

An In-depth Understanding of Infrastructure through the bridge contest

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What's the bridge contest?

The bridge contest is a competition that can assess the strength of a bridge structure made by students.

I would advocate that bridge contests are not only useful for learning mathematical formulas and structural mechanics. They are also effective in fostering a broader work and career consciousness for junior high school students, and by using the theme “bridge”, it can provide students with the opportunity to ask questions such as:

How is public equality promoted in infrastructure? ,

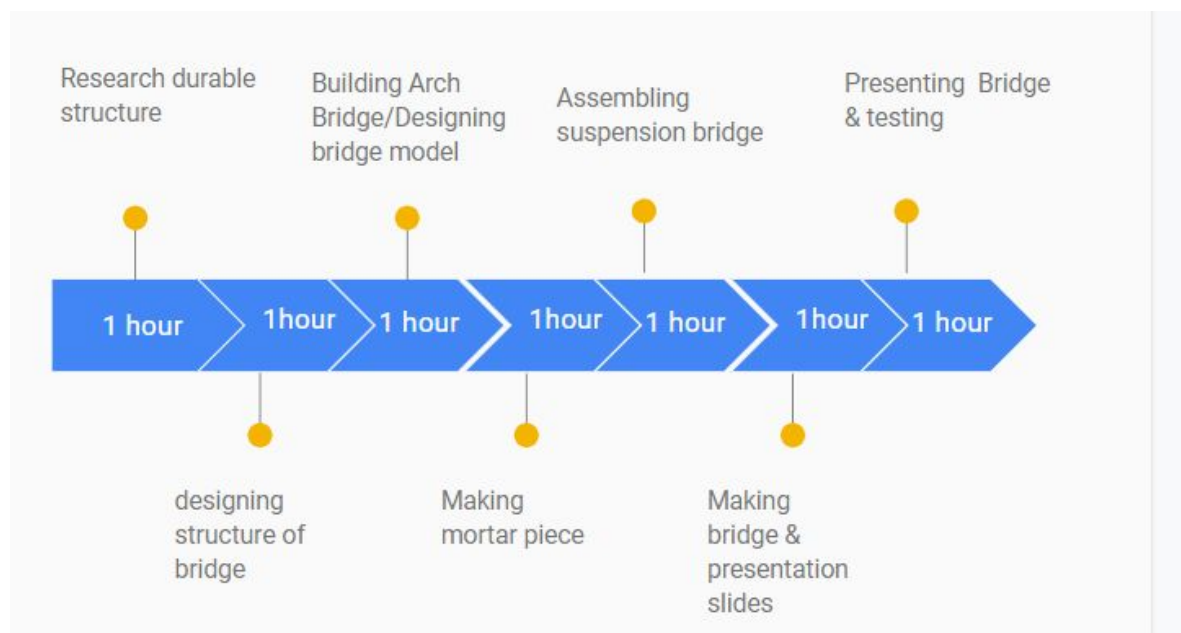
What is the definition of public property for residents and citizens? ,

Who will maintain the infrastructure that will be created using public funds known as a 'blood tax' in Japan? ,

How should future infrastructure be maintained ? , or so.

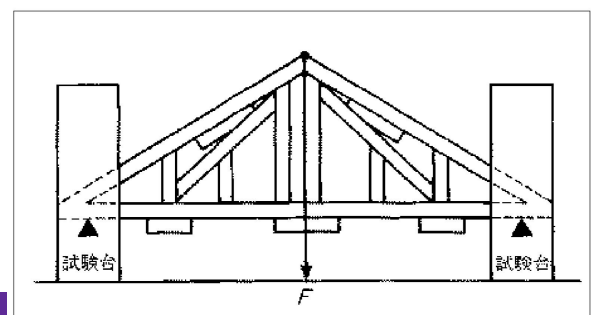
The Bridge Contest is an opportunity to access our argument, the maintenance of infrastructure as social capital.

Process of activities that I designed

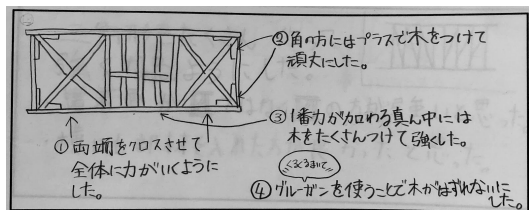


Making Model of bridge & Testing

Twenty years ago, in the subject "Technology" class, the idea of "making things accurately" was dominant. So the activity of "destroying" was new. The students seemed confused about what could be broken. And the work seemed to be difficult. I told my students, "You can do as



many destructive tests as you want." With this liberty the students started a destructive test, saying, "It's okay if I fail!"



The activity quickly became popular.

"Wow, that is Bent !"

"Stop! It will break!" students said.

Then, students in another group were assembled on a destructive test bench during the test. The students had fun doing the destructive tests.

After the test, the students wrote feedback.

