

Analysis And Design Of Skew Bridge

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ABSTRACT

The skew bridge is one whose longitudinal axis makes an angle less than or equal to 90° . The skewness may be a way to avoid certain obstracles and thus create the most economically viable options. Newly designed bridges are often skew. This is due to space constraints in congested urban areas. It can be also needed due to geographical constraints such as mountainous terrains. However force flow in skew bridges is much more complicated than straight bridges. Therefore careful investigation and numerical analysis needs to be performed, in which a skew bridges can be modeled in several ways. In addition skew bridge are common at highway interchange, railway crossing, river crossing and other extreme grade changes where skew geometry is necessary due to space limitations. In this paper, analysis and design of skew bridge is carried out on existing Reinforced Concrete Bridge. The selected bridge is Nanping Bridge was a 43-year-old, two-lane, located at Ninxiang country. Analysis and design of the skew bridge is done by using STADD Pro software. And also the deck slab is manually designed using IRC codal provisions.

Key words: Skew bridge, skewness, Nanping Bridge, STADD Pro software, IRC codal provisions.

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INTRODUCTION

Bridges are very special type of structures. They are characterized by their simplicity in geometry and loading conditions. The majority of bridge decks that are constructed now a days are often some skewed or curved. The skew bridge is one whose longitudinal axis makes an angle less than or equal to 90° . The skewness may be a way to avoid certain obstracles and thus create the most economically viable option. Newly designed bridges are often skew. Tight geometry is often placed on highway structures due to right of way restrictions in congested urban areas. If a road alignment crosses a river or any other obstruction at an inclination different from 90° , a skew crossing may be necessary [1].

Skew bridges are common at highways, river crossing, railway crossing and other extreme grade changes when skewed geometry is necessary due to limitations in space is shown Fig 1. This paper aims at redesign the existing reinforced concrete bridge as a steel skew bridge. For

this purpose an existing Nanping bridge was chosen from the journal. An existing reinforced concrete Nanping bridge (shown in Fig 2) was already in failure in structure [3].



Fig 1 Skew Bridge at highways

For redesign as a steel skew bridge, the required dimensions were collected from the journal of bridge engineering -“Field study of Overload Behavior of an existing Reinforced Concrete Bridge under Simulated load Vehicle Loads” done by Zhang et al., (2011). The total length of span was 40m. The collected data were used for analysis and design of steel skew bridge using software STADD Pro and deck slab was manually designed using IRC codal provision [3].



Fig 2: Nanping Bridge

MATERIALS AND METHODS

This study was conducted the following steps:

- 1) A literature review was carried out to understand the skew bridge specifications and skew bridge design steps.
- 2) The Reinforced Concrete Nanping Bridge was redesigned as a steel skew bridge.
- 3) The analysis and design the skew bridge was conducted using software STADD Pro.

- 4) The deck slab of skew bridge was manually designed using IRC codal provision.
- 5) Finally check for safety.

DATA COLLECTION

The required dimensions were collected from the journal of bridge engineering-“Field Study of Overload Behavior of an Existing Reinforced Concrete Bridge under Simulated Vehicle Loads” done by Zhang et al., (2011). The collected Nanping Bridge details shown in Fig 3. Nanping Bridge was already in failure structure. For redesign the Nanping bridge as a steel skew bridge, the collected dimensions were used.

