KATHMANDU UNIVERSITY

SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

PROJECT PROPOSAL ON

DEMONSTRATIVE MODEL OF TOPOGRAPHY OF TRISHULI HYDROPOWER PROJECT

SUBMITTED TO

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CERTIFICATION

SECOND SEMESTER PROJECT REPORT
ON
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ABSTRACT

We have chosen Trishuli Hydropower Project to show the topography of that area. The topography is the arrangement of the natural and artificial physical features of an area. Through our project, we have shown the land structure of that area by constructing a scaled-down model of the contour lines of that topography.

We cut down each contour line and piled them up one after another as it was on the topographic map to make the demonstrative model. We scaled down the height of 560 meters to 0.28 meters and took an 80-meter contour interval distance and scaled it down to 0.04 meters both of R.F 1:2000. The actual length of the model is 5790 meters and the breadth is 5250 which is reduced to 1 meter and 1 meter respectively.

Throughout the project, we learned about distorted scale, different land topography, and about components of hydropower like dam, penstock and anchor block, and powerhouse. We marked the components with flag in their position by the help of google earth and the topography map that we printed.

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1. Introduction

1.1 Brief History of Hydropower

The use of flowing water to power a turbine to produce electrical energy is known as hydropower. The history of hydropower started over 2000 years ago when water wheels were being used by the ancient Greeks to grind grain. However, after the invention of the electric generator by Michael Faraday, his principles were used as a foundation to generate electricity using hydropower for the first time in Appleton, Wisconsin, USA in 1882 AD. Within a span of seven years of time after the first use, the number of hydropower solely in the USA had reached 200.

Hydroelectricity has been one of the major contributors of electricity in this technical world with a contribution of 16.6% of total electricity generated and is expected to increase about 3.1% each year for the next 25 years. With the help of the largest producers of hydroelectricity like China, Brazil, Portugal and Angola, in 2017, the world produced a record 4,185 terawatt hours (TWh) in electricity avoiding approximately 4 billion tons of greenhouse gases and other harmful pollutants.

1.2 Nepal's Electricity Situation: An Overview

Hydropower is an environment friendly source of energy that produces zero pollution in the air and on the ground. Hydropower has been employed as a natural water-cycle-based renewable energy source since the beginning, and it is a reliable, mature, and cost-effective power generation technology. It is the mechanical energy generated by falling or flowing water. Hydropower is Nepal's primary source of energy as it is blessed with rich hydro resources due to its steep gradient and hilly landscape. The country's three major river systems, as well as their minor tributaries, provide Nepal with the opportunity to generate almost 45,610 MW of power that is both economically and technically possible. Nepal has the capacity to generate more than 83,290 MW of hydropower theoretically. Despite having vast hydropower potential, Nepal is able to produce roughly 787 MW from them. Roughly half of Nepal's population does not have access to grid connected electricity. Industrialization and economic advancement are hampered by a lack of power and energy. Despite having abundant hydropower, hydropower only meets 1% of Nepal's energy needs. According to the country status report, traditional energy sources such as firewood (75 %), petroleum products (9.24 %), animal waste (5.74 %), agricultural residue (3.53 %), electricity (1.47 %), and other renewable resources (0.48 %) provide the majority of Nepal's energy. Due to the bad economy and inability of the government to maintain the electricity supply, there is a major energy deficit. However, the country has three strategic considerations for researching large-scale hydropower, including storage types of projects, meeting the country's required demands through the installation of medium-sized projects, and finally small hydropower projects to meet local community demand.

Figure 1. 1 Major river systems in Nepal

(Source: https://www.researchgate.net/figure/Major-river-systems-in-Nepal-adapted-from-8_fig1_316369029)

According to The Secretary of Ministry of Energy, Water Resources and Irrigation, "The quality and reliability of supply has further improved over the past years. NEA's success in the delivery of reliable and uninterrupted power, which is indispensable to modern life, must be appreciated and felicitated.86.4% of the population has access to on and off grid electricity. The government of Nepal is steadfast in expanding its grid and also using off grid solutions to ensure that Nepal will have electricity for all households in the near future."

