decisions at the intersections by considering the speed and directions of movement of other vehicles and users and its geometry. Therefore, the performance of the intersections determines the overall traffic flow and thus determines the capacity of the road.

Objective of Intersections

The objective of the intersection is to resolve conflicts among the road users at the intersection for safe and efficient movement of both vehicular traffic and the pedestrians. The objectives could be achieved by applying some control over the users of the intersections. There are numbers of ways that could be applied to control the intersections depending mainly on the numbers of traffic of all sorts using the intersections. There are two methods of intersection controls and these are time-sharing and space sharing. The types of intersection control depend on the traffic volume, road geometry, importance of the road cost involved etc.

Existing Intersections and Access Roads to the Highway

There are several major and minor intersections in the road network of Birgunj; they are mainly, Gandak Chowk, Ghantaghar Chowk, Rajat Jayanti Chowk along Tribhuvan Rajpath. Other major intersections are Pratima Chowk the junction of Bypass and Padam Road, and Bhanu Chowk junction of Bypass and Ghantaghar Road. Apart from these major intersections there are several other minor intersections in the city. There is small roundabout in Ghantaghar Chowk that helps to some extent control the flow of traffic. The minor intersections are not very important from traffic congestion point of view. The scope of works in these major roads under STIUEIP is limited to reinstatement of damaged portion. Therefore, improvement of major intersection is the scope of DOR. The Municipality will have to coordinate with DOR and request them to improve the major intersection when DOR will upgrade the road. The DOR is also planning to upgrade the existing road to six lanes standard and they will widen the roads and improve the intersections as required. Improvement of minor intersections in the city within the available width is possible under the scope of STIUEIP. However, these improvements are not significant.

Design of New Intersections

Generally, the intersection controls are termed as Passive control, Semi-Active control and Active control depending on the numbers of traffic of all kinds utilizing the intersection. The controls are mainly managed by time-sharing and space sharing among users. The types of intersection controls depends on the traffic volume, road geometry, importance of the road and cost involved etc. However, the present day volume of traffic of all kinds does not warrant active controls. Therefore, the major intersections in Bypass and TRP roads shall be designed for

semi-active controls with the provision of traffic signs, islands and channelizing the right turning traffic etc. In Strategic roads like TRP, Bypass and Padam Roads the intersection design is supposed to be carried by DOR. In all other minor or insignificant intersections having low converging traffic volumes from side roads, intersections will be designed to control the traffics by providing proper road signs.

Design of Pedestrian Crossings

The objective of providing the pedestrian crossing facilities is to assist the pedestrians to cross the road safely, while exercising due care and attention, with causing minimum delay to the vehicular traffic. Design of the pedestrian crossings is purely based on the nature and extent of the pedestrian traffic flow and it should also take into account the vehicular traffic at the particular place of crossing. There are many alternative methods to achieve the objective of the pedestrian crossings. However, the consultant has considered and provided the pedestrian crossings based on the pedestrian flow pattern, degree of saturation, volume of vehicular traffic, costs involved and the topographical lay out.

Generally, the minimum conditions, which require grade separated pedestrian crossing at a particular place, are:

- Three hundred people crossing the road per hour; or
- The vehicular traffic into any arm of the lane has an average headway of less than 5 seconds during the time that such traffic can flow and is conflicting with a pedestrian flow of at least fifty pedestrian per hour. The flow of the pedestrian and the vehicular traffic is the average of the four busiest hours over any weekday.

The consultant during inventory of vehicular traffic and pedestrians in the busiest hour noted that both of the above mentioned conditions are not prevailing even in most busiest road like TRP and concluded that grade separated pedestrian crossing is not required at this moment. However, it was noted that haphazard movement of mixed traffic made the road chaos and proper traffic management is the need of the hour. Provision of zebra crossing with proper road sign would serve the purpose for the time being. Along with increment of traffic movement at grade pedestrian crossing with signalized traffic signs and eventually grade separated crossing will be required on phase wise basis.

4.2.4 Pavement Design

Pavement design consists of geotechnical investigation of the proposed road, materials survey of proposed and potential quarry sites and laboratory testing on the samples collected from the site, traffic study and establishment of cumulative traffic for design period and finalization of the design thickness of various pavement layers of carriageway, parking lanes, footpath.

Geotechnical Investigation

Geotechnical investigation of the road is required to check the subgrade condition on which the pavement is constructed. This is basically required when the road is proposed for rehabilitation. When a road is rehabilitated the pavement layers are constructed on top of existing subgrade and checking of its strength is mandatory to determine the pavement thickness.

In Birgunj, either there is new construction or there is reinstatement of damaged portion of the road. Reinstatement is the new construction of damaged portion. It was good to investigate the condition of road subgrade and underneath even to finalize the scope of reinstatement, but due to the huge cost involvement for geotechnical investigation and soil sample testing, it was decided to do away these investigations in Birgunj. It was also suggested by PCO that the reinstatement would be done with the same pavement thickness as constructed earlier. It would save both time and money. The consultant had agreed with the PCO suggestions and

completed the design. The same principle will be followed for the reinstatement of roads in Birgunj which will save substantial amount of money required for geotechnical investigations.

For the construction of new roads investigation of subgrade is irrelevant. The roads will be constructed in embankments. They will be raised about 2 to 2.5 m from the original/existing ground. Subgrade will be constructed by fill materials. If encountered any weak spots in the foundation of the embankment they will be treated and constructed the embankment. The top 300mm of embankment will be constructed of better fill material to ensure the minimum subgrade CBR value of 8%. This requirement will be stipulated in the specifications so that the contractor during construction would arrange the better quality fill material to ensure the desired strength of subgrade. Since there is no chance being an inferior quality road without subgrade invetigations, the consultant as suggested by PCO for Birgunj roads has agreed and decided to do away subgrade investigations for the roads of Birgunj too. The minimum subgrade CBR value for pavement design will be considered 8% for new roads which S4 as per TRL ORN 31 Page 52.

Construction Material Survey

Preliminary assessment of the construction material deposit site has been made during field reconnaissance survey. During field visit it is noted that the Churiya Khola along side of TRP and a few streams along east-west highway are the potential sources for raw construction materials like subbase, base, aggregates, sand etc.

The materials from Churiya khola have been used in several used since long time and they meet the required strength and physical characteristics. Also the laboratory testing of those materials is not carried based on the suggestions made by the PCO for BirgunjProject. The consultant also collected information from those experts who were involved in the construction of Hetauda-Birgunj Road and confirmed about the quality of materials from Churiya Khola. Materials from the same quarry were used during rehabilitation of Hetauda-Birgunj Road some 12-15 years ago that entailed the construction of subbase, base and asphalt concrete. Regarding the adequacy, plenty materials are available in these quarries. The minimum CBR value of subbase and base course are considered 30% and 80% respectively. Requirements of other physical characteristics for subbase, base course and wearing course materials shall be stipulated in the specifications.

Traffic Study

In general the objective of the traffic study is to establish reliable traffic parameter for use in design Roads. But the case of traffic study in Birgunj is little different than that principle. As mentioned earlier, there is either new road construction along the route where there is no traffic at present or reinstatement roads which will basically be same as the existing pavement thickness. Where there is no traffic movement at all it is only the matter of projection of future traffic which is normally based on the development trend. The areas where new roads are proposed to construct seem to develop rapidly because the core area is already. It expected to be a lot of traffic movement along these roads once they are completed and the houses are constructed alongside the roads. However, being the internal roads not much heavy loaded vehicular movement is anticipated. Only few loaded trucks carrying construction materials and food stuffs will ply on the 2nd bypass road. It can be expected bit more heavy loaded traffic along canal road because this road will be used for carrying solid waste to landfill site from the different places of the Municipality. In overall it has been estimated that the projected ESAL for ten years starting from the base year end of 2016 would 0.7 to 1.5 million which is T3 as per TRL ORN 31 page 52.

Based on the combination of designed subgrade strength and projected traffic ESAL, the pavent layers as suggetsed by TRL ORN 31 is as follows:

Pavement Design Catalogue developed by TRL, UK is shown in appendix II.

Pavement Thickness

Apart from the above mentioned parameters, the consultant has considered various other aspects to finalize the pavement design such as:

- Reuse of existing pavement (base, sub-base etc) material where possible.
- Quality/Availability of construction materials
- Economic considerations

In our case the CBR value is more than 8 which represent Subgrade Class S4 as per the TRL Road Note 31. ESAL Value over the design period of 10 years is estimated to be between 0.7-1.5 Million ESAL which represents Traffic Class T3. Therefore pavement design has been completed based on the subgrade class S4 and Traffic Class T3 as shown in the Table 3 below:

Table 4 - 3: Pavement Thickness Design

For all new roads		Adopted CBR for Pavement Design (%)	ESAL in 10^6	Design Parameters		Design thickness in mm as per TRL ORN 31		
From km	To km			Sub-grade Class	Traffic Class	Surface Ac (mm)	Base (mm)	Sub-base (mm)
Start	end	8	0.7-1.5	S4	T3	50	175	150

From the above table it is observed that the thickness of base course is 175 mm as required by the overseas Road Note 31 recommendation for our case. As per the standard practice and standard specifications of roads the maximum one layer compacted thickness of any fill materials should not increase 150 mm and preferably should not be less than 100 mm. When 175 mm thick base course is applied there will be two layers of 87.5 mm, which is not preferable. Therefore, a minor adjustment in pavement design has been made and recommended the pavement layers as shown in the table below. Though this design modification will result in slight decrease the base thickness it will not result in early failure of the pavement because the pavement thickness is worked out based on the 30 % CBR value of subbase but the available subbase of Churiya Khola is much better in quality having about 60 % CBR value and also the CBR value of base course obtained from these sources much more than 80%. Considering the better quality of subbase and base materials the thickness of asphalt is also decreased to 40mm and pavement design is finalized as shown in the table 4 below:

Table 4 - 4: Recommended Pavement Thickness

For all new roads		Adopted CBR for Pavement Design (%)	ESAL in 10^6	Design Parameters		Design thickness in mm as per TRL ORN 31		
From km	To km			Sub-grade Class	Traffic Class	Surface Ac (mm)	Base (mm)	Sub-base (mm)
Start	end	8	0.7-1.5	S4	T3	40	150	150

Apart from finalization of the pavement design of new roads the consult felt that it is imperative to mention in the report about the traffic study carried by the consultant in Birgunj.

The consultant have observed Birgunj as one of the most chaos cities from the traffic management point of view. The types of traffics presently prevailing in Birgunj are as follows:

- Heavy vehicles that include trucks, tippers, power trailers and buses
- Medium vehicles like mini trucks, mini buses, tractors
- Light vehicles like car, jeep, vans
- Three wheelers like tempo, rickshaws
- Two wheelers like motor bikes and bicycles
- Horse trodden carts and bullock carts.
- pedestrians

All above mentioned traffics when moving on the roads haphazardly, are making the road chaos. These traffics are neither properly channelized through the designated routes nor they respect the traffic rules. Everything found moving from the same road. The traffic movement especially rickshaws and motorbikes, cycles do not follow the traffic rules. They make the movement in the restricted directions by ignoring the traffic rules. This indicates that either they do not know the traffic rules or they do not respect it. In case if the road users are not aware of traffic rules they need to be trained by arranging awareness campaign by the Municipality with the help of Traffic police and DOR people from traffic section. If people are ignoring the traffic rules knowingly, they should be strictly penalized by enforcing laws.

The consultant strongly recommends for segregation of traffic in various routes as mentioned below:

Bypass Road: This road should be used only for the movement of heavy loaded trucks, through traffic from India to outside of Birgunj, buses that exit from new bus parks and leave the city without entering into the core area.

TRP from Gandak Nahar to Ghantaghar: Allow the movement of city buses, mini buses, microbuses to carry the people. The goods carrying trucks should be strictly prohibited to move in this road during day time. They should be allowed to move only at night when there is no other traffic in the road.

TRP from Ghantaghar to Rajat Jayanti Chowk: Allow only light vehicles like car, jeep, three wheelers (rickshaws, tempos), motor bikes and bicycles. The goods carrying vehicles should strictly be prohibited in day time. They should be allowed to move at night when there is no other traffic.

Other Roads:

Railway Road: This road connects Rajat Jayanti Chowk in the south with Ghantaghar Chowk in the north, the downtown of Birgunj. This road traverses along the densely populated part of Birgunj. There are numbers of tangas (horse trodden carts) in Birgunj. They provide the service from downtown of Birgunj to Raxaul. Raxaul is the market of many Birgunj residents and they are using tangas for transportation from Birgunj to Raxual due to two reasons. First the Municipality/government has not arranged the better alternatives of tangas for transportation second they are providing the cheaper services.

