DEVICE FOR LAUNCHING THE TMS BRIDGE

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ABSTRACT
The paper deals with construction design of special device which is used for launching the TMS temporary bridge set. The device is used with the vehicle that is used to push the bridge structure over the obstacle. The device is frame construction made of steel and connected to end bay of the bridge by the pins. Dismountable, portable and easy to maintain were the main requirements for the device. Paper presents the reasons why this device is designed by this way and there is also made suggestion for static assessment

Key words:
Engineer; Temporary bridges; CAD; CAE – Scia Engineer; Construction Assessment

INTRODUCTION

The Czech Republic is the state with the highest density of road network in Europe. But when a crisis situation comes (flood, landslide, etc.), this problem must be solve immediately, because of limited supply to different parts of the country. That's why there are temporary bridges, that solves the problem of demolished roads and permanent bridges. Construction of bridges is realized by engineer troops with the support of reach-back concept [1]. One of the temporary bridges is TMS bridge set that is specifically developed for this purpose. But even this set should be modernized. One of the requirements for the modernization could be new device for launching, which has lacked in this set so far. [2].

1 TMS BRIDGE SET

The TMS bridge set is the main representative of temporary bridges used for logistics. TMS is road, standardized steel bridge. This bridge is designed for one way traffic lane only (4 meters wide). The TMS bridge is a truss type bridge with the

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roadway being carried between two main girders. The trusses in each girder are formed by 3 - meter panels pinned end to end. Fundamental building module of the bridge is 3 m long bay “Fig. 1”. Each part of the TMS bridge is a standard machine-made piece and is interchangeable. In few cases (single story), no heavy equipment is required to assemble. TMS bridge is determined for wide span (up to 36 meters for MLC 70). It is the most suitable to build one bridge span but it is also possible to build bridge with more spans (max 7 spans). In this case it is necessary to build pier (e.g. PIŽMO). For the construction of pier is also possible to use alternative material (pile bent, grillage using timber or concrete panels).

Figure 1. Intermediate bridge bay

The main girders on each side must be assembled from two trusses side by side. For greater strength, a second story of panels can be added to the trusses. The upper stories are bolted to the top chord of the lower story. Transverse floor beams, called transoms, are clamped to the bottom chords of the trusses and support stringers and decking. Sway braces between the girders provide horizontal bracing and transoms keep the trusses upright. The bracing frames between the trusses provide lateral bracing within each girder [3].

2 THE LAUNCHING WAYS

The classic method of construction TMS is assembled bridge on the plain roller trays and pushing the bridge over the obstacles. The most common way is using launching nose - to ensure counterweight in bridging obstacles. Extending the use of launching nose can also occur in several other ways: [4].

- Manual pushing
- Towing coupling
- Pressing element

2.1 MANUAL PUSHING

There is sufficient manpower to pushing the bridge at the beginning of the building of the bridge. There is insufficient manpower with increasing length of the bridge or if the bridge is launching at an inclination.

2.2 TOWING COUPLING

It serves as a securing element when the bridge comes over the obstacle by using tow rope. Towing coupling is mounted on the central hinge of sway brace in bridge bay that is determined by the schema of the launching. Solution of structure is such that the upper and lower part encloses the middle hinge sway brace. Towing end has hole for pin where the tow rope eye is inserted “Fig. 2”. The rope must be stretch over the obstacle and the other end of the rope is connected to truck.

Then the truck moves away from obstacle or uses winch, rope is stretched and the temporary bridge is towed over the obstacle. In this case of launching it is necessary to secure brake because the rope can carry only tension stress. Second end of towing coupling is connects with the screw towing coupling parts together and securing coupling is a shear pin which provides the maximum force of 150 kN strength.

Figure 2. Towing coupling

2.3 PRESSING ELEMENT

The pressing element is temporary steel structure that is used to move the bridge by truck. It consists of a counter face steel plate with four screw holes, welded U-profile and the attached hinge towing device. The structure is mounted on the last transom in bridge construction “Fig. 3”.

The pressing element is used to connect the truck through the drawbar to transom. Pressing element is mounted on the center of last transom of the bridge. This method is used for final launching of the bridge, when there is not enough manpower for launching.