1.3 Topography:

Topography is the study of the land surface. In particular, it lays the underlying foundation of a landscape. These features typically include natural formations such as mountains, rivers, lakes, and valleys. Manmade features such as roads, dams, and cities may also be included. Topography often records the various elevations of an area using a topographical map. The origin of topography comes from "topo" for "place" and "graphia" for "writing". It's closely related to surveying which are concerned with accurately measuring the land surface. And it's also closely tied to geography and mapping systems like GIS.

Figure 1. 2 Topographic map of Nuwakot

(Source : http://pahar.in/nepal-topo-maps/)

1.4 Topographic al Features:

Topography studies the elevation and location of landforms.

- Landforms - Landforms studied in topography can include anything that physically impacts the area. Examples include mountains, hills, valleys, lakes, oceans, rivers, cities, dams, and roads.
- Elevation - Elevation is usually shown by the curved lines in the topography maps called contour lines. The difference between those lines give slope of the surface.
- Latitude - Latitude gives the north/south position of a location in reference from the equator. The equator is a horizontal line drawn around the middle of the Earth that is the same distance from the North Pole and the South Pole.
- Longitude - Longitude gives the east/west position of a location. Longitude is generally measured in degrees from the Prime Meridian.

1.5 Nepal Trishuli Hydroelectric Power Plant

Trishuli Hydropower Station is constructed on the banks of Trishuli River at Trishuli Bazar, Nuwakot. It was commissioned in 1967 AD in assistance with the Government of India at a cost of INR 140 million with its initial installed capacity of 21 MW having 7units of 3 MW each. It was later rehabilitated in 1995AD and upgraded to 24 MW with 6 units each 3.5MW and one unit 3 MW. It is a peaking run-of-river plant with peaking capacity of 21 MWh and annual design generation of 163 GWh. The cumulative generation of THPS since its first run has reached 5,445.62 GWh of which 138.964 GWh has been generated in FY 2076/77. The energy generation in this year is 79.12 % of design generation and 92.81%of generation target.

Table 1. 1 Table of latitude and longitude

Latitude N		**Longitude E**	
27^{o} 55' 09"	27^{o} 58' 25"	85^{o} 08' 45"	85^{o} 11' 11"

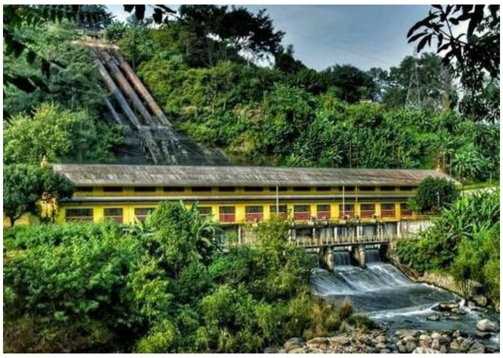


Figure 1. 3 Trishuli Hydropower Station, located at Trishuli, Nuwakot.

(Source:https://www.facebook.com/permalink.php?story_fbid=703649740438050&id=292929351510093)

2. Objectives and Limitations

2.1 Objectives

- To determine the position of any feature or more generally any point in terms of latitude, longitude, and altitude and recognize typical landform patterns.
- To prepare a demonstrative model of the topography of the Trishuli Hydropower Project.
- To be familiar with the use of reduced scale and distorted scale.

2.2 Limitations

- We were not able to demonstrate all the components.
- Information can be outdated as it gives the date as to when the survey was made. (Landscapes and places on a map can change over time.)
- We couldn’t include whole boundary of project site as including whole boundary would make our scale even smaller.

3. Literature Review

3.1 Run-of-River Hydropower

Initially run of the river hydropower plant was introduced in 1878 England. Run-of-river hydroelectricity (ROR) or run-of-the-river hydroelectricity is a type of hydroelectric generation plant whereby little or no water storage is provided. Run-of-the-river power plants may have no water storage at all or a limited amount of storage, in which case the storage reservoir is referred to as pondage. A plant without pondage is subject to seasonal river flows, thus the plant will operate as an intermittent energy source. Many of the larger ROR projects have been designed to a scale and generate capacity rivalling some traditional hydro dams. Run of river hydroelectricity production has the advantage of being a cost-effective and reliable energy technology. Its output can be predicted relatively well as this varies mainly with annual rainfall patterns and only gradually varies day-to-day instead of minute-wise. Output is also positively correlated with demand, i.e. output is maximum in winter when there is more water available (British Hydropower Association, 2005). The technology could have a strong impact on improving energy security of supply and reducing poverty alleviation (International Hydropower Association, 2002).