From the observation it has been noticed that it is not easy to restrict tangas in Bigunj without properly addressing the lively hoods issues of tanga operators. They are depending on this profession since decades and decades. Restriction of tangas movement will adversely affect the lively hoods of tanga operators and their families. Therefore, a sustainable alternative of tangas must be sought. If tangas are removed without arranging other alternative means of transport for the movement of the people within the city, it will create problem to the Birgunj residents and visitors.

Due to the tangas pulled by the horses or mules, there are plenty horses, khachchads and mules in Birgunj. STIUEIP is meant for the environmental improvement of Birgunj. During study it has been investigated that one of the reasons for environmental degradation of Birgunj are the horses, khachchads and mules used for pulling the carts. Where there is horse dung there are lot of flies in the day time and mosquitoes at night apparently this being suitable atmosphere for their growth. Flies are making the environment of Birgunj very dirty. During the visits of Birgunj city it can be observed that the food stuffs meant for selling by the street vendors are fully covered by the flies. Moreover, the sweets are most culprit from this point of view. Consumption of such food stuffs may cause cholera and other epidemic diseases. Mosquitoes are the headache of Birgunj residents almost all seasons of the year. To make Birgunj city clean, these tangas must be removed sooner or later.

Until tangas are replaced by other suitable means of transport like pollution free three wheelers, electric rails etc, they need to be confined only in one route and railway road seems the appropriate one. They should not be allowed to move in other routes haphazardly. Special arrangement should be made to destroy the flies and mosquitoes and curb their reproduction.

Apart from tangas rickshaws, motorcycles, bicycles, cars jeeps and vans also can use this road without creating traffic nuisances.

All other small inners roads should be used for rickshaws, bicycles, motor bikes, cars, jeeps. Construction materials carriers should be allowed only at night time. If this can strictly be enforced, the post STIUEIP Birgunj can be relatively congestion free and environmentally improved city.

4.2.5 Design of Lanes in Poor Settlements

Provision and design of lanes in poor settlement is one of the scopes of consulting services under STIUEIP, Birgunj. First the clusters of poor settlement will be identified and prioritized. In prioritized locations, internal lanes will be surveyed and designed. Typical example of poor settlement in Birgunj is the Dom Tole in Chhapkyiya, Naguwa Tole and a few squatters along Sirsiya and Singaha River banks. During PPTA study a total 30000 m^2 of neighborhood improvement is envisaged. This comes to be around 10 km lengths if average 3 m width of neighborhood lanes is considered.

From the field visit observation it has been noted that width of such neighborhood lanes improvement is not consistent. In some places it is less than 3m whereas in some places it is more than 4m. However total length of such lane improvement is not more than 3km. If average width is considered to be 3.5 m then total area of neighborhood improvement will be about 10500m2. However, item wise quantity has been worked out and included in the items of road works. The cost of improvement of these neighborhood roads has been incorporated in the estimate of road construction. Typical section of neighborhood improvement is shown in the volume: Drawings.

4.2.6 Design of Roadside Drains and Cross-drainage Structures

During various site visits the consultant has observed that there are plenty roadside drains in Birgunj Municipality road networks. We shall have to check the condition and adequacy of the size so that proper measures could be suggested. In most of the cases the storm drains are found without having cover slabs and garbage disposed on it thereby posing threats to blockage during monsoon. Even if the condition of the existing drains is good and size of the drains is adequate, it becomes mandatory to clean and cover them with slabs in such a way so that it could not be easily removed and garbage thrown in future. Cost for these repair and maintenance works will be included in the estimate of Storm Drains.

No drains are observed in roads like 2nd bypass, canal roads where storm drain outlets are proposed. Pipe drains in the middle of the road are proposed in these roads. The main pipe in the middle of the roads will receive the storm water from water inlets provided on the sides of the road by 300m NP3 RCC pipes. Drain size will be determined based on the run off discharge to be established from the catchment areas and hydrological data. The consultants have prepared various types of typical road side drains and cross-drainage structures for various design discharges. Typical design consists of roadside drains, pipe culverts, and slab culverts. During finalization of detail design, existing structures will be used maximum possible. In the urban area, it is essential that the settlement is not flooded due to the road upgrading and appropriate water conduit will be designed to take storm water safely to the nearby natural stream.

5 ENSURE THAT ROAD SAFETY ISSUES IDENTIFIED DURING DESIGN STAGE ARE PROPERLY ADDRESSED DURING CONSTRUCTION AND ENSURE THAT A ROAD SAFETY AUDIT (RSA) IS UNDERTAKEN ON COMPLETIOIN OF WORKS.

Road Safety Audit (RSA) Report is prepared based on the completed geometric design and the feedback obtained from the site visits. During site visits black spots are identified by observations, by consultations with stakeholders and by collecting the accident data from the traffic police. Appropriate safety measures will be designed, incorporated in the drawings and cost will be included in the estimates. Road Safety Audit Report shall be prepared in the standard form acceptable to the client and submitted separately. The Road Safety Report so prepared will be audited upon completion of the road construction whether the safety measures mentioned in Safety Audit Report are complied or not. If the safety measures are not provided as mentioned in Road Safety Audit Report and do not comply with the requirement, then it will be advised to fulfill those shortcomings so that road safety is maintained and the road would serve as for a ***forgiving highway***.

5.1 Aims and Benefits of RSA

The main aim of RSA is to ensure that all new road/upgrading schemes operate as safely as practicable. This means that safety should be considered throughout the entire cycle of design, construction and pre-opening of any Project facility. Specific aims of the RSA are to:

- minimize the risk of accidents likely to occur/occurring on the Project facility and to minimize their severity;
- minimize the risk of accidents likely to occur/occurring on adjacent roads, i.e. to avoid creating accidents elsewhere on the network;
- recognize the importance of safety in highway design to meet the needs and perceptions of all types of road users; and to achieve a balance between needs of different road user types where they may be in conflict;
- reduce long-term costs of a Project facility, bearing in mind that unsafe designs may be expensive or even impossible to correct at a later stage;
- increase awareness about safe design practices among all those involved in the planning, design, construction and maintenance of roads.

The benefits of RSA are numerous. They range from more obvious direct improvements in a design to things as broad as enhancement of corporate safety policies. Other important benefits are:

- safer new highways through accident prevention and accident severity reduction;
- safer road networks;
- the enhancement of road safety engineering;
- reduced whole life-costs of road schemes;
- providing one component of local and state accident reduction targets;
- a reduced need to modify new schemes after they are built;
- a better understanding and documentation of road safety engineering;
- eventual safety improvements to standards and procedures;
- more explicit consideration of the safety needs of vulnerable road users.

6 DESIGN DRAWINGS

It is the responsibility of the DSC to produce appropriate design drawings to be included in the bidding documents. The DSC upon completion of the design of entire roads under the scope of STIUEIP, have produced those standard design drawings and included them in the bidding documents. These detailed design drawings are prepared with sufficient details so that can be used by the contractors for setting out and execution of the works.

7 COST ESTIMATE

The Cost Estimate for the improvement of road and lanes in Birgunj that will entail upgrading and/or new roads construction and improvement of poor neighborhood lanes are prepared based on the evaluation of the unit rates and quantities obtained from the design and inventory, costing have been carried out in the format using District rates and norms for analyzing approved by GON. The wages of local skilled and unskilled labour are based on approved district wage rates. The cost of equipment has been included owning, running and mortgage of equipment and cost for operation. Alternatively equipment cost has also been based on the hire charge of equipment established by DoR and other departments of GoN. Any item of works details of which have not been found in the norms for rate is based on the current market price which is considered to be more practical, workable and to the extent possible economical. Summary of Cost Estimate for road works is shown in the table below and detail of cost estimate is included in Annex III.

Table 7- 1: Summary of Cost Estimate

S.No.	Item Description	Engineer's Estimate Amount (NRs.)	%
1	Earthworks	62,698,568.92	13.10
2	Structures	76,758,736.99	16.04
3	Pavement Works	187,543,158.34	39.19
4	Miscellaneous	148,591,418.93	31.05
5	Day works	1,420,499.60	0.30
6	Slope Stabilization and Bio-engineering Works	1,547,693.00	0.32
	Total Amount of Road	**478,560,075.78**	**100.00**

8 ROADS MAINTENANCE

The maintenance of roads is carried during the construction and post construction or operation phases. Maintenance of roads during construction and during defects notification period is the responsibility of the construction contractors and they will carry out this task. The cost of roads maintenance during construction and during defects notification period is the part of the contract and its cost will be incorporated in the BoQ. Maintenance of roads during operation phase is the responsibility of the client, i.e. responsibility of the Municipality and it is suggested that the maintenance of roads during this phase would be properly carried.

The maintenance process as a whole comprises a number of maintenance activities mainly "cyclic" in nature. Planned maintenance is a systematic process where in a series of small but timely investments in the maintenance activities are made for maintaining and/or improving the condition of roads, that is, with the process aiming to keep the road surface not only open to trafficable but also at a desired level of service, where by the cost effective and efficient transport system as a whole is envisaged and huge investment that accrue as a result of untimely failure of road network is differed in the future. As of now the maintenance standards and practices are developed by DoR and these standards and practices are to be adopted by other organizations like municipalities, DOLIDAR, district roads authorities and so on.

The types of maintenance practiced by DoR are briefly summarized below. This is strongly recommended that the Municipality during operation phase would take care of maintenance to prevent the roads from further damage and save the huge investment as a result of pre-matured failure.

- Routine Maintenance: This type of maintenance is required round the year on every road because of traffic movement as well as environmental degradation. It covers grass cutting, drain cleaning, removing debris and draining water from the carriageway, bridges and culverts maintenance and road furniture maintenance, etc. Generally 1 length man is employed for every 3 km in dry season and for every 2km in wet season by DoR. This is applicable for through roads where normally less volume of routine maintenance is expected. For the municipal roads more number of length men may require. This needs be checked by the Municipality Engineers during operation and establish a norm.
- Recurrent Maintenance: This type of maintenance is required at varying interval during the year with a frequency that depends mostly on volume of traffic. It covers repairing of potholes and ruts, dragging and grading on unpaved roads, whereas on paved roads it covers repairing potholes, patching, repairing edges and shoulders, sealing cracks, spot gravelling or providing base courses and small repairs of structures.
- Specific Maintenance: This type of maintenance is done as required by the road condition and in circumstances where exist excess volume of work quantity mainly due to existing site conditions or backlog work which are not covered in the national average quantity as set in the norms under the category of recurrent maintenance and/or the periodic maintenance interventions. Potholes maintenance in large scale, gravelling of unpaved shoulder, construction of structures, drain repair, replacing traffic signs and cross drains and other similar activities are carried out under this category of maintenance. Specific maintenance as a whole can also be referred as a backlog maintenance which is resulted from unaddressed periodic maintenance intervention in time and/or the small scale rehabilitation or resealing road work needed just after opening the traffic addressing the emergency condition.
- Periodic Maintenance: This type of maintenance is "cyclic" and is required normally at intervals of 5-8 years, but the cycle may be shorter, if justified economically to intervene

earlier than anticipated (high traffic volume and poor condition of road). Periodic maintenance on gravel roads is re-gravelling and includes repairing of structures such as steel bridges. For paved roads, it is surface dressing (resealing) asphalt overlay, re-gravelling of unpaved shoulder, painting or replacing of old signs, etc.

- Preventative Maintenance: This type of maintenance is required to prevent the potential damages of roads and bridges. Provision of river training works in combination of tree plantation where there is potential threat of bank erosion and road damage, provision of bio engineering works in combination of small structures where there is potential threat to the road damage due to land slide or slope failure are the typical examples of the preventative maintenance.
- Emergency Maintenance: This type of maintenance is required for immediate opening of road closure during disasters, like flood, erosion, landslide, and earthquake. It covers removal of debris and other obstacles, placement of warning signs and diversion works. Emergency maintenance requires timely assessment of damages, reporting to higher authorities, sending the notice of road closures and management of machines and equipment to open the road as soon as possible for the movement of traffic.
- Rehabilitation: This is not new construction but includes road construction activities like renewing the road surfacing with correction of base and sometimes also correction of sub base. Rehabilitation of a road is done between 10-15 years depending upon the importance of road and level/volume of traffic on the road.

