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Department of Civil Engineering

Thapathali Campus, Institute of Engineering

Kathmandu, Nepal



# Cover Page

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INSTITUTE OF ENGINEERING

THAPATHALI CAMPUS

DEPARTMENT OF CIVIL ENGINEERING

**FORMULATION OF COMPUTER APPLICATION FOR DESIGN OF PRESTRESSED BOX GIRDER BRIDGE**

BY

AASHISH GHIMIRE(THA074BCE002)

BISHAL SHAKYA(THA074BCE026)

EMADUDDIN AHMAD(THA074BCE032)

KUSHAL ACHARYATHA074BCE045)

MILAN JOSHI(THA074BCE046)

NIKESH DAWADI(THA074BCE048)

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE

BACHELOR'S DEGREE IN CIVILENGINEERING

January, 2022

Kathmandu, Nepal

# Title Page



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# Certificate

TRIBHUVAN UNIVERSITY

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THAPATHALI CAMPUS

DEPARTMENT OF CIVIL ENGINEERING

**CERTIFICATE**

This is to certify that the work contained in this report entitled **"** **Design of prestressed box girder bridge"** in partial fulfillment of the requirement for the Bachelor's degree in Civil Engineering, as a record of research work, has been carried out by **“Aashish Ghimire(THA074BCE002)”** under my supervision and guidance in the Institute ofEngineering, Thapathali Campus, Kathmandu, Nepal. The work embodied in this report has been submitted elsewhere for degree.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Supervisor, name of Supervisor

Title

Name of the Department

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Co- Supervisor, name of Co-Supervisor,

Title

Name of the Organization,

Date

TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

THAPATHALI CAMPUS

DEPARTMENT OF CIVIL ENGINEERING

**DESIGN OF PRESTRESSED BOX GIRDER BRIDGE**

By

AASHISH GHIMIRE(THA074BCE002)

A project report submitted in partial fulfillment of the requirements of the Bachelor's Degree in Civil Engineering

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| …………………………… | …………………………… |  |
| Name | Name |  |
| Supervisor | Internal Examiner |  |
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| Name |  |  |
| External Examiner | Head of Department, Civil |  |
| IOE, Thapathali Campus |  |
|  |  |

July, 2020

Kathmandu, Nepal

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**ABSTRACT**

# **CHAPTER I**

## **INTRODUCTION**

## **1.0.1General Background**

Design of structures involves the designing of various types of structures such as residential buildings, bridges, multi-storied frame structures, steel towers etc. These structures are subjected to various loads such as uniformly distributed loads, uniformly varying loads, point loads, internal loads etc. which may subject the structure to shear force, axial force, bending and torsional moments. These structures serve to transfer the load to the soil on which their foundations lie, such that the structure is able to serve its purpose without risk of failure in any form.

The designing of bridges requires analysis of internal forces in the members of the structure. The designing of bridges requires sizing of members to resist the internal forces that occur in the members so as to allow the structure to appropriately serve its purpose for its intended useful life. Without proper analysis and designing of bridge according to the provided guidelines via the specified standard code (Nepal Bridge Standards-2067), the structure will not be able to serve its intended purpose and may result in failure and loss of both finances and civilian lives.

This project undertakes the task of automation of design of prestressed box girder bridge using python programming language. With a program designed specifically for the purpose of design of prestressed box girder bridges, the process can be made easy, fast and reliable for similar projects.

Python is a widely used general-purpose, high level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python Software Foundation. It was designed with an emphasis on code readability, and its syntax allows programmers to express their concepts in fewer lines of code.

This project has been undertaken as an essential requirement for bachelor’s degree in civil engineering as specified under the course content provided by Institute of Engineering, Tribhuvan University. The project aims to analyze the proposed bridge structure, provide design and detailing as well as provide an appropriate estimate of its durability (safety) and cost of construction. All the theoretical knowledge acquired have been accordingly utilized for practical application for the analysis, design and detailing of the proposed bridge. The purpose of this project work is to be well acquainted in the practical implementations of knowledge and skills required in the field of Civil Engineering.

## **1.0.2 Specific Background**

### **1.0.2.1 History of Bridge**

Bridge is a structure that provides passage over obstacles such as valleys, rough terrain or bodies of water by spanning those obstacles with natural or manmade materials. They first begun to be used in ancient times when first modern civilizations started rising in the Mesopotamia.

From that point on, knowledge, engineering, and manufacture of new bridge building materials spread beyond their borders, enabling slow but steady adoption of bridges all across the world. In the beginning bridges were very simple structures that were built from easily accessible natural resources- wooden logs, stone and dirt. Because of that, they had ability only to span very close distances, and their structural integrity was not high because mortar was not yet invented and rain slowly but constantly dissolved dirt fillings of the bridge. Revolution in the bridge construction came in Ancient Rome whose engineers found that grinded out volcanic rocks can serve as an excellent material for making mortar. This invention enabled them to build much more sturdy, powerful and larger structures than any civilization before them. Seeing the power of roads and connections to distant lands, Roman architects soon spread across the Europe, Africa and Asia, building bridges and roads of very high quality. Modern bridges are usually made with the combination of concrete, irons and cables, and can be built from very small sizes to incredible lengths that span entire mountains, rough landscapes, lakes and seas.