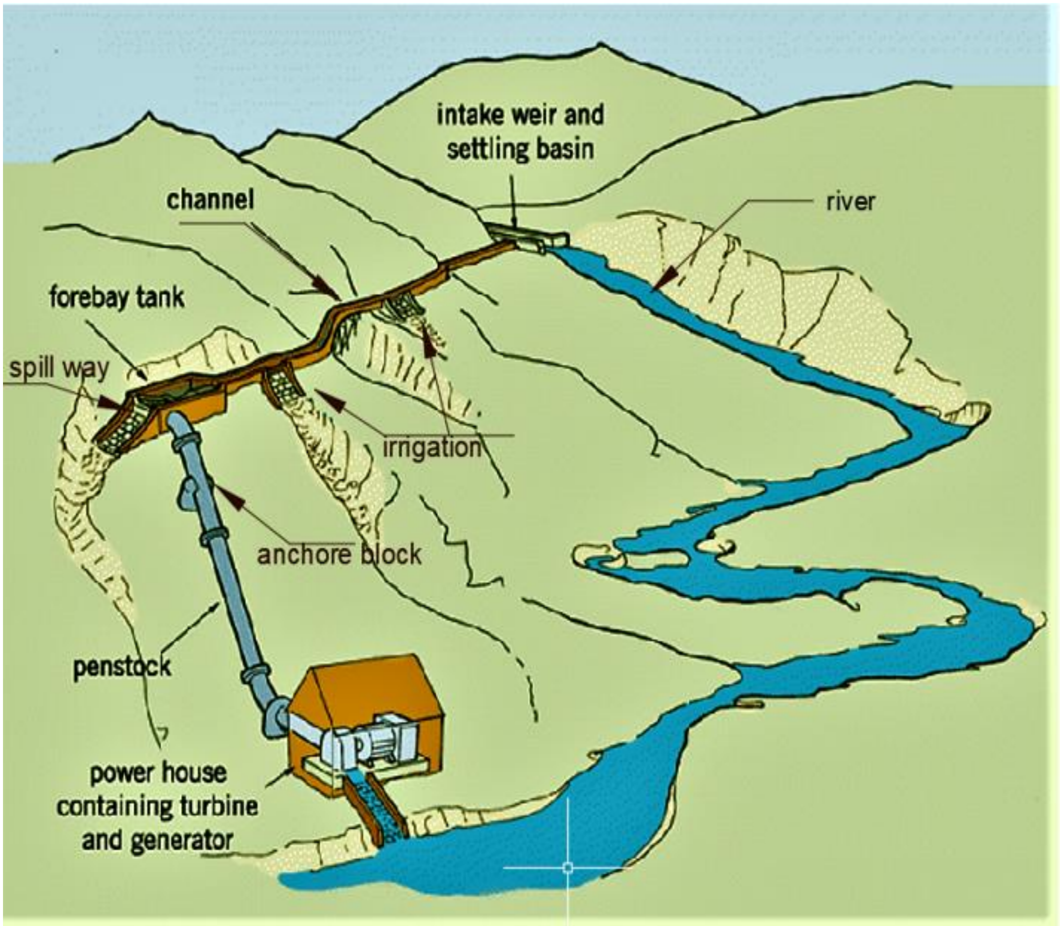


Figure 3. 1 A typical run-of-river small hydropower plan

(Source : https://images.app.goo.gl/vgZCon6RVxEzM4aE8)

3.2 Components of Run-Of-River-Hydropower

The various components of run-of-river hydropower development are given below:

3.2.1 Weir: A weir is a small barrier built across a stream or river to raise the water level slightly on the upstream side.
3.2.2 Intake: Intake is the structure between river and canal. It consists of a gate to open/close the water feed to prevent major debris to enter the system.
3.2.3 Gravel Trap: The gravel trap separates silt and debris from the water before it enters penstock and turbine. It can be placed on the beginning or the end of the canal.
3.2.4 Power Canal: A Power Canal refers to a canal used for hydraulic power generation, rather than for transport of water.
3.2.5 Forbay Tank: A forebay is a basin area of hydropower plant where water is temporarily stored before going into intake chamber.
3.2.6 Penstock: Penstocks are like large pipes laid with some slope which carries water from intake structure or reservoir to the turbines.
3.2.7 Powerhouse: Power house is a building provided to protect the hydraulic and electrical equipment.
3.2.8 Tailrace: The tail race is a channel feeds back the water from the turbines to the river.