Annex I

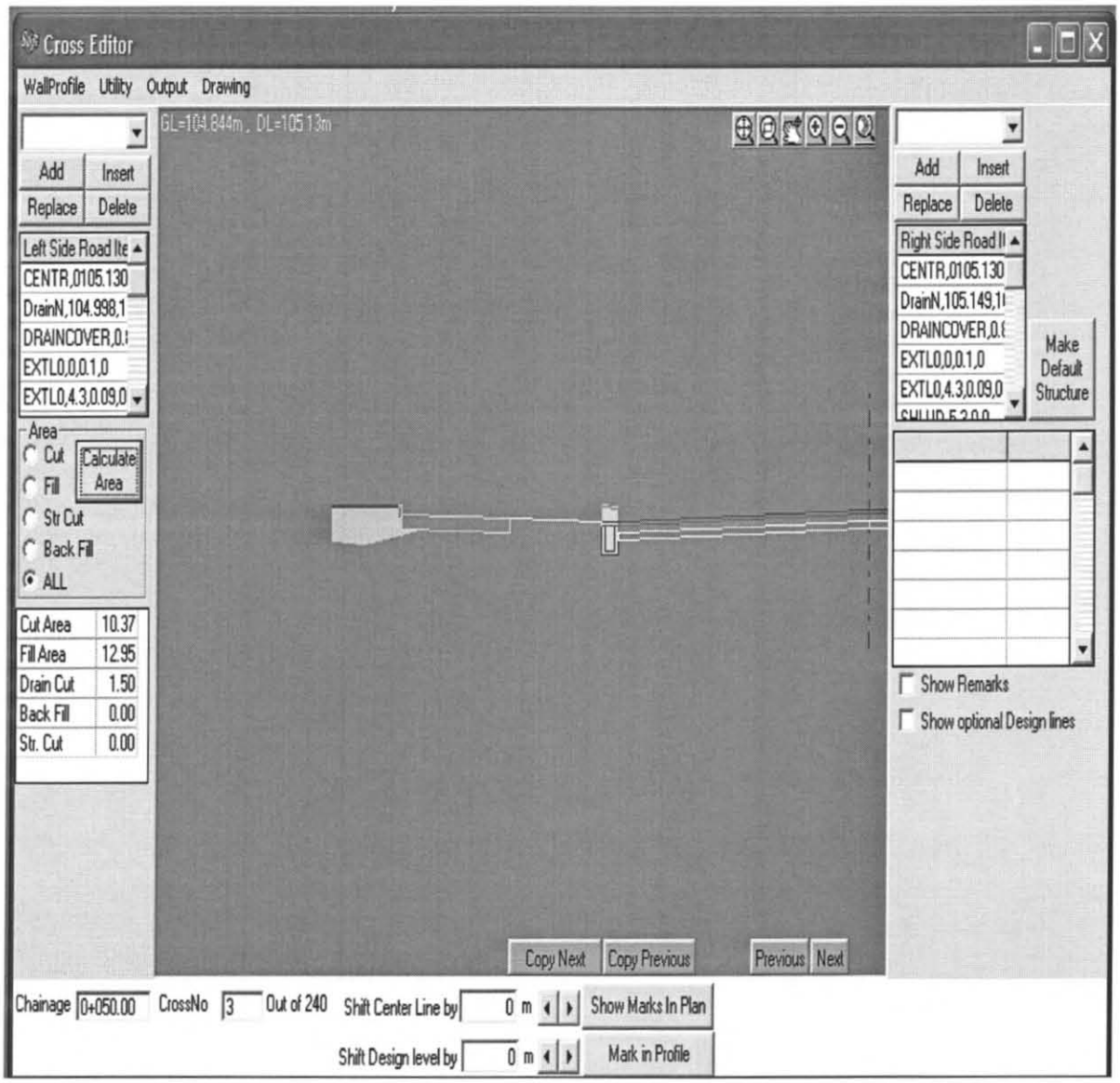
Design inputs used in soft ware

Some of the important inputs used in the software for the design of urban roads in Birgunj are shown in the table below. These inputs are the data required by the road design software **S_W Road**.

Design Inputs

SN	Descriptions	Inputs	Unit	Notes
1.0	**Carriage Way**			
1.1	Road Width	varies	M	
1.2	Camber Slope	2.5	%	
1.3	Camber Side	1		2 for Hill Side, 1 for Both Side
2.0	**Vertical Alignment Design**			
2.1	Design Speed	Varies	Km/hr	
2.2	Stopping Sight Distance	110	M	
2.4	Minimum Change in Grade	1.5	%	
3.0	Super Elevation Design			
3.1	Maximum Outer Edge Slope (1in..)	60	M	
3.2	Normal Outer Edge Slope (1in..)	100	M	
3.3	Minimum Super Elevation	3	%	
3.4	Se Design By Option	0		0-By Program, 1-By User
4.0	Extra Widening Design			
4.1	Extra Widening Transition Rate	0.1	m/m	For Extra Widening Totally Outside the Curve
4.2	Fixed Transition Length	10	M	Fixed Length Irrespective of Widening
4.3	Ew Design By Option	0		0 –By Program, 1- By User
4.4	Extra Widening Placement Method	1		0 for Totally Inside, 1 for 1/3 Inside, 2 for Totally Outside
4.5	Extra Widening Transition Length Calculation	0		0 for Transition Rate, 1 for Fixed Length
5.0	**Right of Way**			
5.1	Right of Way	25	M	Either Direction
6.0	**Starting Chainage**			
6.1	Starting Chainage	0	M	

- **Plotting of Drawings:** The Road design software SW_Road, as mentioned above, generates the drawings, which can be plotted in AutoCAD format as shown in the figure below. Detail Design Drawings are being prepared and will be presented in separate Volume.

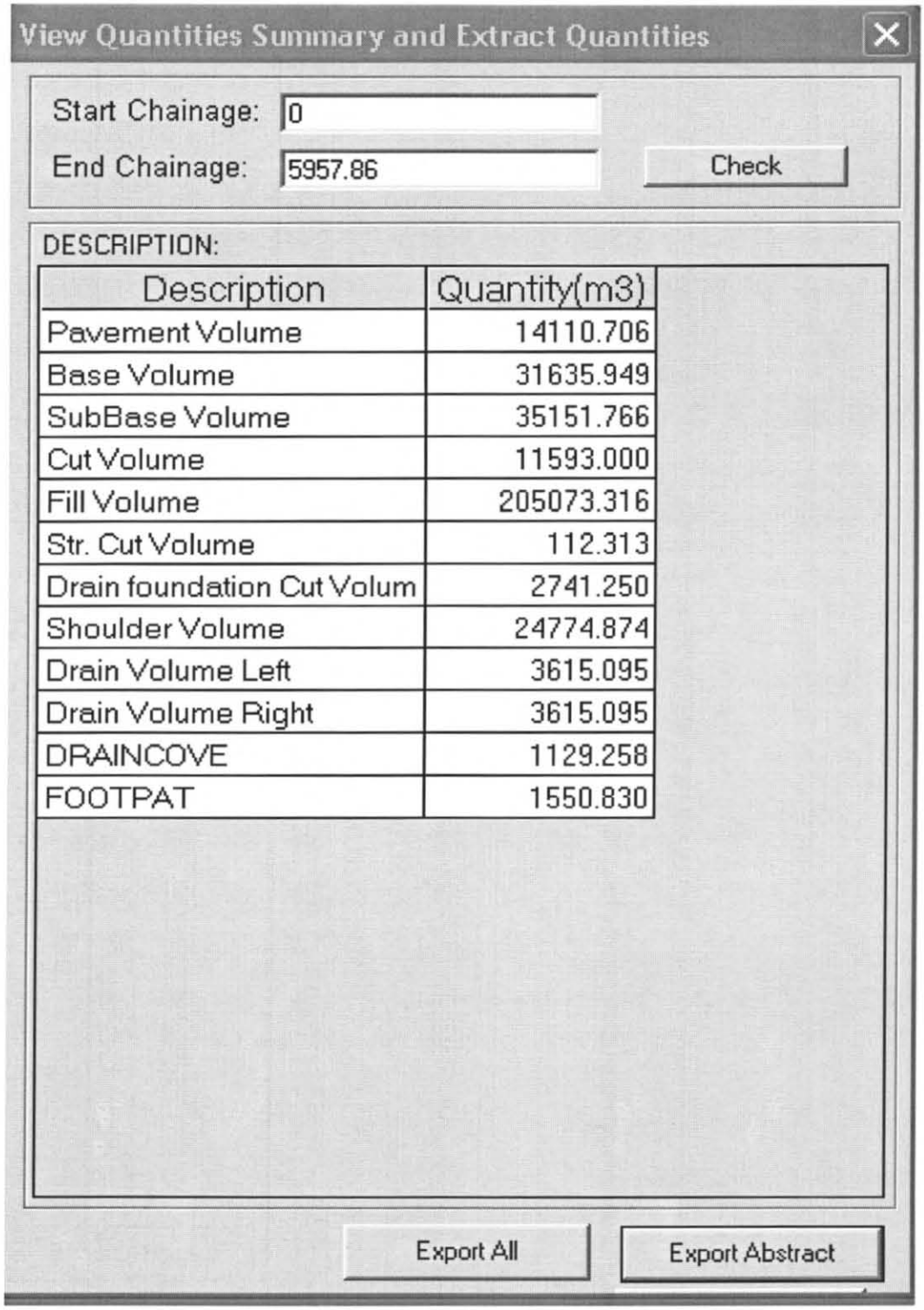


- **Quantity Calculation:** The Design software has the facility to calculate the quantity of various items in the Excel format as shown below. Besides that, it provides the cumulative quantity in a summary format as shown.

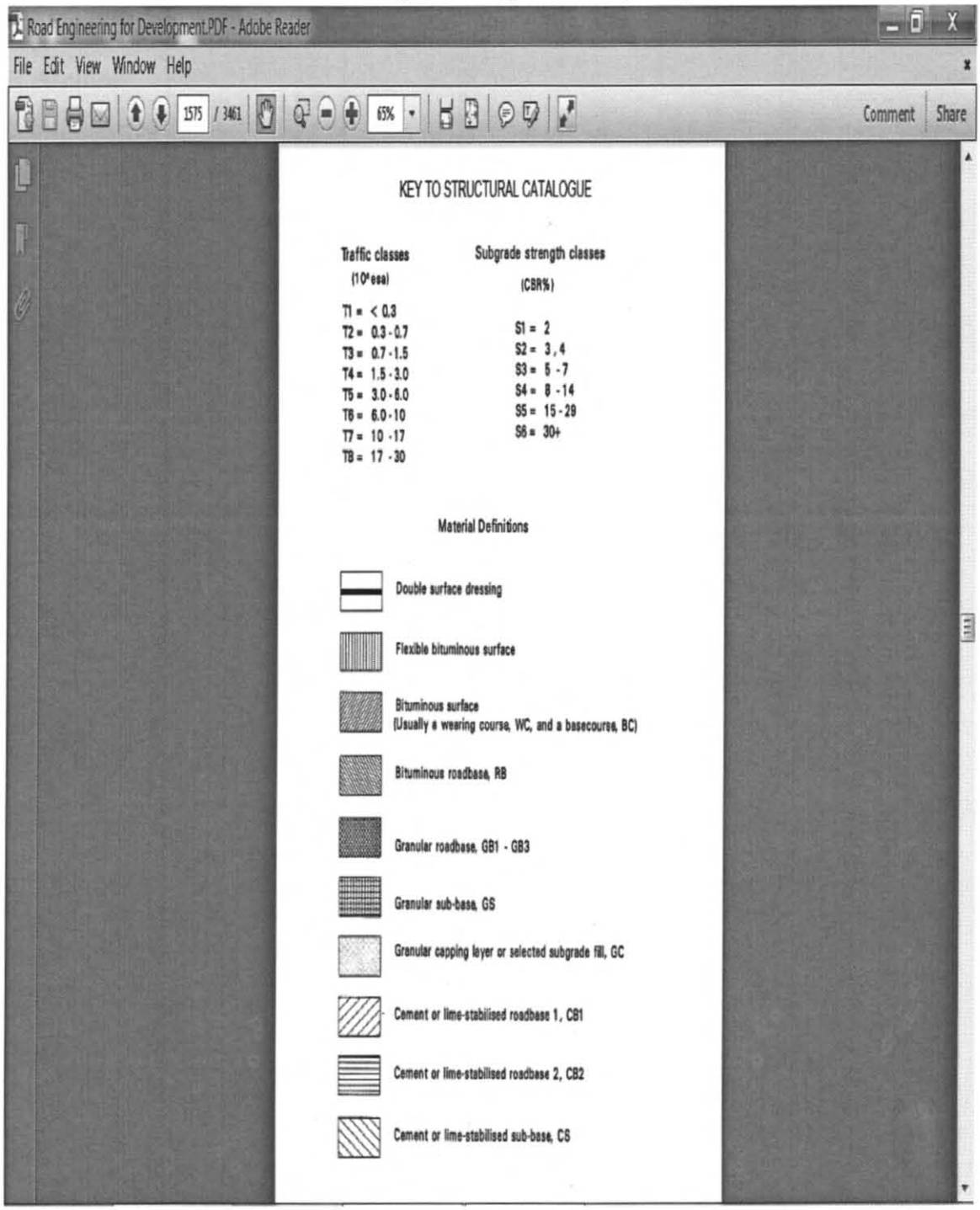
- **Format for Production of Quantity Calculation:**