### **1.0.2.2 Bridge Elements**

Generally, for a typical bridge, there are 6 major parts:

* Deck
* Girders (Longitudinal and Cross)
* Bearing
* Abutment
* Foundation

### **1.0.2.3 Prestressing**

Prestressing is the process by which a concrete element is compressed, generally by steel wires or strands. Precast elements may be prestressed during the construction process (pre-tensioning) or structures may be stressed once completed (post-tensioning). Prestressing compensates for the tensile stresses introduced when the element is loaded. Hence the concrete generally remains in compression.

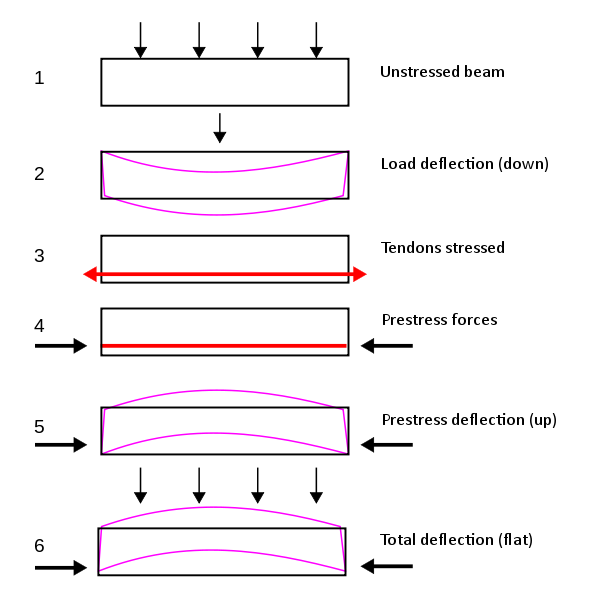


Fig 1.1: Forces in Prestressed Structure

### **1.0.2.4 Bridge Design Codes**

### **1.0.2.5 Python Programming Language**

Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small- and large-scale projects.

**Design philosophy and features**

Python strives for a simpler, less-cluttered syntax and grammar while giving developers a choice in their coding methodology. Rather than building all of its functionality into its core, Python was designed to be highly extensible via modules. This compact modularity has made it particularly popular as a means of adding programmable interfaces to existing applications. Its core philosophy is summarized in the document The Zen of Python (PEP 20), which includes aphorisms such as:

* Beautiful is better than ugly.
* Explicit is better than implicit.
* Simple is better than complex.
* Complex is better than complicated.
* Readability counts.

**Syntax and semantics**

Python is meant to be an easily readable language. Its formatting is visually uncluttered, and often uses English keywords where other languages use punctuation. Unlike many other languages, it does not use curly brackets to delimit blocks, and semicolons after statements are allowed but rarely used. It has fewer syntactic exceptions and special cases than C or Pascal.

Python uses whitespace indentation, rather than curly brackets or keywords, to delimit blocks. An increase in indentation comes after certain statements; a decrease in indentation signifies the end of the current block. Thus, the program's visual structure accurately represents its semantic structure.

**Libraries and Modules**

A module is a software component or part of a program that contains one or more routines. A library is defined as a prewritten set of one or more modules designed to perform specific tasks. They can be imported into a code for easier functionality and usage.

Python's large standard library, commonly cited as one of its greatest strengths, provides tools suited to many tasks. As of September 2021, the Python Package Index (PyPI), the official repository for third-party Python software, contains over 329,000 packages with a wide range of functionality, including:

* Automation
* Data analytics
* Databases
* Documentation
* Graphical user interfaces
* Image processing
* Machine learning
* Mobile apps
* Multimedia
* Computer networking
* Scientific computing
* System administration
* Test frameworks
* Text processing
* Web frameworks
* Web scraping

A number of libraries are used in the formulation of this project as well such as:

* Numpy
* Pandas
* Tkinter
* Openpyxl
* Pillow
* Matplotlib, etc.