"Triangles are put in the structure, and small pieces of wood are laid on top to strengthen the center," said one student who noted the truss structure.

Some students noticed the processing accuracy, saying, "It was better to improve the surface area (cut the diagonal of the tip) so that the wood could touch more."

"It's a good idea to build 'slowly' so that the lower weight doesn't shake," said one student. Some students noticed the structure of the entire bridge, saying, "The entire bridge must be uniform."

The students mentioned not only the strength and structure but also the test method, and they were very interested and engaged in the activity of the bridge contest. After class, we watched a video of Akashi Kaikyō Bridge construction.

"It's not just a matter of using a lot of materials. Safety is the first priority, but even such a narrow pier can support a long bridge girder. I thought that such a job would be good", "The

図3 生徒のプレゼンスライドの一部

people on the site have amazing skills and accuracy in calculations of the bridge design," said the students.

Many students showed interest in engineering and technology as well as learning mathematical formulas and structural mechanics in the bridge contest. In addition, some students improved their career awareness.

Building Arch bridge

“A real brick arch that is safe for people to stand on”

The arch structure was invented 5000 years ago by the Sumerians of Mesopotamia and is said to have been the cornerstone of today's architecture. It is said that both the arcade in front of the station and the architecture are derived from this arch. Build a mortar bridge using cement. Both concrete and mortar use a material called cement. The name changes depending on whether or not gravel is mixed.

This is a project to assemble an arch bridge on which people can stand with bricks. Lay the bricks on the brick base with sand and water. If you add water to the sand, it will become moderately sticky and play a role in joining bricks. If there is no water, adjust by spraying.



Making different pieces of mortar

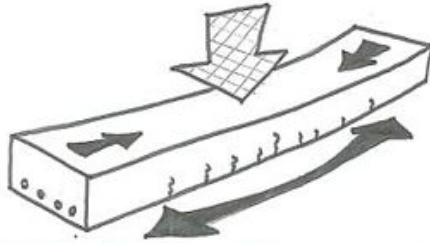
- Do you know the difference between mortar and concrete? -



Concrete is composed of large aggregates (gravel, etc.) in addition to cement and sand. Mortar is mainly made of cement and sand. In this class, all students made mortar specimens and conducted strength tests under various conditions. A science teacher gave a lecture on the scientific story of cement.



3-3 モルタル強度試験



製作する試験ピース

- 1 鉄骨（針金）入り 真水

真水

- 2 鉄骨（針金）なし 真水

真水

- 3 鉄骨（針金）なし （不純物1）

不純物1

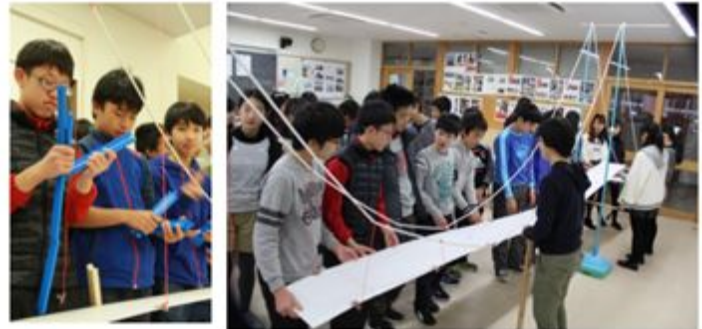
PROJECT SUSPENSION BRIDGE

- Same steps for the model and the real one -



This is an activity in which students can learn how to plan a big project like building a suspension bridge. The construction process of a model bridge is the same as a real bridge

Teamwork is especially important in the construction of social capital such as suspension bridges. The real pleasure lies in fitting all the puzzle pieces together correctly. Identify construction conditions, select construction methods based on the results of geological / ocean current surveys, and in some cases hold briefing sessions for residents' understanding, and design routes to balance the loading of building materials and the transport of excavated earth and sand. There are a variety of issues, such as devising an efficient transport method procedure,



too. A huge project can be advanced while balancing the construction period, cost and safety. It is not something even a skilled leader can do working alone.

In the class, each process is divided and roles are divided, and a suspension bridge is made with the objects around us. It is an activity to cooperate in assembling and dismantling a suspension bridge model within a limited time. The anchorage is a student desk, the caisson is a climbing base, the main

tower is a climbing frame, the main cables and hanger ropes are vinyl strings, and the bridge girder is a white board. Lifelines such as railroads, roads, and water supply routes have all been equipped with Plarails, and have a new trendy look.



The suspension bridge of the model also bends when the toy Shinkansen passes through it. If you shake one side of the suspension bridge, the other side will shake as well.

Going to real bridge “Akashi Kaikyo Bridge”

I always bring my students on a real bridge tour. The students are volunteers who want to see a real bridge. I plan a trip to the longest Bridge tour in the world, Akashi Strait Bridge, and lead students once a year.