AREA(m2)						VOLUME(m3)								
Chainage	Cut Area	Base Fill Area	Ord Fill Area	Str.Cut Area	Back Area	Mean Dist.	Cut Vol.	Base Fill Vol.	Ord Fill Vol.	Str.Cut Vol.	Back Vol.	Soil Type	Drain Cut Area	Drain Cut Vol.
0	0.025	3.725	0	0	0	12.5	0.313	46.563	0	0	0	OS	0.36	4.5
25	3.57	15.283	0	0	0	25	89.25	382.063	0	0	0	OS	0.36	9
50	10.37	12.945	0	0	0	25	259.25	323.625	0	0	0	OS	1.495	37.375
75	6.4	19.25	0	0	0	25	160	481.25	0	0	0	OS	0.703	17.563
100	13.678	9.585	0	0	0	25	341.938	239.625	0	0	0	OS	1.275	31.875
125	6.332	12.08	0	0	0	25	158.312	302	0	0	0	OS	1.093	27.313
150	4.457	9.928	0	0	0	25	111.437	248.188	0	0	0	OS	0.877	21.937
175	3.835	9.685	0	0	0	25	95.875	242.125	0	0	0	OS	0.905	22.625
200	2.2	9.92	0	0	0	25	55	248	0	0	0	OS	0.317	7.937
225	8.87	6.845	0	0	0	25	221.75	171.125	0	0	0	OS	1.533	38.313
250	7.493	6.832	0	0	0	25	187.313	170.812	0	0	0	OS	1.048	26.188
275	7.175	12.943	0	0	0	25	179.375	323.563	0	0	0	OS	0.735	18.375
300	8.898	5.173	0	0	0	25	222.438	129.313	0	0	0	OS	1.4	35
325	13.155	2.243	0	0	0	25	328.875	56.063	0	0	0	OS	1.64	41
350	15.315	8.798	0	0	0	25	382.875	219.938	0	0	0	OS	1.445	36.125
375	15.868	21.3	0	0	0	25	396.688	532.5	0	0	0	OS	1.08	27
400	12.975	18.5	0	0	0	25	324.375	462.5	0	0	0	OS	0.96	24
425	5.015	15.885	0	0	0	25	125.375	397.125	0	0	0	OS	0.295	7.375
450	6.778	23.945	0	0	0	25	169.438	598.625	0	0	0	OS	0	0
475	8.17	14.26	0	0	0	25	204.25	356.5	0	0	0	OS	0.8	20
500	6.908	9.46	0	0	0	25	172.688	236.5	0	0	0	OS	0.73	18.25
525	4.273	15.69	0	0	0	25	106.813	392.25	0	0	0	OS	0.68	17
550	0	24.325	0	0	0	25	0	608.125	0	0	0	OS	0.347	8.687
575	0.593	36.068	0	0	0	25	14.813	901.688	0	0	0	OS	0.005	0.125
600	0	27.53	0	0	0	25	0	688.25	0	0	0	OS	0.36	9
625	0	39.327	0	0	0	25	0	983.187	0	0	0	OS	0.24	6
650	0	45.5	0	0	0	25	0	1137.5	0	0	0	OS	0	0
675	0	46.143	0	0	0	25	0	1153.563	0	0	0	OS	0	0
700	0	45.903	0	0	0	25	0	1147.563	0	0	0	OS	0	0
725	0	49.415	0	0	0	25	0	1235.375	0	0	0	OS	0	0
750	0	43.347	0	0	0	25	0	1083.687	0	0	0	OS	0	0

- **Format for Production of Summary and Extract of Quantities:**



Pavement Design Catalogue developed by TRL of UK



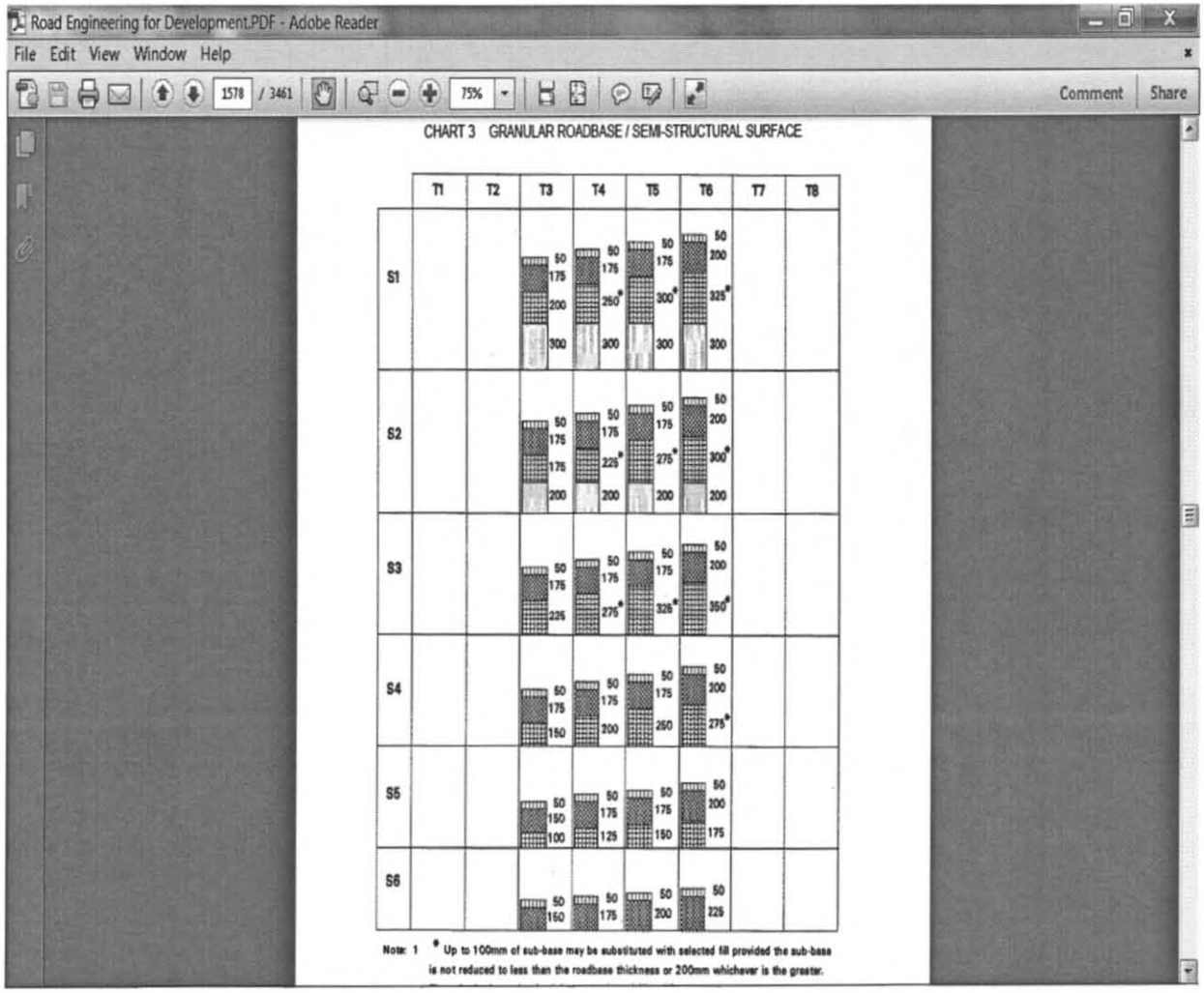


CHART 3 GRANULAR ROADBASE / SEMI-STRUCTURAL SURFACE

	T1	T2	T3	T4	T5	T6	T7	T8
S1			50 / 175 / 200 / 300	50 / 175 / 250* / 300	50 / 175 / 300* / 300	50 / 200 / 325* / 300		
S2			50 / 175 / 175 / 200	50 / 175 / 225* / 200	50 / 175 / 275* / 200	50 / 200 / 300* / 200		
S3			50 / 175 / 225	50 / 175 / 275*	50 / 175 / 325*	50 / 200 / 350*		
S4			50 / 175 / 150	50 / 175 / 200	50 / 175 / 250	50 / 200 / 275*		
S5			50 / 150 / 100	50 / 175 / 125	50 / 175 / 150	50 / 200 / 175		
S6			50 / 150	50 / 175	50 / 200	50 / 225		

Note: 1 * Up to 100mm of sub-base may be substituted with selected fill provided the sub-base is not reduced to less than the roadbase thickness or 200mm whichever is the greater.

Annex III

Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP)
SMEC International Pty Ltd
in association with
BDA & CEMAT Consultants (P) Ltd.
Birgunj Sub Metropolitan City

SUMMARY OF ENGINEER'S ESTIMATE

S.No.	Item Description	Engineer's Estimate Amount (NRs.)	%
1	Earthworks	62,698,568.92	13.10
2	Structures	76,758,736.99	16.04
3	Pavement Works	187,543,158.34	39.19
4	Miscellaneous	148,591,418.93	31.05
5	Day works	1,420,499.60	0.30
6	Slope Stabilization and Bio-engineering Works	1,547,693.00	0.32
	Total Amount of Road	**478,560,075.78**	**100.00**

Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP)
SMEC International Pty Ltd
in association with
BDA & CEMAT Consultants (P) Ltd.
Birgunj Sub Metropolitan City

Summary Of Cost Carried to BoQ

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
Part 2: EARTHWORKS						
201	2.01a	Site clearance including clearing and grubbing thin bushes(bushes up to girth 30cm - trees and saplings less than 15 nos per 100 sq.m.) including uprooting, carrying and disposing of vegetation, grass, bush, necessary for the construction of works and removal up to a lead of 10 m	Sqm.	134932.60	20.70	2,793,104.82
	2.01 c.i	>300mm - 600mm girth	no.	5.00	138.59	692.93
	2.01c.i i	>600mm - 900mm girth	no.	4.00	184.78	739.13
	2.01c.i ii	>900mm - 1800mm girth	no.	3.00	554.35	1,663.04
	2.01c.i v	>1800mm - 2400mm girth	no.	2.00	1,421.40	2,842.80
	2.01c. v	>2400mm - 3000mm girth	no.	2.00	4,616.00	9,231.99
	2.01c. vi	>3000mm girth	no.	2.00	14,807.43	29,614.87
202	2.02	Dismantling Bridge, Culvert and Other Structures including stockpiling the reusable materials and disposal of unsuitable materials:				
	2.02a	Plain Cement Concrete	cu.m.	10.00	1421.40	14,214.00
	2.02b	Reinforced Cement Concrete	cu.m.	20.00	3908.85	78,177.00
	2.02c	Brick Masonry in Cement Mortar	cu.m.	20.00	753.34	15,066.84
	2.02d	Stone Masonry in Cement Mortar	cu.m.	20.00	753.34	15,066.84
	2.02e	Pipe culverts(RCC or HDP Pipe)				
		(i) Up to 600 mm dia.	RM	10.00	147.00	1,470.00
		(ii) Above 600 mm dia.	RM	10.00	290.00	2,900.00
	2.02f	Gabion Works	cu.m.	10.00	360.68	3,606.80

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
907	2.05	Earthwork excavation for foundation through all types of soil including disposal up to 1 km.				
	2.05a	Common Material	cu.m.	500.00	248.75	124,372.50
905	2.07	Roadway excavation including disposal up to 1km all complete as per specifications.				
	2.07a	Common Material	cu.m.	4642.22	248.75	1,154,729.57
908	2.08	Backfilling to structures with pervious selected materials including compaction and watering all complete as per drawings and specifications.	cu.m.	500.00	1,749.61	874,805.00
908	2.09	Backfilling to structures with suitable common fill materials including compaction and watering all complete as per drawings and specifications.	cu.m.	1000.00	177.68	177,675.00
909	2.10 a)	Formation of embankment with suitable fill materials for a depth of 300mm from the sub grade level including compaction in layers not exceeding 150mm compacted depth, watering and haulage all complete as per drawings and specifications.	cu.m.	172481.11	331.30	57,143,595.80
	2.11	Haul excessive cut materials for reuse or disposal above 1km lead	cu.m./ km	5000.00	51.00	255,000.00
		Total of Part 2 - Carried to Summary				**62,698,568.92**
Part 3: STRUCTURES						
2600	3.03	Providing and laying coursed random rubble stone masonry in cement mortar grade MM 5 (Approx 1 : 6 Cement Sand Mortar) including scaffolding, curing, preparation of mortar etc. all complete, mason height 0-5 m, lead 30 m (machine mixing), mortar 35%.	cu.m.	495.00	6,175.14	3,056,696.03
2600	3.04	Providing and laying coursed random rubble stone masonry in cement mortar grade MM 7.5 (Approx 1 : 4 Cement Sand Mortar) including scaffolding, curing, preparation of mortar etc. all complete, masoned height 0-	cu.m.	50.00	6,854.75	342,737.38