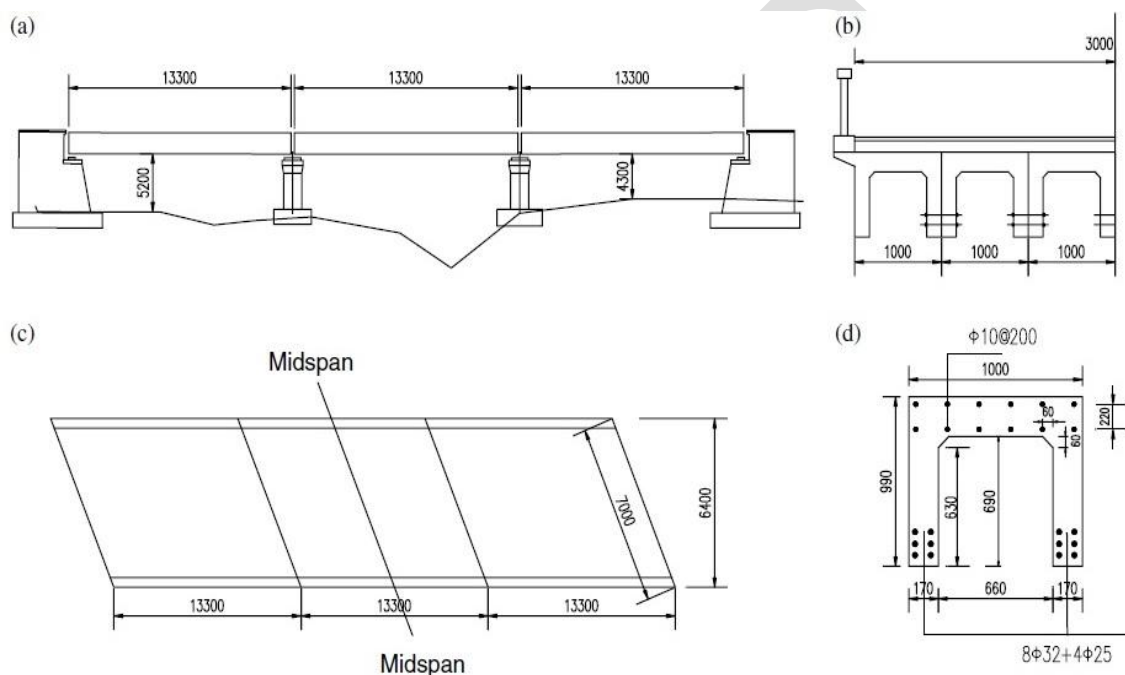


Fig 3: Nanping Bridge details

MOELING

The collected Nanping bridge details and dimensions were used for modeling the steel skew bridge by STADD Pro software. Materials used and materials properties were mentioned in Table 1.

Table1. Materials Properties

Sl. No.	Materials	E(kN/mm ²)	Density(Kg/mm ³)
1	Steel	205.000	7.83E
2	Concrete	21.718	2.4E

ANALYSIS AND DESIGN OF SKEW BRIDGE

In this paper, the analysis was carried out under finite element method and design also conducted using software STADD Pro. Finite Element Analysis (FEA) is a computerized method for predicting how a product reacts to real-world forces, vibration and physical effects. FEA shows whether a product will break, wear out or work the way it was designed. The analysis and designed results were noted in Fig 4 and Fig 5.