This structure bends the transom, and therefore it is necessary to replace it with better quality pressure element. The second problem could happen when the construction is towed back form obstacle. In this case the last transom is held only by 8 short bolts that are not designed to tensile stress.

Figure 3. Pressing element

2.4 PROBLEMS OF LAUNCHING WAYS

The ways of launching mentioned above have different problems. Among the most important of them we can classify these:

- insufficient manpower,
- suitable braking of bridge during launching and
- inappropriate point of attachment to the construction of the bridge with regard of static load.

3 DESIGN OF LAUNCHING DEVICE

As it is mentioned above the methods and ways of launching are not appropriate and it would be advantageous to replace them with new device for launching. This device should avoid the problems mentioned in previous paragraph. The next aim is to design an optimal pressing element according to chosen parameters. These parameters are:

- Easy to handle;
- Price availability;
- Simple maintenance and storage;
- Easy assembly and disassembly.

There were several drafts of the construction. All drafts were designed of structural steel S 235. Drafts are adapted to connect to a military vehicle Tatra T-815 6x6 and its basic dimensions, such as height hitch. Drafts were made in Autodesk Inventor 2012 and static calculations were calculated in Scia Engineer 14 [2].

The final draft of the launching device is composed of U-profiles. This construction is connected by the bolts. Two U-profiles are provided with lugs for connection to a female end of the triangle panel. One U profiles is equipped with towing eye for connection to a truck and a second U profile is designed as a stiffening of the structure “Fig. 4”.

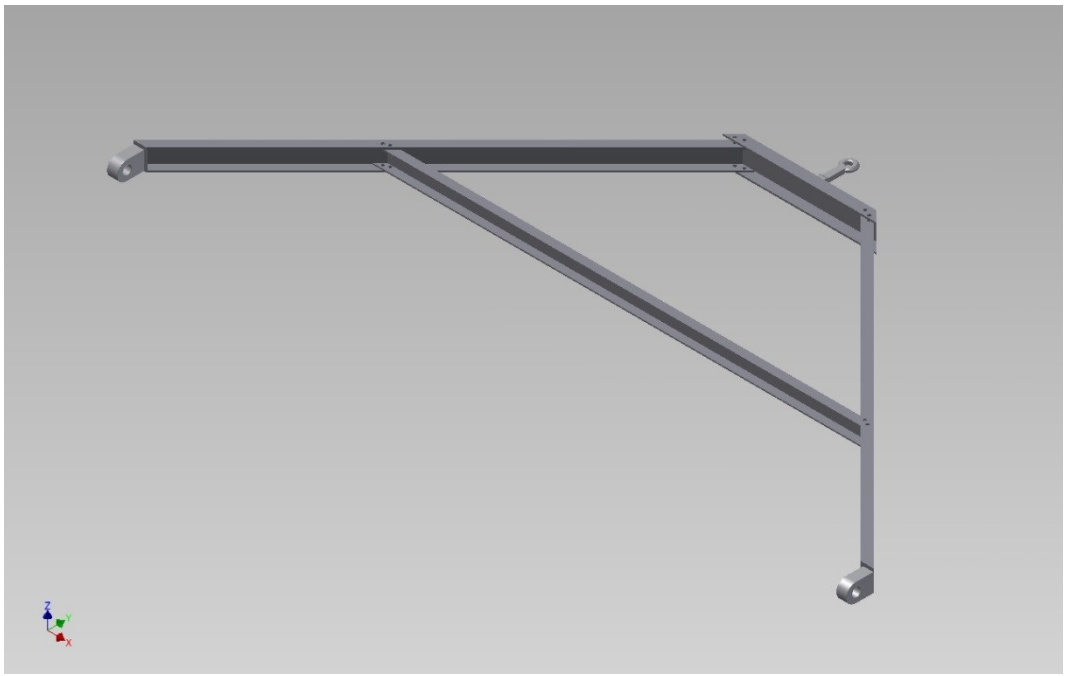

Figure 4. Design of launching device

4 ASSESMENT OF LAUNCHING DEVICE

Static calculations were performed in Scia Engineer 14 software. The calculation was performed as static without dynamic factors. Load factors were not

considered. The structure was created as a beam plane structure with well-defined profiles U (Table 1) [5].