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
		5 m, lead 30 m (machine mixing), mortar 35%.				
2400	3.06	Supply and place Boulder soling in foundation	cu.m.	20.00	2,449.50	48,990.00
	3.07	Brick Masonry for Roadside drains				
2000	3.08	Supply and place ordinary concrete class				
	3.08a	Providing and placing machine mixed cement concrete, M10/40 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m.	20.00	7,318.24	146,364.87
	3.08b	Providing and placing machine mixed cement concrete, M15/40 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m.	50.00	8,550.84	427,542.11
	3.08c	Providing and placing machine mixed cement concrete, M20/20 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m.	4260.00	10,615.62	45,222,546.53
	3.08d	Providing and placing machine mixed cement concrete, M25/20 concrete including compaction, curing, testing etc all complete as per specifications and drawings.	cu.m.	20.00	13,373.32	267,466.43
2000	3.09	Providing and laying reinforcement including cutting, bending, binding, fixing in position all complete as per specifications and drawings	Tonne	1.00	100,958.50	100,958.50
1800	3.10	Providing, preparing and installing formwork (using ply and soft wood) and removing after completion for foundation and footings (Class F2 Finish)	Sqm.	50.00	600.90	30,044.79
700	3.11	Supply and place reinforced concrete pipe class NP3				

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
	3.11a	Providing and laying 900 mm dia (internal) RCC pipes with or without collars, jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand)	RM	20.00	11,507.43	230,148.60
	3.11b	Providing and laying 600 mm dia (internal) RCC pipes with or without collars, jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand)	RM	20.00	6,537.41	130,748.11
RCC Slab Culvert(6m*2 and 6m*1) Singha River and MD-1						
201	2.01a	Site clearance including clearing and grubbing thin bushes(bushes up to girth 30cm - trees and saplings less than 15 nos per 100 sq.m.) including uprooting, carrying and disposing of vegetation, grass, bush, necessary for the construction of works and removal up to a lead of 10 m	Sqm.	230.40	20.70	4,769.28
	2.05a	Common Material	cu.m.	1998.57	248.75	497,133.41
908.00	2.08	Backfilling to structures with pervious selected materials including compaction and watering all complete as per drawings and specifications.	cu.m.	234.07	1,749.61	409,534.71
2000	3.08	Supply and place ordinary concrete class				
	3.08b	Providing and placing machine mixed cement concrete, M15/40 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m.	211.72	8,550.84	1,810,384.32
	3.08d	Providing and placing machine mixed cement concrete, M25/20 concrete including compaction, curing, testing etc all complete as per specifications and drawings.	cu.m.	734.28	13,373.32	9,819,783.72
2000	3.09	Providing and laying reinforcement including cutting, bending, binding, fixing in position all complete as per specifications and drawings	Tonne	132.57	100,958.50	13,384,526.99
1800	3.10	Providing, preparing and installing formwork (using ply and soft wood) and removing	Sqm.	1378.54	600.90	828,361.22

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
		after completion for foundation and footings (Class F2 Finish)				
		Total of Part 3 - Carried to Summary				**76,758,736.99**
Part 4: PAVEMENT WORKS						
1000	4.01	Preparation of sub grade for rehabilitation or other similar works (filling or cutting depth of 10 to 20 cm), common soil, compaction 95% MDD	Sqm.	150031.20	113.16	16,977,358.06
1200	4.03	Providing, Laying, spreading, leveling and compaction of sub base grading as per table 12.1 of standard specifications	cu.m.	15445.89	2,074.74	32,046,172.62
1200	4.04	Supplying and laying graded crushed stone base material including compaction to required level as specified including watering finishing etc. all complete.	cu.m.	15390.89	2,570.43	39,561,264.09
1300	4.05	Providing and spraying bituminous prime coat MC30/MC70 including cleaning the road surface using wire, brushes, broom etc. before applying prime coat.	Ltr.	100834.80	129.52	13,059,997.25
1302	4.06	Providing, supplying and applying sand blinding over newly primed or bleeding surface.	Sqm.	150031.20	7.07	1,060,836.86
1303	4.07	Supply and apply 80/100 Grade Bitumen for tack coat.	Ltr.	27500.40	151.89	4,176,932.63
1308	4.08	Wearing Course 40 mm thick	cu.m.	4148.17	19,444.88	80,660,596.83
		Total of Part 4 - Carried to Summary				**187,543,158.34**
3100	5.01a	Providing, laying and fixing Filter Fabrics (Geo-Textile) in position including stretching, interposing between structural surface and pervious back fill	Sqm.	100.00	102.47	10,246.50
	5.01b	Providing and Back filling with graded filter materials in layer with necessary watering and compaction.	cu.m.	100.00	1,749.61	174,961.00
	5.01c	Providing, jointing and laying HDP/PVC pipes with or without collar etc complete in place as per specifications, 110 mm outer dia. (Presuure=4 kg/cm^2).	RM	100.00	550.29	55,029.01

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
	5.01d	Providing, jointing and laying HDP/PVC pipes with or without collar etc complete in place as per specifications, 160 mm outer dia.	RM	100.00	1,125.00	112,500.12
1500	5.04	Supplying and erecting traffic sign in place including 50 mm dia steel tube, 2 mm thick steel plate, cement concrete, painting , writing and supporting steel angle nut and bolt etc complete a) 60 cm Dia circular, 60 cm equilateral triangle and 60 cm x 45 cm rectangular shaped sign (single post).	no.	50.00	70,088.42	3,504,421.00
1500	5.05	Supplying and erecting traffic sign in place including 50 mm dia steel tube, 2 mm thick steel plate, cement concrete, painting , writing and supporting steel angle nut and bolt etc complete a) 1.2 m x 0.75 m size bigger traffic sign with back support and two or more post.	no.	10.00	11,225.00	112,250.00
1500	5.08	Supply and place road marker stone as shown on drawings				
1500	5.09	Supplying and applying paint for Road marking including cleaning, watering, booming etc all complete (15 cm wide strip), more than two coats over new bitumen surface.	RM	10000.00	89.67	896,700.00
	5.10	Supply and placing Kerb Stones	RM			
1400	5.10a	Supply and placing Kerb Stone at the edge of road all complete as per drawings.	RM	28914.00	1,138.12	32,907,601.68
1400	5.10b	Supply and placing Kerb Stone at median all complete as per drawings.	RM	500.00	1,480.26	740,130.00
1500	5.11	Supply and placing New Jersey Barrier all complete as per drawings.	RM	100.00	5,803.72	580,372.00
1400	5.12	Supply and placing Guard Rail all complete as per drawings.	RM	500.00	2,318.55	1,159,274.06
	5.13	Supply and place light duty RCC cover slab for pedestrian movement	RM	28632.00	2,179.57	62,405,448.24
	5.14	Supply and place heavy duty RCC cover slab for vehicular movement	RM	100.00	3,194.85	319,485.00

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
	5.15	Supply and place rain inlet as per drawings all complete.	no.	500.00	6,628.00	3,314,000.00
1400	5.16	Supply and place interlock tiles for footpath including sand bedding	Sqm.	39296.00	1,076.42	42,299,000.32
		Total of Part 5 - Carried to Summary				**148,591,418.93**
Part 6: DAY WORKS						
		Work shall only be executed as Day Works only under the written instructions of the Engineer.				
	6.01	**Labour**				
		The rates inserted shall include all costs of labour such as insurance, accommodation, travelling, hand tools, supervision, overhead and profits.				
	6.01a	Foreman / Supervisor	md	100.00	350.00	35,000.00
	6.01b	Skilled labour (Mason, Carpenter, mechanics etc.)	md	100.00	450.00	45,000.00
	6.01c	Operators	md	100.00	450.00	45,000.00
	6.01d	General labour (Unskilled, helpers, assistant operators etc.))	md	150.00	300.00	45,000.00
	6.01e	Administrative Personnel	md	10.00	450.00	4,500.00
	6.02	**Materials**				
	6.02a	Concrete NP3 Pipe 600mm Diameter	m	20.00	4,724.28	94,485.60
	6.02b	Concrete NP3 Pipe 900mm Diameter	m	20.00	8,482.10	169,642.00
	6.02c	Concrete NP3 Pipe 1200mm Diameter	m	20.00	11,011.00	220,220.00
	6.02d	Cement	Tonne	5.00	11,500.00	57,500.00
	6.02e	Sand	m^3	20.00	927.00	18,540.00
	6.02f	Aggregate	m^3	40.00	1,700.00	68,000.00
	6.02g	Reinforcing Steel (Fe 415)	Tonne	2.00	76.00	152.00
	6.02h	Formwork Class F2	m^2	50.00	500.00	25,000.00
	6.02i	Diesel	Ltr.	500.00	103.00	51,500.00
	6.02j	Petrol	Ltr.	250.00	130.00	32,500.00
	6.02k	Bitumen	Ltr.	1,000.00	100.00	100,000.00
	6.03	**Equipment**				
	6.03a	Tipper Truck 4-6 tonne capacity	hour	20.00	450.00	9,000.00
	6.03b	Tipper Truck 8-10 tonne capacity	hour	20.00	600.00	12,000.00
	6.03c	Water Tanker 4000 - 6000 lit Capacity	hour	20.00	640.00	12,800.00
	6.03d	Front End loader 1-1.5m^3	hour	20.00	3,609.00	72,180.00
	6.03e	Excavator - 135hp	hour	20.00	3,465.00	69,300.00
	6.03f	Motor Grader	hour	20.00	3,609.00	72,180.00
	6.03g	Vibratory Roller static weight	hour	20.00	3,465.00	69,300.00

Spec. Clause Ref.	Item No.	Description	Unit	Quantity	Engineer's Rate (NRs.)	Engineer's Estimate Amount (NRs.)
		8-10 tonnes				
	6.03h	Concrete Mixer 0.4m^3	hour	20.00	1,000.00	20,000.00
	6.03i	Concrete needle vibrator	hour	20.00	120.00	2,400.00
	6.03j	Bulldozer D-6 or Larger Capacity	hour	20.00	3,465.00	69,300.00
		Total of Part 6 - Carried to Summary				**1,420,499.60**
Part 7: SLOPE STABILIZATION and BIO-ENGINEERING WORKS						
2800	7.19	Slopes Preparation including trimming of uneven surface, leveling the surface for bio engineering works and disposal of resulted materials up to 15 m all complete as per drawings and specifications.	Sqm.	10000.00	5.62	56,177.50
2800	7.59	Providing and supplying of grass sodding works including sod cutting, transporting, placing in position and water sprinkling (Lead up to 10m) all complete as per drawings and specifications.	Sqm.	10000.00	149.15	1,491,515.50
		Total of 7 - Carried to Summary				**1,547,693.00**

Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP)
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Birgunj Sub Metropolitan City

Summary Of Quantity Carried to BoQ

Item No	Description	Unit	Quantity	Remarks
2.01a	Clearing and grubbing thin bushes(bushes up to girth 30cm - trees and saplings less than 15 nos per 100 sq.m.) including uprooting, carrying and disposing of vegetation, grass, bush, necessary for the construction of works and removal up to a lead of 10m	Sqm.	134,932.60	2000*1.5
2.01b	Excavation and removal of top soil including compaction to prepare foundation for embankment fill as per drawings and specifications	Sqm.		
2.01c	Felling of trees (the girth measured at a height of 1m above ground level) including cutting of trunks and branches, removing the roots, stacking serviceable materials and disposal of unserviceable materials to 10m distance and backfilling the depressions/pits.			
2.01 c.i	>300mm - 600mm girth	no	5.00	
2.01c.ii	>600mm - 900mm girth	no	4.00	
2.01c.iii	>900mm - 1800mm girth	no	3.00	
2.01c.iv	>1800mm - 2400mm girth	no	2.00	
2.01c.v	>2400mm - 3000mm girth	no	2.00	
2.01c.vi	>3000mm girth	no	2.00	
2.02	Dismantling Bridge, Culvert and Other Structures including stockpiling the reusable materials and disposal of unsuitable materials:			
2.02a	Plain Cement Concrete	cu.m..	10.00	Provisional
2.02b	Reinforced Cement Concrete	cu.m..	20.00	Provisional
2.02c	Brick masonry in Cement mortar	cu.m..	20.00	Provisional
2.02d	Stonemasonry in Cement mortar	cu.m..	20.00	Provisional