3.3 Advantages and Disadvantages of Run-of-River Hydropower Plant

3.3.1 Advantages

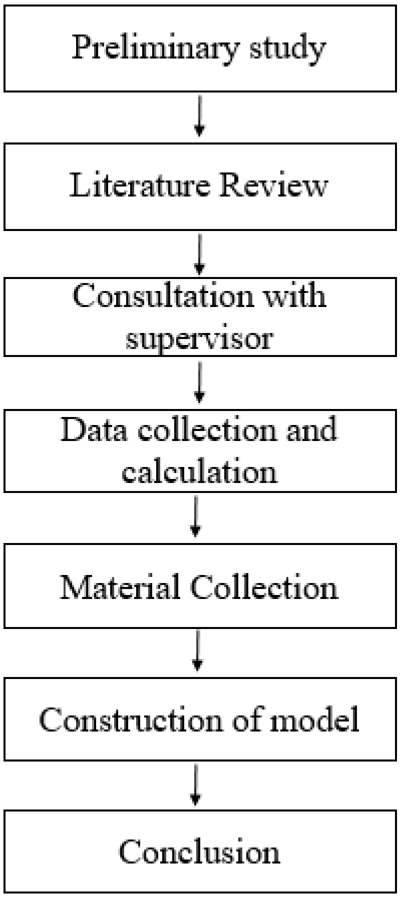
- Flooding the upper part of the river is not required as it doesn’t need a reservoir.
- Comparatively fewer greenhouse gases are produced.
- Fish migration is not affected as the river still flows in parallel with the penstock.

3.3.2 Disadvantages

- Continuous production of electricity in maximum capacity is not possible as the output is highly dependent on the natural run-off.
- Production may not be able to fulfill the demand during peak hours.

4. Methodology

The basic principle of the Trishuli hydropower power plant and its topographical references were primarily gathered by web surfing and consultation with our supervisor. The method that will be used in the development of this project is as follows:



4.1 Preliminary Study

Preliminary study is an initial exploration of issues related to the proposed quality evaluation. Preliminary exploration was done for the construction of the model of the Trishuli Hydropower Project. References regarding the topic were surfed in websites focusing on civil construction.

4.2 Consultation

Respected supervisors and instructors were approached for the initial idea. Seniors were also consulted regarding the protocols that came across the project.

4.3 Dimensions

Table 4. 1 Table of RF calculation

NAME OF COMPONENTS	DIMENSION ACTUAL (m)	DIMENSION IN OUR MODEL (m)	R.F
Contour Interval	80	0.04	1:2000
Height of highest hill	560	0.28	1:2000
Length of map	5700	1	1:5700
Breadth of map	5200	1	1:5200

4.4 Materials Required

- Polypropylene foam
- Plywood
- Enamel
- Adhesive

4.5 Model Construction

- Plywood is be used to construct the base of the model.
- Polypropylene foam is used to make the surrounding elevation of the terrain.
- The model is painted with enamel.

5. Budget

Table 5. 1 Table of budget

Materials Required	Size/Volume	Quantity	Rate (Rs.)	Total Cost (Rs.)
Map	1m*1m	1	180	180
Map	A_o	2	180	360
Plywood	1m*1m	1	800/ m^2	800
Polypropylene foam	2m*1.5m	1	1300/ m^2	1300
Enamel	1 liter	1	450	450
Paintbrush	5mm	1	100	100
Adhesive	1 kg	1	300	300
Wood dust	2 kg	1	150	150
Miscellaneous	-	-	-	200
Total				3840

6. Work Schedule

Month	December				January				February				March				April				May	
Week → / Work ↓	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Proposal preparation		■	■																			
Consultation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Proposal defense			■																			
Material collection		■			■																	
Construction of model											■	■	■	■	■	■						
Midterm presentation																	■					
Finishing and coloring																		■	■	■		
Final report submission																					■	
Final Project Defense																						■

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Completed Work	■

7. Results

The main objective of our project was to be familiar with the topography of Trishuli Hydropower Project. Following outcomes were obtained after the completion of this project:

- We constructed the demonstrative model of topography of Trishuli Hydropower Plant
- We became familiar with scale reduction and distorted scale.
- We became familiar with the concept of latitude, longitude, altitude and recognize typical landform patterns.