Walking on the grating of the bridge girder (a lattice-shaped sunoko made of iron) that cannot be entered normally, retirees who were involved in construction and design during their career will provide engineering explanations. We ascend to the top using the main tower elevator with the former engineer. There is a panoramic view of about 300m and 360 degrees above the sea surface. Students will be surprised at the huge functional beauty of Akashi Kaikyo Bridge by listening to the commentary of the former engineer and the experience of the bridge contest obtained in class. The number of participants is small, about 20 people, but the students who participated feel very moved. I would like to introduce the impressions of the students below. Both of them have something like a real feeling that cannot be obtained in class.

"The explanation by the guide at the first museum was very easy to understand while looking at the exhibits, etc. Then I actually walked down the bridge and saw the size of the towering tower from the sea up close. I also thought that the presence of a large number of large parts was a sign of the



difficulty of the construction: climbing the summit overlooking Honshu, Awaji Island, and the Seto Inland Sea provided a very good view. On the way back I was able to ask the guide questions and I think it was worthwhile to have questions answered in a very easy-to-understand explanation. Japan was one of the passions of those who spent ten years working on construction, and there are many challenges and difficulties in building a bridge that still holds the record for longest bridge ever built. I was impressed by the technology present in the design."



"Looking at the bridge on the return train, I noticed that a triangular pole was supporting the bridge. When I thought about it, I realized that it was the same with the Akashi Kaikyo Bridge. I thought that the triangle is a shape that could easily support objects, and I was able to learn more details with the help of the commentators. I wanted to make use of it in a technical lesson, I wanted to make a small model of the cute bridge, and I wanted to make it immediately, and above all, the view from the top of the tower was a superb view. It was like walking down the bridge to the ground, it was a very mysterious view I had never seen, I thought I wanted to see my family, I was scared to get to the top of the tower Look through the metal net I was worried that the sea would fall right underneath, but I was relieved because the employees said, "This is a bridge that I made, so I can't break it. I want to come again with my family. "



Think and experience the present and future of social capital



Talks from MLIT experts, drone experiences, VR work at heights

(With Ministry of Land、 Infrastructure and Transport)

Mr. Fujita (MLIT) came to our school and talked about the present and future of the maintenance and management of social capital such as bridges. And Mr. Aoyama of Special Altitude Technology Co., Ltd. gave us the experience of bridge inspection and VR experience, and Mr. Sakaguchi of NPO Pasu Asumu Civil Engineering (Drone Shooting Creators Association) said that drone recording is currently in the pilot stage of consideration for future bridge inspection.



In the technical course at Doshisha Junior High School, we learn through experience the social capital that is our common property (strength test of bridge model, mortar test piece production and strength test, arch structure production, management of huge project with suspension bridge model) We have developed our own curriculum to think about future social life and the future of shared capital. Civil engineering that supports our infrastructure is exactly what we call the design of human social life. It is a topic that is packed with elements of STEAM (Science, Technology, Engineering, Art, Mathematics), but it is discussed often. Also, It is not done. STEAM focuses on this genre and strives to develop rich learning for students. In the future, a new learning style will be adopted in which students will be able to respond flexibly by learning live and working while actively connecting PBL (project-based learning) learning methods to the actual society and the field. For this reason, in one of the classroom exercises, we collaborated with the MLIT.

* Lecture of experts from MLIT: Maintaining social capital (measures for aging bridges). Creating the future.

* A proposal for inspection using a drone as a new bridge inspection technology.

Students experience indoor operation and shooting (practice with professional photographers and drone pilots)



* Experience inspection by VR (high-altitude inspection model) from an inspection company undertaking the work of the Ministry of Land, Infrastructure, Transport and Tourism (⇒ VR experience)

Students said,

"Tell me in detail about things I have heard but haven't heard of, such as infrastructure and lifelines, with examples. "

"I knew that the deterioration of social capital was a problem now, but I didn't know at all that there were people using the latest drones to maintain it. And through the experience, I was able to get to know them and think about applications from a slightly different field, such as drones. I was able to meet interesting people and it was a very good experience. "

Students consider themselves to be a hero who can change reality as a citizen.

My goal as a teacher

If you want to think more deeply about infrastructure as social capital, you need more diverse academic knowledge. You will also need a deeper understanding of thought and philosophy. Also, you will want more ways of thinking when making decisions. Students living in the future will face

increasing budgets for repairs, aging infrastructure, and the problems of declining population. In such a pressing situation, we, teachers, cannot give students a quiet, fixed knowledge in a one-way manner. And we, teachers, must not give classes as if we hold all the answers. The challenges facing students in the future society will not be solved by the knowledge and methods of aged human beings.

I am thinking of my future students who are international students from the future world. The society in which students live in the future is completely different from the society in which our old humans have lived. Human problems (global warming, climate change) caused by the relationship between nature and humanity already exist on a global range.

What can I do for international students from the future world?

What should I do for our students from the future world?

I want to think about it with students in the future. I would like to explore and learn with students living in the future and approach the future society by sharing the sense of ownership.