Item No	Description	Unit	Quantity	Remarks
2.02e	Pipe culverts(RCC or HDP Pipe)			
	(i) Up to 600mm dia.	m	10.00	Provisional
	(ii) Above 600mm dia.	m	10.00	Provisional
2.02f	Gabion Works	cu.m..	10.00	Provisional
2.04	Earthwork excavation of soft soil for drain and trenches including shoring, strutting, bracing, sheeting and disposal up to 1 km	cu.m..		
2.05	Earthwork excavation for foundation through all types of soil including disposal up to 1 km.			
2.05a	Common material	cu.m..	500.00	Provisional
2.07	Roadway excavation including disposal up to 1km all complete as per specifications.			
2.07a	Common material	cu.m..	4,642.22	
2.08	Backfilling to structures with pervious selected materials including compaction and watering all complete as per drawings and specifications.	cu.m..	500.00	Provisional
2.09	Backfilling to structures with suitable common fill materials including compaction and watering all complete as per drawings and specifications.	cu.m..	1,000.00	Provisional
2.10 a)	Formation of embankment including compaction in layers not exceeding 150mm compacted depth, all complete as per specifications for the depth below 300mm from sub grade level using suitable excavated materials conforming . 8% CBR.	cu.m..	172,481.11	
2.11	Haul excessive cut materials for reuse or disposal above 1km lead	cu.m../km	2,000.00	
3.03	Providing and laying coursed random rubble stonemasonry in cement mortar grade mm 5 (Approx 1 : 6 Cement Sand mortar) including scaffolding, curing, preparation of mortar etc. all complete, masoned height 0-5m, lead 30m (machine mixing),mortar 35%.	cu.m..	495.00	
3.04	Providing and laying coursed random rubble stonemasonry in cement mortar grade mm 7.5 (Approx 1 : 4 Cement Sand mortar) including scaffolding, curing, preparation of mortar etc. all complete , masoned height 0-5m, lead 30m (machine mixing),mortar 35%.	cu.m..	50.00	
3.06	Supply and place Boulder soling in foundation	cu.m..	20.00	
3.08	Supply and place ordinary concrete class			

Item No	Description	Unit	Quantity	Remarks
3.08a	Providing and placing machine mixed cement concrete, M10/40 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m..	20.00	Provisional
3.08b	Providing and placing machine mixed cement concrete, M15/20 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m..	50.00	Provisional
3.08c	Providing and placing Concrete M 20/20 for Gutter and other structures	cu.m..	4,260.00	
3.08d	Providing and placing machine mixed cement concrete, M 25/20 concrete including compaction, curing, testing etc all complete as per specifications and drawings.	cu.m..	20.00	
3.09	Providing and laying reinforcement including cutting, bending, binding, fixing in position all complete as per specifications and drawings	Tonne	1.00	
3.10	Supply and place formworks including false works required for concrete works including removal			
3.10a	Providing, preparing and installing formwork (using soft wood) and removing after completion for foundation and footings (Class F1 Finish)	Sqm.	50.00	
3.10b	Providing, preparing and installing formwork (using timber) and removing after completion for slab and superstructures (Class F2 Finish)	Sqm.	4,320.00	
3.11	Supply and place reinforced concrete pipe class NP3			
3.11a	Providing and laying 900mm dia (internal) RCC pipes with or without collars, jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand)	m	20.00	
3.11b	Providing and laying 600mm dia (internal) RCC pipes with or without collars, jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand)	m	20.00	
	RCC Slab Culvert(6m*2 and 6m*1) Shingha River and MD-1			
2.01a	Site clearance including clearing and grubbing thin bushes(bushes up to girth 30cm - trees and saplings less than 15 nos per 100 sq.m.) including uprooting, carrying and disposing of vegetation, grass, bush, necessary for the construction of works and removal up to a lead of 10 m	Sqm.	230.40	
2.05a	Common Material	cu.m.	1,998.57	
2.08	Backfilling to structures with pervious selected materials including compaction and watering all complete as per drawings and specifications.	cu.m.	234.07	
3.08	Supply and place ordinary concrete class			

Item No	Description	Unit	Quantity	Remarks
3.08b	Providing and placing machine mixed cement concrete, M15/40 concrete, for the foundation and footing etc. including compaction, curing, testing etc all complete as per specification and drawing.	cu.m.	211.72	
3.08d	Providing and placing machine mixed cement concrete, M25/20 concrete including compaction, curing, testing etc all complete as per specifications and drawings.	cu.m.	734.28	
3.09	Providing and laying reinforcement including cutting, bending, binding, fixing in position all complete as per specifications and drawings	Tonne	132.57	
3.10	Providing, preparing and installing formwork (using ply and soft wood) and removing after completion for foundation and footings (Class F2 Finish)	Sqm.	1,378.54	
4.01	Preparation of subgrade for rehabilitation or other similar works (filling or cutting depth of 10 to 20 cm), common soil, compaction 95%mDD	Sqm.	150,031.20	
4.03	Providing, Laying, spreading, leveling and compaction of sub base grading as per table 12.1 of standard specifications	cu.m..	15,445.89	
4.04	Supplying and laying graded crushed stone base material including compaction to required level as specified including watering finishing etc. all complete.	cu.m..	15,390.89	
4.05	Providing and spraying bituminous prime coat MC30/MC70 including cleaning the road surface using wire, brushes, broom etc. before applying prime coat.	Ltr.	100834.80	
4.06	Providing, supplying and applying sand blinding over newly primed or bleeding surface.	Sqm.	150031.20	
4.07	Supply and apply 80/100 Grade Bitumen for tack coat.	Ltr.	27500.40	
4.08	Wearing Course 40 mm thick	cu.m.	4,148.17	
5.01a	Providing, laying and fixing Filter Fabrics (Geo-Textile) in position including stretching, interposing between structural surface and pervious back fill	Sqm.	100.00	Provisional
5.01b	Providing and Back filling with graded filter materials in layer with necessary watering and compaction.	cu.m..	100.00	Provisional
5.01c	Providing, jointing and laying HDP/PVC pipes with or without collar etc complete in place as per specifications, 110mm/125mm outer diameter.	m	100.00	Provisional
5.01d	Providing, jointing and laying HDP/PVC pipes with or without collar etc complete in place as per specifications, 160mm outer dia.	m	100.00	Provisional

Item No	Description	Unit	Quantity	Remarks
5.03	Supplying and fixing in place RCC delineator and guard post with reflective element including excavation, backfilling, painting and erection etc all complete as per drawings and specifications.	No.	100.00	Provisional
5.04	Supplying and erecting traffic sign in place including 50mm dia steel tube, 2mm thick steel plate, cement concrete, painting , writing and supporting steel angle nut and bolt etc complete a) 60 cm Dia circular, 60 cm equilateral triangle and 60 cm x 45 cm rectangular shaped sign (single post).	No.	50.00	Provisional
5.05	Supplying and erecting traffic sign in place including 50mm dia steel tube, 2mm thick steel plate, cement concrete, painting , writing and supporting steel angle nut and bolt etc complete a) 1.2m x 0.75m size bigger traffic sign with back support and two or more post.	No.	10.00	Provisional
5.08	Supply and place road marker stone as shown on drawings			
5.09	Supplying and applying Thermoplastic Road marking paint including cleaning, watering, booming etc all complete (15 cm wide strip),more than two coats over new bitumen surface.	m	10,000.00	13300*3/4
5.10	Supply and Placing Kerb Stones			
5.10a	Supply and Placing Kerb Stone at the edge of road all complete as per drawings.	m	28,914.00	
5.10b	Supply and Placing Kerb Stone at median all complete as per drawings.	m	500.00	Provisional
5.11	Supply and Placing New Jersey Barrier all complete as per drawings.	m	100.00	Provisional
5.12	Supply and Placing Guard Rail all complete as per drawings.	m	500.00	Provisional
5.13	Supply and Placing e light duty RCC cover slab for pedestrian movement	m	28,632.00	
5.14	Supply and place heavy duty RCC cover slab for vehicular movement	m	100.00	Provisional
5.15	Supply and Placing rain inlet as per drawings all complete.	no.	500.00	Provisional
5.16	Supply and Placing interlock tiles for footpath including sand bedding	Sqm.	39,296.00	
7.19	Slopes Preparation including trimming of uneven surface, leveling the surface for bio engineering works and disposal of resulted materials up to 15m all complete as per drawings and specifications.	Sqm.	10,000.00	Provisional
7.59	Providing and supplying of grass sodding works including sod cutting, transporting, placing in position and water sprinkling (Lead up to 10m) all complete as per drawings and specifications.	Sqm.	10,000.00	Same as 7.19

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Quantity Estimate Of New Road Contruction

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
1	Removal of top soil including clearing and grubbing							
	2nd bypass Road							
	School North	1	1,605.00	12		19260.00	m2	
	School to Pratima Chowk	1	654.00	12		7848.00	m2	
	Pratima Chowk to Maidiya Pond	1	2,332.00	12		27984.00	m2	
	Pond area	1	274.00	4		1096.00	m2	
	Maiudiya Pond to Nagawa Chowk	1	1,248.00	2		2496.00	m2	
	Nagawa Chowk to Rajat Jayanti Chowk	1	1,348.00	12		16176.00	m2	
	Canal Road	1	1,800.00	12		21600.00	m2	
	Access Road to SLS	1	576.00	6		3456.00	m2	
	Access Road to STP	1	1,625.00	14		22750.00	m2	
	Total					122666.00	m2	
	Total Qty Carried to BoQ					**134932.60**	**m2**	
2	Roadway Excavation							
	2nd bypass Road							
	School North		1,605.00			200.00	m3	Quantity extracted from software output
	School to Pratima Chowk		654.00			100.00	m3	
	Pratima Chowk to Maidiya Pond		2,332.00			1000.00	m3	
	Pond area		274.00			250.00	m3	
	Maiudiya Pond to Nagawa Chowk		1,248.00			100.00	m3	
	Nagawa Chowk to Rajat Jayanti Chowk		1,348.00			100.00	m3	
	Canal Road		1,800.00			2020.20	m3	
	Access Road to SLS		576.00			200.00	m3	
	Access Road to STP		1,625.00			250.00	m3	

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
	Total					4220.20	m3	
	Total Qty Carried to BoQ					**4642.22**	m3	
3	Formation of Embankment							
	2nd bypass Road							
	School North		1,605.00			28000.00	m3	Quantity extracted from software output
	School to Pratima Chowk		654.00			10000.00	m3	
	Pratima Chowk to Maidiya Pond		2,332.00			20000.00	m3	
	Pond area		274.00			700.00	m3	
	Maiudiya Pond to Nagawa Chowk		1,248.00			20000.00	m3	
	Nagawa Chowk to Rajat Jayanti Chowk		1,348.00			35000.00	m3	
	Canal Road		1,800.00			10101.01	m3	
	Access Road to SLS		576.00			6000.00	m3	
	Access Road to STP		1,625.00			27000.00	m3	
	Total					156801.01	m3	
	Total Qty Carried to BoQ					**172481.11**	m3	
4	Subgrade Preparation							
	2nd bypass Road							
	School North	1	1,605.00	12		19260.00	m2	
	School to Pratima Chowk	1	654.00	12		7848.00	m2	
	Pratima Chowk to Maidiya Pond	1	2,332.00	12		27984.00	m2	
	Pond area	1	274.00	12		3288.00	m2	
	Maiudiya Pond to Nagawa Chowk	1	1,248.00	12		14976.00	m2	
	Nagawa Chowk to Rajat Jayanti Chowk	1	1,348.00	12		16176.00	m2	
	Canal Road	1	1,800.00	12		21600.00	m2	
	Access Road to SLS	1	576.00	10		5760.00	m2	
	Access Road to STP	1	1,625.00	12		19500.00	m2	
	Total					136392.00	m2	
	Total Qty Carried to BoQ					**150031.20**	m2	
5	Sub base							
	2nd bypass Road						m3	