# **CHAPTER II**

## **DESIGN PHILOSOPHY**

## **2.0.1 Limit State Design**

## **2.0.2 Bridge Design Structure**

## **2.0.2.1 Hydological Study**

## **2.0.2.2 Geological Study**

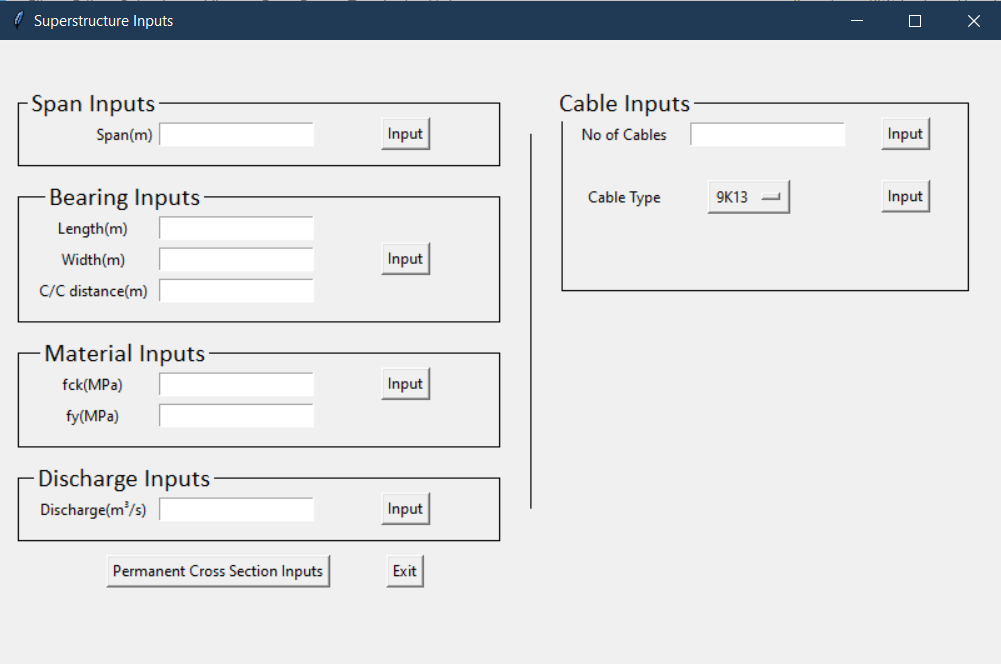
## **2.0.2.3 Section Initialization**

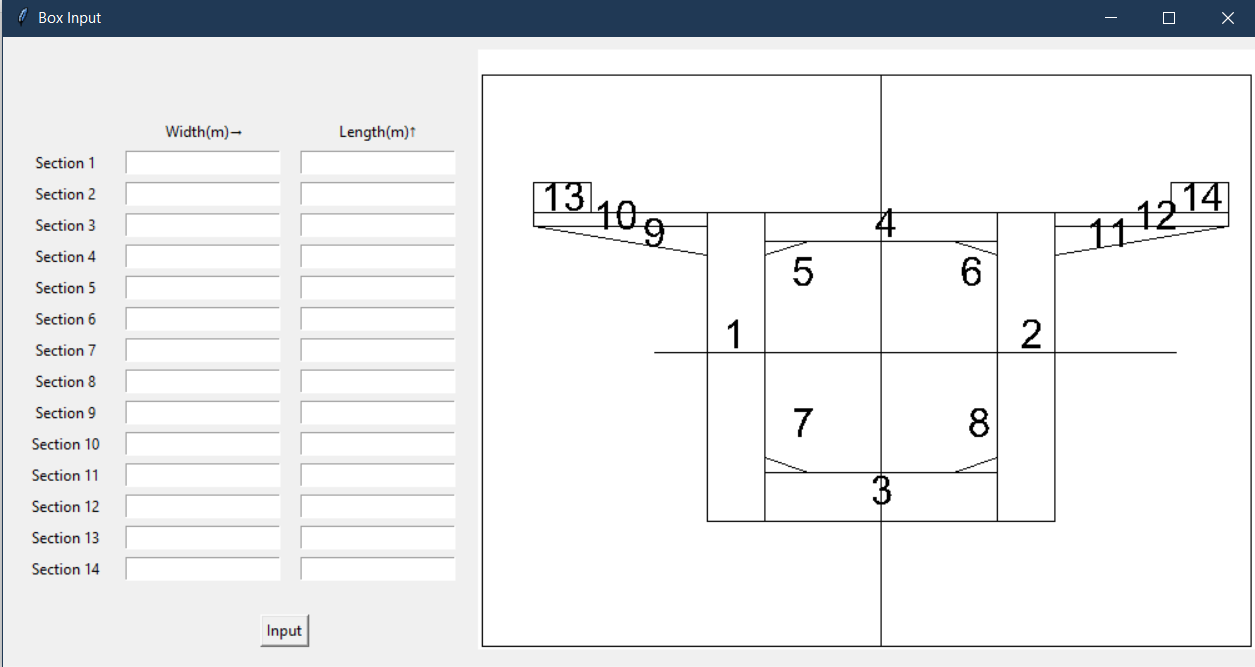
## **SUPERSTRUCTURE**

## **2.0.1 Programming Flow structure**

## **2.0.1 Superstructure Inputs**

The necessary inputs for superstructure design of prestressed box girder are taken from user which include:





## 