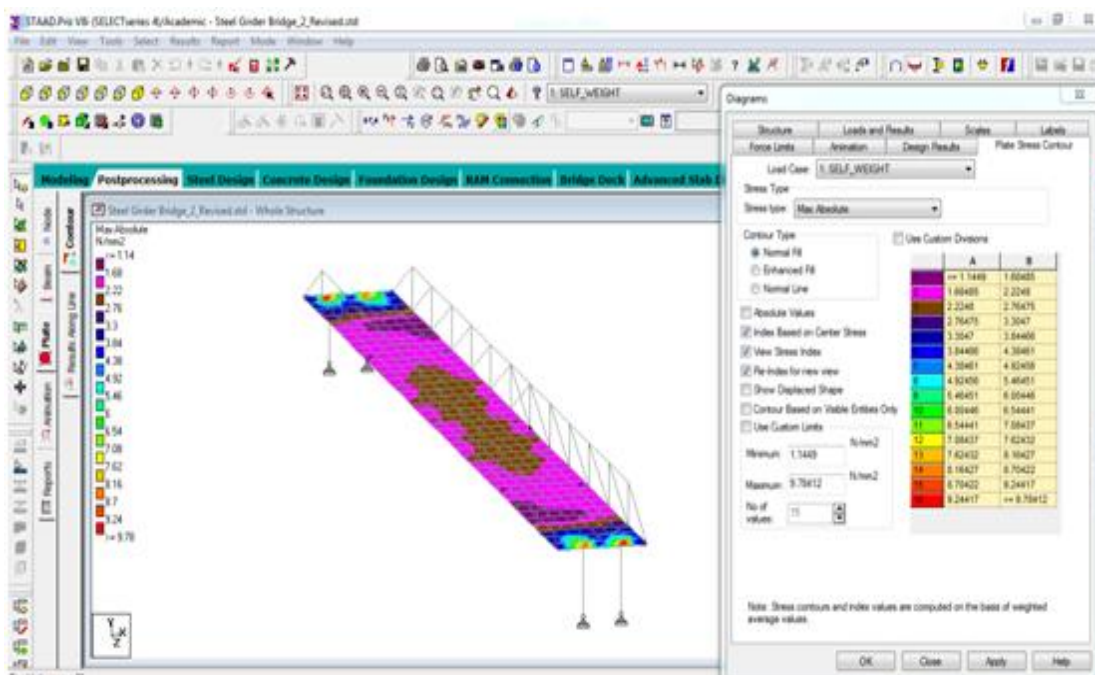


Fig 4: Analysis result under self weight

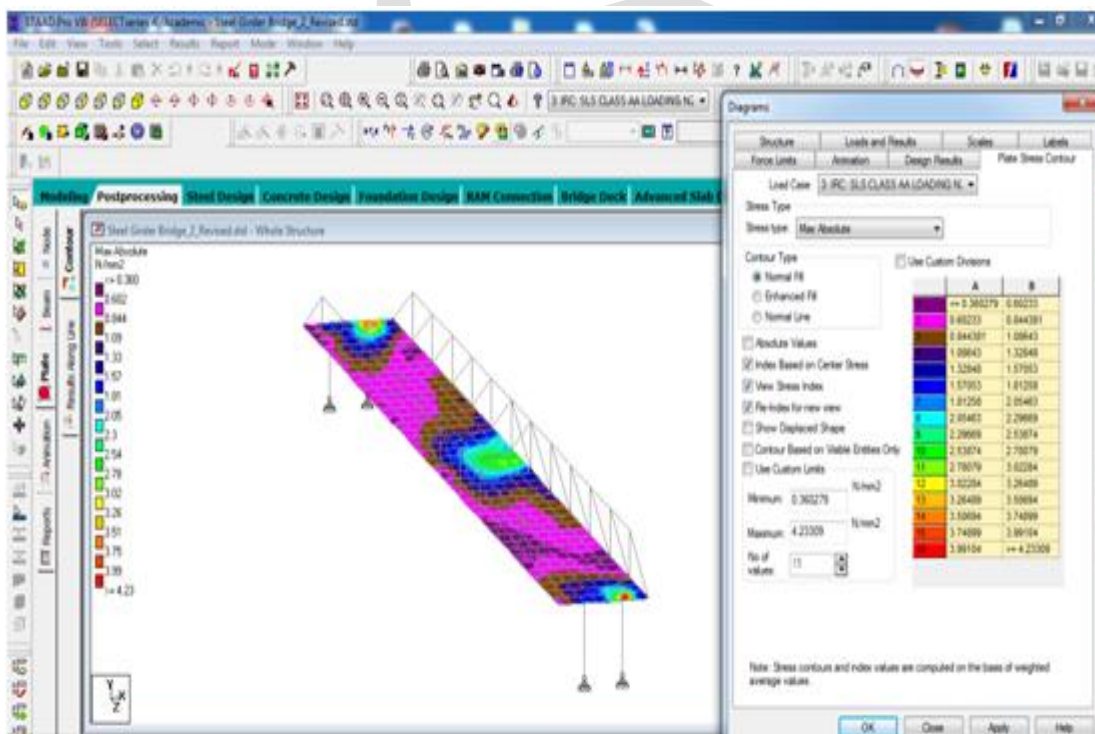


Fig 5: Analysis result under IRC Class AA loading

MANUAL DESIGN OF SKEW BRIDGE

The manual design of steel skew bridge was conducted as per the codes IRC : 6-2000 and IS 800. In Fig 6 shows the skew bridge details of Nanping Bridge. In both software design and manual design the Nanping skew bridge was safe under design.

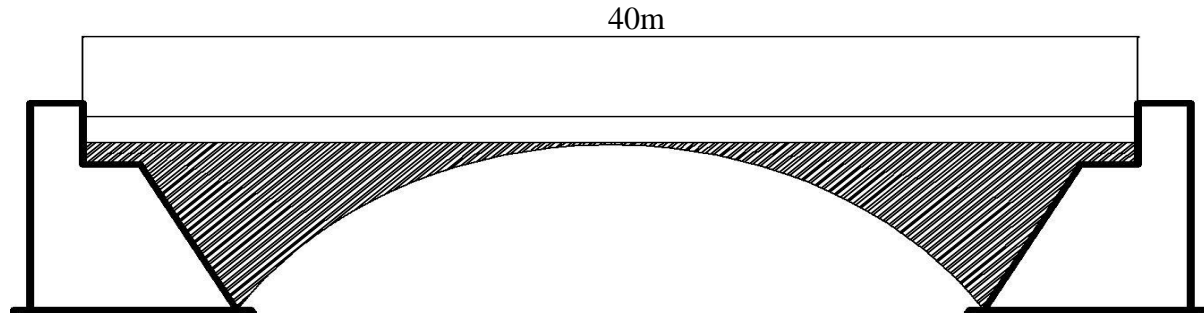


Fig 6: Skew bridge details of Nanping bridge

CONCLUSION

An existing reinforced concrete Nanping bridge was already in failure in structure. If it is steel skew bridge the bridge design was safe. The renovation cost is more but the life span for skew bridge design is comparatively longer than the reinforced concrete bridge. Both software and manual design of Nanping skew bridge was safe.

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