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
	School North		1,605.00			1950.00	m3	Quantity extracted from software output
	School to Pratima Chowk		654.00			800.00	m3	
	Pratima Chowk to Maidiya Pond		2,332.00			2800.00	m3	
	Pond area		274.00			370.00	m3	
	Maiudiya Pond to Nagawa Chowk		1,248.00			1550.00	m3	
	Nagawa Chowk to Rajat Jayanti Chowk		1,348.00			1650.00	m3	
	Canal Road		1,800.00			2171.72	m3	
	Access Road to SLS		576.00			700.00	m3	
	Access Road to STP		1,625.00			2050.00	m3	
	Total					14041.72	m3	
	Total Qty Carried to BoQ					**15445.89**	m3	
6	Base Course							
	2nd bypass Road							
	School North		1,605.00			1950.00	m3	
	School to Pratima Chowk		654.00			800.00	m3	Quantity extracted from software output
	Pratima Chowk to Maidiya Pond		2,332.00			2800.00	m3	
	Pond area		274.00			370.00	m3	
	Maiudiya Pond to Nagawa Chowk		1,248.00			1550.00	m3	
	Nagawa Chowk to Rajat Jayanti Chowk		1,348.00			1650.00	m3	
	Canal Road		1,800.00			2171.72	m3	
	Access Road to SLS		576.00			650.00	m3	
	Access Road to STP		1,625.00			2050.00	m3	
	Total					13991.72	m3	
	Total Qty Carried to BoQ					**15390.89**	m3	
7	Supply and apply Prime Coat							
	2nd bypass Road							
	School North	1	1,605.00	8		12840.00	m2	
	School to Pratima Chowk	1	654.00	8		5232.00	m2	
	Pratima Chowk to Maidiya Pond	1	2,332.00	8		18656.00	m2	

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
	Pond area	1	274.00	10		2740.00	m2	
	Maiudiya Pond to Nagawa Chowk	1	1,248.00	8		9984.00	m2	
	Nagawa Chowk to Rajat Jayanti Chowk	1	1,348.00	8		10784.00	m2	
	Canal Road	1	1,800.00	8		14400.00	m2	
	Access Road to SLS	1	576.00	7		4032.00	m2	
	Access Road to STP	1	1,625.00	8		13000.00	m2	
	Total					91668.00	m2	
	Total Qty Carried to BoQ					**100834.80**	m2	
8	supply and apply Tack Coat							
	2nd bypass Road							
	School North	1	1,605.00	8		12840.00	m2	
	School to Pratima Chowk	1	654.00	8		5232.00	m2	
	Pratima Chowk to Maidiya Pond	1	2,332.00	8		18656.00	m2	
	Pond area	1	274.00	10		2740.00	m2	
	Maiudiya Pond to Nagawa Chowk	1	1,248.00	8		9984.00	m2	
	Nagawa Chowk to Rajat Jayanti Chowk	1	1,348.00	8		10784.00	m2	
	Canal Road	1	1,800.00	8		14400.00	m2	
	Access Road to SLS	1	576.00	7		4032.00	m2	
	Access Road to STP	1	1,625.00	8		13000.00	m2	
	Total					91668.00	m2	
	Total Qty Carried to BoQ					**27500.40**	m2	
9	Asphalt Concrete							
	2nd bypass Road							
	School North		1,605.00			520.00	m3	
	School to Pratima Chowk		654.00			210.00	m3	
	Pratima Chowk to Maidiya Pond		2,332.00			760.00	m3	Quantity extracted from software output
	Pond area		274.00			95.00	m3	
	Maiudiya Pond to Nagawa Chowk		1,248.00			410.00	m3	
	Nagawa Chowk to Rajat Jayanti Chowk		1,348.00			450.00	m3	
	Canal Road		1,800.00			606.06	m3	

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
	Access Road to SLS		576.00			170.00	m3	
	Access Road to STP		1,625.00			550.00	m3	
	Total					3771.06	m3	
	Total Qty Carried to BoQ					**4148.17**	m3	
10	Precast Concrete Kerb							
	2nd bypass Road							
	School North	2	1,605.00			3210.00	m	
	School to Pratima Chowk	2	654.00			1308.00	m	
	Pratima Chowk to Maidiya Pond	2	2,332.00			4664.00	m	
	Pond area	2	274.00			548.00	m	
	Maiudiya Pond to Nagawa Chowk	2	1,248.00			2496.00	m	
	Nagawa Chowk to Rajat Jayanti Chowk	2	1,348.00			2696.00	m	
	Canal Road	2	1,800.00			7128.00	m	
	Access Road to SLS	2	576.00			1152.00	m	
	Access Road to STP	2	1,625.00			3250.00	m	
	Total					26452.00	m	
	Total Qty Carried to BoQ					**28914.00**	m	
11	Light duty drain cover slab							
	2nd bypass Road							
	School North	2	1,605.00			3210.00	m	
	School to Pratima Chowk	2	654.00			1308.00	m	
	Pratima Chowk to Maidiya Pond	2	2,332.00			4664.00	m	
	Pond area	1	274.00			274.00	m	
	Maiudiya Pond to Nagawa Chowk	2	1,248.00			2496.00	m	
	Nagawa Chowk to Rajat Jayanti Chowk	2	1,348.00			2696.00	m	
	Canal Road	2	1,800.00			7128.00	m	
	Access Road to SLS	2	576.00			1152.00	m	
	Access Road to STP	2	1,625.00			3250.00	m	
	Total					26178.00	m	
	Total Qty Carried to BoQ					28632.00	m	
12	Interlock tiles for footpath							
	2nd bypass Road							
	School North	2	1,605.00	1		3210.00	m2	
	School to Pratima Chowk	2		1		1308.00	m2	

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
			654.00					
	Pratima Chowk to Maidiya Pond	2	2,332.00	1		4664.00	m2	
	Pond area	1	274.00	1		274.00	m2	
	Maiudiya Pond to Nagawa Chowk	2	1,248.00	1		2496.00	m2	
	Nagawa Chowk to Rajat Jayanti Chowk	2	1,348.00	1		2696.00	m2	
	Canal Road	2	1,800.00	1		3600.00	m2	
	Access Road to SLS	2	576.00	1		1152.00	m2	
	Access Road to STP	2	1,625.00	1		3250.00	m2	
	Total					22650.00	m2	
	Total Qty Carried to BoQ					**24915.00**	m2	
12	Concrete M20/20 for Gutter							
	2nd bypass Road							
	School North	2	1,605.00	0.5	0.15	240.75	m3	
	School to Pratima Chowk	2	654.00	0.5	0.15	98.10	m3	
	Pratima Chowk to Maidiya Pond	2	2,332.00	0.5	0.15	349.80	m3	
	Pond area	1	274.00	0.5	0.15	20.55	m3	
	Maiudiya Pond to Nagawa Chowk	2	1,248.00	0.5	0.15	187.20	m3	
	Nagawa Chowk to Rajat Jayanti Chowk	2	1,348.00	0.5	0.15	202.20	m3	
	Canal Road	2	1,800.00	0.5	0.15	270.00	m3	
	Access Road to SLS	2	576.00	0.5	0.15	86.40	m3	
	Access Road to STP	2	1,625.00	0.5	0.15	243.75	m3	
	Total					1698.75	m3	
	Total Qty Carried to BoQ					**1868.63**	m3	
13	Formwork for Gutter							
	2nd bypass Road							
	School North	2	1,605.00		0.15	481.50	m2	
	School to Pratima Chowk	2	654.00		0.15	196.20	m2	
	Pratima Chowk to Maidiya Pond	2	2,332.00		0.15	699.60	m2	
	Pond area	1	274.00		0.15	41.10	m2	
	Maiudiya Pond to Nagawa Chowk	2	1,248.00		0.15	374.40	m2	
	Nagawa Chowk to Rajat Jayanti Chowk	2	1,348.00		0.15	404.40	m2	
	Canal Road	2	1,800.00		0.15	540.00	m2	

S.No.	Item of Works	No.	Length	Breadth	Height	Quantity	Unit	Remarks
	Access Road to SLS	2	576.00		0.15	172.80	m2	
	Access Road to STP	2	1,625.00		0.15	487.50	m2	
	Total					3397.50	m2	
	Total Qty Carried to BoQ					**3737.25**	m2	
14	Stone Masonry Work in 1:6 Cement Sand Mortar							
	2nd bypass Road							
	School North	2	1,605.00				m2	
	School to Pratima Chowk	2	654.00				m2	
	Pratima Chowk to Maidiya Pond	2	2,332.00				m2	
	Pond area	1	274.00			450.00	m2	Quantity extracted from Software output
	Maiudiya Pond to Nagawa Chowk	2	1,248.00				m2	
	Nagawa Chowk to Rajat Jayanti Chowk	2	1,348.00				m2	
	Canal Road	2	1,800.00				m2	
	Access Road to SLS	2	576.00				m2	
	Access Road to STP	2	1,625.00				m2	
	Total					450.00	m2	
	Total Qty Carried to BoQ					**495.00**	m2	

Quantity Estimate of RCC Culvert

S.no.	Description	Nos.	Length (m)	breadth (m)	Height (m)	Quantity	Unit
1	Site clearance	1	12.000	12.000		**230.400**	m^2
2	Excavation ordinary Soil						
a	Main Culvert	1	9.500	40.506		384.804	
b	Retaining Wall L/S	2	4.000	4.265		34.123	
	Retaining wall R/S	2	4.000	1.690		13.520	
c	Wing wall Section C+D	2	6.000	3.010		36.120	
d	Protection Wall Section A+B	1	16.000	3.010		48.160	
e	Up stream toe wall	1	21.000	1.500	3.500	110.250	
f	Down stream toe wall	1	15.000	1.500	3.500	78.750	
g	Gabion mattress 50cm Thick.						
	Up stream out of toe wall	1	21.000	3.000	1.500	94.500	
	Up stream in side of toe wall	1	17.675	4.150	1.500	110.027	
	Down stream Out toe wall	1	15.000	3.000	1.500	67.500	
	Down stream under the exsisting	1	15.625	4.000	1.500	93.750	

S.no.	Description	Nos.	Length (m)	breadth (m)	Height (m)	Quantity	Unit
	Bridge						
	Down stream	1	14.800	8.000	1.500	177.600	
					Total	**1998.566**	**m^3**
3	Compacted selected Granular materials backfill						
a	Main Culvert Back side	1	7.000	0.900	3.700	23.310	
	Main foundation	1	16.500	10.500	0.500	86.625	
b	Retaining Wall L/S	2	3.100	0.900	3.700	5.580	
	Retaining wall R/S	2	3.100	0.900	3.700	5.580	
c	Wing wall Section C+D	2	6.000	0.900	3.400	10.800	
d	Protection Wall Section A+B	1	16.000	0.900	3.400	14.400	
					Total	**234.072**	**m^3**
4	Cement concrete M15 in foundation base						
a	Main foundation	1	16.500	9.500	0.100	15.675	
b	Retaining Wall L/S	2	4.000	2.500	0.500	20.000	
	Retaining wall R/S	2	4.000	2.500	0.500	20.000	
c	Wing wall Section C+D	2	6.000	2.500	0.500	30.000	
d	Protection Wall Section A+B	1	16.000	2.500	0.500	40.000	
e	Approach Slab	2	9.500	3.500	0.100	6.650	
					Total	**211.720**	**m^3**
5	Cement concrete M25						
a	Main Raft foundation	1	16.500	9.500	0.800	125.400	
b	Main Abutment wall	2	9.500	1.075	5.500	112.338	
	Abutment wall on slab base capping	2	9.500	0.900	0.500	8.550	
	Abutment wall on slab Side capping	2	9.500	0.300	0.300	1.710	
c	Main Pier	1	9.500	0.800	5.500	41.800	
	Pier slab base capping	1	9.500	1.100	0.500	5.225	
d	Up stream toe wall	1	21.000	1.000	2.000	42.000	
	Down stream toe wall	1	15.000	1.000	2.000	30.000	
e	Approach Slab	2	9.500	3.500	0.200	13.300	
f	Railing post	16	0.150	0.150	1.100	0.396	
	Railing post	4	0.500	0.500	1.100	1.100	
g	Deck- slab	2	6.900	9.500	0.500	65.550	
h	Footpath	2	6.900	1.250	0.250	4.313	
i	Wearing Course	2	6.900	7.000	0.075	7.245	
					Total	**734.282**	**m^3**
6	Wooden form works for M15						
a	Cement concrete M15 in foundation base						
	Main foundation	1	52.000		0.100	5.200	
	Retaining Wall L/S	2	13.000		0.500	13.000	
	Retaining wall R/S	2	13.000		0.500	13.000	
	Wing wall Section C+D	2	17.000		0.500	17.000	