Table 1. Cross section profiles of beams

Material	Steel S 235
Profile 1	U 180
Profile 2	U 140
Profile 3	U 120
Profile 4	Rectangle 120; 68
Load	100 kN

There was only one load case applied on the structure. Load of the structure was designed as 15% weight of the TMS bridge launched during exercise in Kojetin where the launching device should be tested. The weight of the bridge structure is 660 kN. This means that the force acting on launching device is 100 kN. Strain on its structure does not exceed the yield strength.

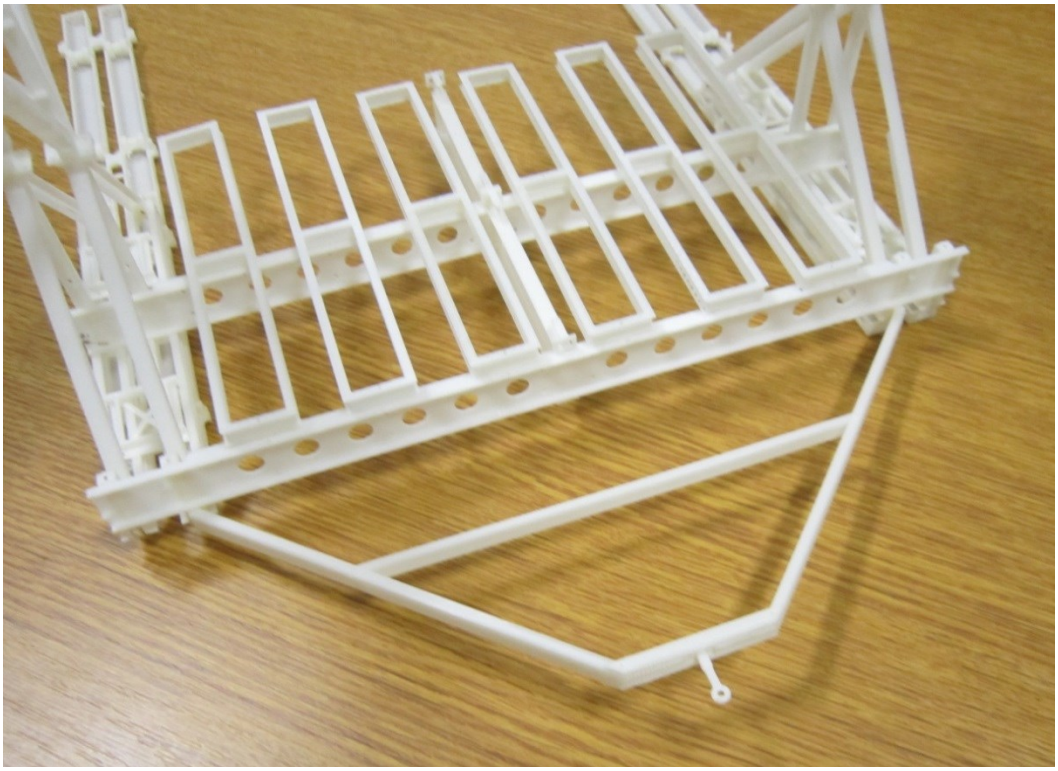

Figure 5. 3D model of construction

5 TESTING OF STRUCTURE

The design of launching device was initially printed as a 3D model from plastic material. The model was printed in 1:20 scale. The printed model was verified by basic parameters of a possible connection with the construction of the bridge TMS “Fig. 5”.

Subsequently, the construction was manufactured of steel in real dimensions “Fig. 6”. The total weight of the structure is 175 kg. The basic components of beams enable handling only by human power. Overall, it is necessary to assembly and connects construction by two people. The construction should be tested during training in building of the temporary bridge in September, but there was short delay and the construction was finally manufactured in the month of November.

Figure 6. Launching device – prototype

CONCLUSION

Launching device was created to simplify handling of the bridge during its launching and subsequent downloading back from obstacles. Its construction has been chosen to transfer stress caused by pushing vehicle directely to the main girders because girders are able to adequately absorb the strain. After performing the necessary tests in May it will be designed some adjustments that may possibly change some design details.

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