8. Conclusions

Finally, after many weeks of hard work we constructed the demonstrative model of topography of trishuli hydropower with assistance of our project supervisor and seniors. We built a demonstrative model and also got familiar with the engineering terms, skills, and the use of different tools. We faced a lot of problems during our project days but we seek the solutions for them. With the completion of the project we successfully achieved our objectives. We completed our project within the expected time and estimated budget.

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Annex-I (Drawings)

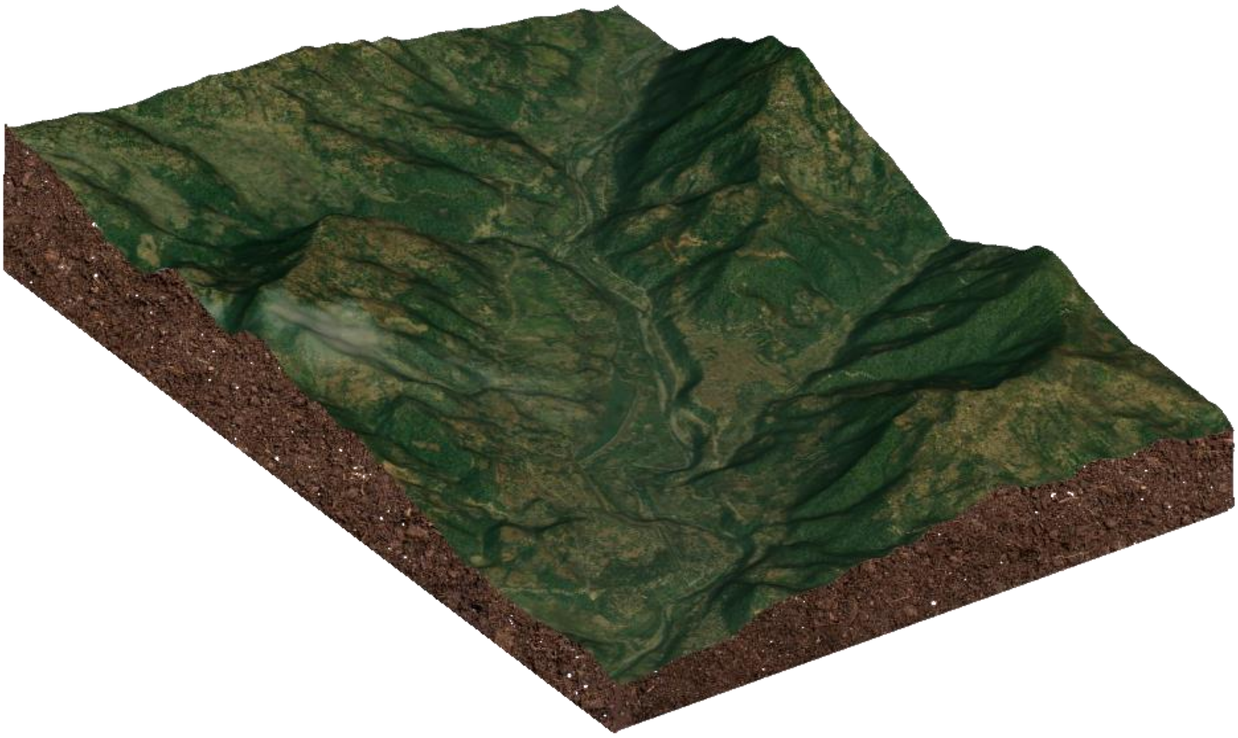

Figure Annex 1 3d View of topographical map

Annex-II (Data)

Table Annex 2 (data) 1: Measurements of the location

Description	Details
1 Contour Interval	80 m
Height of highest hill	560 m (from river surface)
Length of map	5700 m
Breadth of map	5200 m
Total number of contours	7 (80 m each)
Height of the river from sea level	500 m
Height of the highest point from sea level	1060 m
Approximate length of the river	6940 m
Area of the selected region	29.64 km^2

Annex-III(photographs)

Figure Annex 3. 1 Constructed model