

Questions for Design Solution Reasoning

Students may be considering different design solutions for a variety of reasons. Below is a set of generic questions to push students' thinking.

- What makes this design solution better or worse than the other design solutions?
 - Does this design solution meet our criteria?
 - Is this design solution feasible for the people of Ryoishi?
- Were there criteria and constraints that you felt were really important when choosing the best solution for Ryoishi? Why are the rankings for those criteria/constraints more important to consider when compared to other criteria or constraints?
 - Do you think the criteria and constraints you are valuing would also be the ones most valued by the people of Ryoishi?
 - What constraints would be important for Ryoishi, and how well does this solution meet the constraints of Ryoishi?
- When thinking about different criteria and constraints being more important than others to the people of Ryoishi, does that change your decision?

Questions based upon individual design solutions:

Below are some ways to help students evaluate choices for specific design solutions. The questions below can help students compare and evaluate alternative design solutions and support students in developing an argument using evidence for the usefulness of their chosen design solution. This list is not exhaustive and gives examples of what questions might lead students to consider alternatives to their chosen design solution.

Design solution	Student Considerations	Questions to Extend Students' Thinking	Target Observations or Ideas
Seawall	<p>Ocean views may not be important to the citizens.</p> <p>It is rated higher than most others in other areas.</p>	<p>We think the view may not be important, but are there other criteria/constraints that are more important than others?</p> <p>If you added the scores, sea walls have the same total as submerged breakwaters. What would make this design better than the submerged breakwater?</p>	<p>Seawalls are rated lower than other solutions in their ability to break waves. The Ryoishi waves were high, so Ryoishi may need a design that can break waves effectively.</p> <p>Criteria and constraints will need to be re-evaluated based upon the needs of Ryoishi.</p>
Levee or sea dike	<p>Highest rated overall.</p> <p>It doesn't cost much compared to the others.</p> <p>It doesn't require much maintenance.</p>	<p>Even though it is the highest rated overall, Ryoishi experienced higher than predicted wave heights during the 2011 tsunami. Does this design solution meet the potential wave heights of future tsunamis that might reach Ryoishi?</p> <p>How well did the levee or sea dike meet the need to break up the waves?</p>	<p>Re-evaluate the notes considering Ryoishi's needs, noting that the levee/sea dike performs worse with larger waves and may not meet the community's needs.</p> <p>Determine that the levee/sea dike did not meet the criteria as well as other solutions.</p>

<p>Recurved wall</p>	<p>Highest ranked in ability to break waves and impact on boats.</p>	<p>If you look at the overall ratings, it is ranked the same as the tetrapods. Why would it be better than a tetrapod design solution? What are you considering that would make it more effective for Ryoishi?</p> <p>Is there anything in the notes that you read that would make a recurved wall less appealing to the citizens of Ryoishi?</p>	<p>Students will have to assess which criteria and constraints they are prioritizing, and whether the community of Ryoishi's would also value those criteria/constraints.</p> <p>Notes will need to be re-evaluated. The cost is high and most walls can block access to the beach for wildlife. Students will need to consider the needs of the community.</p>
<p>Tetrapod</p>	<p>It sounds like it looks cool.</p> <p>Only one ranking for tetrapod was below a 3.</p>	<p>It ranked lower in marine life than most of the other design solutions. Is that rating important for the fishermen of Ryoishi?</p> <p>Are some considerations more important than others? Although tetrapods have several 4 ratings, does it make it better than another design? Are there certain criteria or constraints that we should value over others?</p>	<p>Constraints that are important for the community will be re-evaluated. Easy paths for boats to access fish and the health of the environment is important for fishermen.</p> <p>Revisit the other constraints to determine if some should have higher priority than others.</p>
<p>Rock armor</p>	<p>It breaks waves better than the levee/sea dikes, and has a decent score on ocean view and cost.</p>	<p>Are there other design solutions that may score better than rock armor on certain criteria/constraints that Ryoishi may value?</p>	<p>Re-consider the criteria and constraints. It does not meet the criteria as well as other designs.</p>
<p>Submerged breakwater</p>	<p>Does OKat breaking waves and keeps the ocean view.</p> <p>Doesn't have a high impact on boats and doesn't require a ton of maintenance.</p>	<p>Submerged breakwater performs decently on the ability to break waves, but doesn't score as well as most other design solutions on impact to marine life. Is that an important consideration for the people of Ryoishi?</p> <p>The submerged breakwater scored really well on ocean view. Is that the most important constraint for Ryoishi?</p>	<p>Re-consider the criteria and constraints based upon the needs of the community. Ryoishi may need a design that doesn't harm marine life.</p> <p>Re-consider the criteria and constraints based upon the needs of the community. Ocean view may not be as important to Ryoishi as other communities.</p>

<p>Mangrove forests</p>	<p>They scored very highly on marine life and impact on boats--very important to the fishermen of Ryoishi.</p> <p>They do OK with wave protection of smaller tsunamis.</p> <p>They are natural solutions.</p> <p>Second highest rated design when points are added together and it's a natural solution.</p>	<p>How well do mangrove forests protect against large tsunami waves?</p> <p>What would make mangrove forests better or worse than the other natural solution, a pine forest?</p> <p>When points are totaled, mangrove forests are the second highest rated design solution. Even though it has a high total, is there something more important to consider than just the total ratings? Are there certain ratings that are more important than others?</p>	<p>Students should re-evaluate notes and determine that they work well for only small waves.</p> <p>Re-evaluate notes to determine that mangrove forests cannot grow well in the region, but pine forests can. Pine forests do not meet the criteria as well as mangrove forests.</p> <p>Re-evaluate criteria and constraints based upon the needs of the community.</p>
<p>Pine forests</p>	<p>A natural solution that can grow in the area.</p> <p>Very environmentally friendly and doesn't impact boats at all since it's on land.</p> <p>It has a very low cost and is more friendly to marine life than a levee/sea dike.</p>	<p>The pine forest design solution's overall score is tied with rock armor. What makes this better or worse than rock armor?</p> <p>What would make this design solution better or worse than the mangrove forest?</p>	<p>Compare criteria and constraints of both designs with the needs of the community.</p> <p>Re-evaluate notes to determine that mangrove forests cannot grow well in the region, but pine forests can. Pine forests do not meet the criteria as well as mangrove forests.</p>