S.no.	Description	Nos.	Length (m)	breadth (m)	Height (m)	Quantity	Unit
	Protection Wall Section A+B	1	37.000		0.500	18.500	
	Approach Slab	2	26.000		0.100	5.200	
					Sub-Total (a)	71.900	
b	Cement concrete M25						
	Main Raft foundation	1	52.000		0.800	41.600	
	Main Abutment wall	2	21.140		5.500	232.540	
	Abutment wall on slab base capping	2	20.800		0.500	20.800	
	Abutment wall on slab Side capping	2	19.600		0.300	11.760	
	Main Pier	1	20.600		5.500	113.300	
	Pier slab base capping	1	21.200		0.650	13.780	
	Up stream toe wall	1	44.000		2.000	88.000	
	Down stream toe wall	1	32.000		2.000	64.000	
	Approach Slab	2	26.000		0.200	10.400	
	Railing post	16	0.600		1.100	10.560	
	Railing post	4	2.000		1.100	8.800	
	Deck- slab base	2	6.900	9.500		131.100	
	Deck- slab side	2	32.800		0.500	32.800	
	Footpath side	2	16.300		0.250	8.150	
	Wearing Course	2	14.000		0.075	2.100	
					Sub-Total (b)	789.690	
					Total a+b	**1378.544**	**m^2**
7	Rainforcement bar						
	2.3% of Total quantity of Concrete M20 + M25					**132574.543**	**Kgs**

Quantity Estimate (Neighborhood Lanes)

S#	Item of Works	Unit	No.	Length	Breadth	Height	Quantity	Re-marks
1	Excavation for preparing of formation	m3	1	3,000.00	3.5	0.15	1,575.00	
2	Subgrade Preparation	m2	1	3,000.00	3.5		10,500.00	
3	Subbase/sand gravel filling below paving	m3	1	3,000.00	3.5	0.15	1,575.00	
4	Provide 65mm thick paving blocks	m2	1	3,000.00	3.5		10,500.00	
5	Concrete M20/20 for side drain (300mmx100mm)	m3	2	3,000.00	3.5	0.1	2,100.00	

Response to Comments on Draft Final Report: Roads & Lanes, STIUEIP Birgunj

S.No.	Comments	Response
	Main Report	
1	The print of **figure 2.-1 new and existing road network in** Birgunj is not clear and not readable; please replace this page (figure) with clear and readable font.	More clear and readable Figure will be included in the final report.
2	In the text, it has been written that there is encroachment in some of location of the alignment of second by- pass road. In drawing also houses are shown within the carriageway, but in the document, the details of the building and houses have not been given for the further action. Please provide the list of the houses to be cleared with all details such as storey, type of house, length, breadth, location name of owner etc.	There are encroachments in a few places only. The property especially the compound walls are found fallen in the footpath not in the carriageway. These encroachments are illegal and also not of the serious nature because they are built without the permission of Municipality in already acquired land. The compound wall removal cost is included in the BOQ. However, these details have been provided in Social safeguard report.
3	In the text, it has been written that the length of the second by pass road is 7.5km from the Gandak chowk to Janajagriti Chowk. But in the drawing the whole length of road has been divided in six part and total length is only 5.128km : i. Gandak Chowk- School North: km 1 .60489 ii. School south-Partima Chowk: km0.654 iii. Partima Chowk- Maidiya pond: km 2.33819 iv. Maidiya pond Area :km0.274 v. Maidiya pond- Inarwa: km 1.2472 vi. Inarwa Chowk- Vansar: km 1.348 The total length is km 5.128. Pl clarify, why there is the ambiguity in drawing and document?	The total length is 7.466km not 5.128. This 7.446km was rounded to 7.5km and accordingly mentioned in the report.
4	Please correct the length of the canal road in the text as 3.564km instead of **about 4km** as in the plan & profile and cross section has been done for the e 3.564km	It has been corrected accordingly.
5	Similarly, please correct the length of the Access road to Landfill site in the	The length of this section of the road is 576 m as per the final

	text as ***573m*** instead of **about 600m** as in the plan & profile and cross section has been done for the 573m.	drawing and corrected accordingly in the final report.
6	Regarding the access road to sanitary treatment plant, DSC has chosen optional II as a best option among four alternatives and estimate has been done accordingly.	In fact DSC has recommended Option I as the best from technical, environmental, social and economic point of view. It is the shortest route having less bends and covers more area. But the alignment of Option I traverses along the left bank of Sirsiya River the border of Nepal and India. In case if trans-border problem occurs during construction, the project may jeopardize. This issue was discussed by DSC with the client and agreed that both options I & II were designed and cost estimate finalized for the longer route so that there would be no hassle during construction if Option I could not be constructed.
7	This possible alternative route is suggested due to existing access road to STP traversed through heavily crowded village of poor community. The widening and road needs demolishment of number of houses and geometry of road is also not proper for movement of the construction vehicle.	Yes, DSC agrees it and hence an alternative route has been proposed.
8	This proposed access road to STP will be used by the construction vehicles. After construction also, only operational vehicle or very limited traffic will be on the road. Therefore there is no need to design this road with blacktop pavement and width 8m wide with foot paths and storm drain. Here, DSC has designed this road as per second by pass road, or canal road. **Please design the road with width 4.5m in gravel road standard and provide cross drainage structure with some pipe culverts as per the requirement.**	The road is designed as 8m carriageway plus 2x2m footpath. BMSC is expecting free donation of land in condition that there will be a standard blacktop road so that the remaining land value would be appreciated, otherwise people will not donate the land. Regarding the width of the road, DSC have been recommending to widen up to 8m carriageway for many roads in future and in no case less than 6m even in most crowded core areas. In such case it is not logical to design a single lane road which will be even difficult for the movement of construction vehicles. Also the nationwide trend to widen the urban roads has to be taken into consideration when finalizing the design. Therefore, it is suggested that the DSC recommended design road with 8m carriageway + 2x2m footpath is constructed. Also during discussion with PIU, 8m road with 2 footpaths of 2m wide was agreed.
9	Furthermore, as proposed access road passes through the private land, **what is the status of land acquisition of the proposed access road? The process of acquiring land needs to be resolved before the start of the access road construction and**	Municipality is fully aware of this issue and will initiate for the acquisition of land.

	STP.	
10	What is the basis of the design of pavement layer as 40 mm thick asphalt concrete? The design of the pavement should be supported by traffic study and sub- grade strength. DSC has not incorporated any details of the traffic study and its analysis done for the calculation Equivalent Standard axle Load (esa). In the document DSC has made traffic forecast for the design period of 10 years as within (0.7-1.5) $x10^6$ esa.	The basis of providing 40 mm thick asphalt and other pavement layers are mentioned in the report. So far traffic analysis is concerned there is no road and no traffic at present where new roads are proposed to construct. Therefore, it is irrelevant to carryout present traffic survey. The design traffic therefore is to be forecast which has been done by DSC and provided the projected traffic for 10 years period. DSC has also studied the traffic congestion problem in the city and recommended the concerned authority to take the measures to overcome these problems in future.
11	***DSC has to carry out traffic analysis and provided 10 years forecast for pavement design as given in their scope of consulting services:*** But the detailed calculation of traffic analysis is missing in the document.	Same as clarification given in item 10 above.
12	Similarly, subgrade strength for the proposed new roads has been taken s Ss4 which have CBR value within a range of 8 to 14 but in the document of the laboratory test result for sub grade soil strength (CBR value) in different locations of roads is missing. Please support your design with detailed traffic analysis and laboratory test of subgrade strength. **Please put the test results and analysis to support the design data in the annex.**	All the new roads will be constructed in embankment with embankment height more than 2m. The embankment will be constructed with imported materials. Subgrade is the topmost part of embankment or bottom part of the pavement layers. At present there is no subgrade and checking the strength of non-existing thing is not possible and checking the strength of foundation is meaningless. To get the desired CBR value of minimum 8, DSC has envisaged to fill the top 300mm embankment with imported material meeting CBR value of 8 and provision has been made in the BOQ. Regarding traffic analysis our previous clarification is valid in this case too.
13	As the consultant(DSC) has designed pavement as per TRRL Road note 31 for the new road of the second by pass road and canal road for the subgrade class S_4 and traffic class T_3 The maximum Traffic will be attained during the design period of 10 years. Therefore considering gradual increase of traffic, it is suggested to put the top layer of asphalt in tw0 layers without changing total thickness	In most of the municipal or urban roads of Nepal it has been observed that the roads are filed not due to failure of pavement but due to the failure of wearing course apparently due to less thickness and poor quality. Changing the wearing course thickness from 40mm to 25mm will not contribute in saving substantial amount rather will

	of pavement layers. **A phase wise construction policy adopted for road will give high return of capital investment. The pavement** thickness will be 25mm asphalt base 150mm, and sub base 150mm. This will reduce the cost, therefore it is advised to carry the cost estimate accordingly	invite potential risk of road damage during operation phase. Moreover, overlaying of asphalt concrete in early stage of operation phase will result more expenses due to contractual issues and the trend of high inflation rate that persist in our country. However, if PMSC and client strongly suggest to go for phase wise asphalt overlaying by reducing the initial phase thickness DSC will follow the advice. Hence DSC has provided the thickness of wearing coat as 40mm and cost calculation made accordingly.
	Cost Estimate	
14	The list of roads which has to be reinstated due to construction of storm drain and sewer has not been included in the draft design report of road. All the design and costing related to roads (new construction as well as reinstatement work) should be placed in the road work documents.	The cost for the reinstated portion of the road due to construction of storm drains and sewer lines are kept under Sewerage and Drainage Package as it is not a new road construction work. Only the cost for the construction of new roads has been kept under this heading.
15	Why the physical contingency and contingency for the price adjustment has been put as 10%	No provision has been made for physical and price contingencies under the heading "SUMMARY OF ENGINEERING ESTIMATE". A provision for 5% of physical contingencies and 5% of price contingencies has been made in preparing the Final Project Cost Estimate which includes all the sub-project component..
16	Why the detailed design and cost estimate for the bridge with 10 to 12m span or double cell slab culvert over Singaha Khola and single cell culvert over MD1 is not done and cost for the construction hasbeen put in the provisional sum? DSC should have done detailed design and cost estimate of those structure instead of putting the construction cost in lump sum basis (NRs 12 million) in Provision Sum	The detail design and cost estimate for both of the culvert to be provided on Singaha and Sirsiya Khola has been made and cost calculation works haves been done accordingly in the final report.
17	There is no need of sand blinding items to be used for all roads where priming will be done. It is contractors' responsibility to protect primed surface. If, after the application of the prime coat, the bituminous material if fails to penetrate within the time specified or if the road has to be used by traffic, blinding material has been spread in the amount required to absorb any excess bituminous material and to protect the primed surface. The traffic can be diverted to other alternative routes	As it is an item rate quantity hence, it will be paid only in the area where it is necessary

	also Therefore this item will not be required.	
18	The prime coat is sufficient to bind the premix carpeting with the pavement layers. There is no need to apply tack coat over the primed surface before laying of premixed carpeting /asphalt concrete as its functions to bind the new bituminous carpet with old bituminous surface. As the cost estimate is done for the new road construction, there is no need of the tack coat item. We can use tack coat for reinstatement work or for new bituminous work over old bituminous surface. Please delete this item.	DSC proposes that there would be tack coat prior to applying the asphalt concrete to have proper interface bonding of asphalt concrete with underneath layer.
19	There is practice for all stone masonry works in 1:4 cement sand mortar not in 1:6 cement mortar	Stone masonry walls and other structures which are very close to traffic load are provided with 1:4 cement sand mortar and those which are far from traffic load are provided with 1:6 cement sand mortar. In case of Birgunj the proposed stone masonry wall is 2 m far from carriageway along the side of footpath. So from structural point of view it is also quite safe in 1:6 cement sand mortar.
20	Please review thoroughly the language of Bill of quantity where the detailing is missing, check the specification numbers in BOQ	It has been thoroughly revised and included in the final Bill Of Quantities.
	Drawings	
21	Why scale of the plan of road is school *south- pratima chowk* is not same as other plan drawing no BIRG/PP-1/3, sheet no 1, 2 and 3.	It will be corrected before final submission.
22	To drain off the road surface water RCC Inlet chamber should be kept in both side of road at staggered basis at the interval of 30m.Please draw the typical section of second by- pass Road.	Typical drawing for Rain inlet has been incorporated with typical drawing for 2nd Bypass road.
23	Please provide all the list of roads to be reinstated after the construction of storm drain and \ sewers and typical section road to be reinstated.	The cost for the reinstatement of the road after the construction of storm drain/sewer line has been included under the Sewerage and Drainage sub-project. Under this sub-project the cost and length for only the new roads have been considered.
24	Please provide the drawings of the typical section of light cover slab as well as cover slab for road crossing	It has been provided accordingly in final drawings.