



POLY BRIDGE

ADVANCED MECHANICS

WITH
POLY BRIDGE 2

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Original Link to the Document:

<https://docs.google.com/document/d/15CZyDDJ2-Dd0CKmXmPNW3Sc2fvvtkGCj4sgdFA-Ruyk/edit?usp=sharing>

Poly Bridge for Dummies, an accompanying, much simpler handbook than this one:

<https://docs.google.com/document/d/1NmuRDXXJFX5ayPbg6WuFwQYK7uYn8Aajpt2dA1rDnt8/edit?usp=sharing>

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Preface

One of the great things about the Poly Bridge series is the diversity of its player base. To many people, Poly Bridge is merely a simple fun game about building bridges. However, as you begin to dive deeper into the game, you will find a very diverse world of different players and creators. From amateur builders just starting out, to seasoned engineers looking to push the boundaries of what is possible in the game. Each player brings their own unique perspective and expertise to the table, and there is something that everyone can be a part of.

However, with so many different mechanics and techniques to learn, it can be intimidating to know where to start. This textbook is here to help guide you through the complex world of Poly Bridge's scientific community, providing a solid foundation of knowledge to build upon as you progress deeper into understanding how to not only play the game but master it.

This textbook aims to be a centralized hub for all major developments made in the Poly Bridge community. We will delve into techniques ranging from the groundwork underlying all of the hydraulic utility to the most complex mechanical beasts, from the fundamentals of the game's physics engine to the glitches that exploit it.

So whether you're a seasoned veteran or a new player just starting out, we hope that this textbook will be a valuable resource on your journey through the art of Poly Bridge's most advanced mechanics, and to become a grandmaster builder.

Acknowledgements

Thank you to the following people for contributing to this project!

Cookiebox678 - Creating the "Recreational Mechanics" unit

ScrapMechanic5 - Creating the "Advanced Constructions" unit

Minecxt - Creating the "Jank" units.

Madeline (741strawberries) - Assistance and drafting sections for the "Fundamental Poly Bridge" unit.

Fundamental Poly Bridge

This unit covers much of the things that are generally very practical in the main Poly Bridge campaign, but explained in much greater detail.

1 - Hydraulics and Drawbridges

Hydraulics represent the foundational—and usually the only—power source that players are required to employ. They are initially presented in level “1-6: First Drawbridge,” and subsequently reappear in over fifty levels throughout the official campaign of the game.

Despite the hydraulic tutorials provided within the game, many people still encounter difficulties with the fundamental principles of constructing hydraulic drawbridges. And unfortunately, not even the game helps guide you through some of the later, much more mechanically involved levels.

The solutions to these levels are often actually rather simple! However, simple does not mean intuitive. Thus, it is not uncommon for people to struggle greatly on levels like 3-13: Diagonal Elevator, 4-15: Twists and Turns, and 5-11: All Together Now.

In this chapter, we will provide a referenceable guide for building drawbridges, including an alternative approach to creating them. We will also discuss the most basic yet invaluable necessities that will make your time playing almost all of the hydraulic levels in the main campaign a breeze.

1.1 - The Fundamental Drawbridge

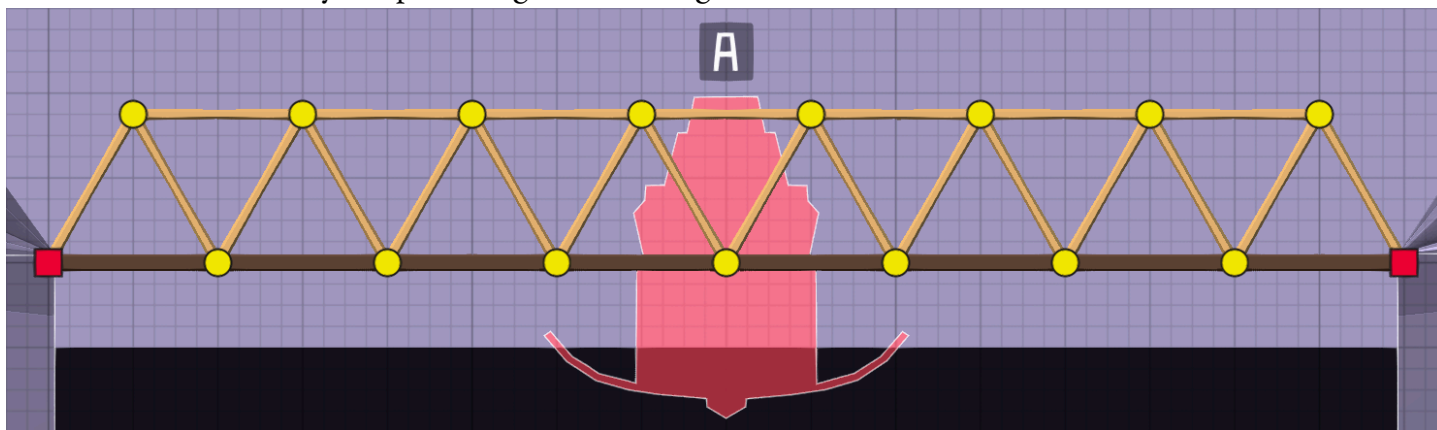
The game holds your hand with learning how to build drawbridges, however it doesn't stick all that well for many. So, we will cover a slower, but more in-depth approach to the same tutorial.

(For a simpler, though less thorough variant of this tutorial, refer to the PB for Dummies Handbook: [“Simple Hydraulic Bridge”](#))

DON'T Build a Drawbridge Yet

Before building your drawbridge, it is important to ensure that you can first make a bridge capable of spanning the desired length. If help is needed on this step, it is highly recommended to refer to the [“Poly Bridge for Dummies”](#) handbook, which covers much of the bridge-building side of Poly Bridge 2.

Here, I have built a very simple triangle truss bridge.



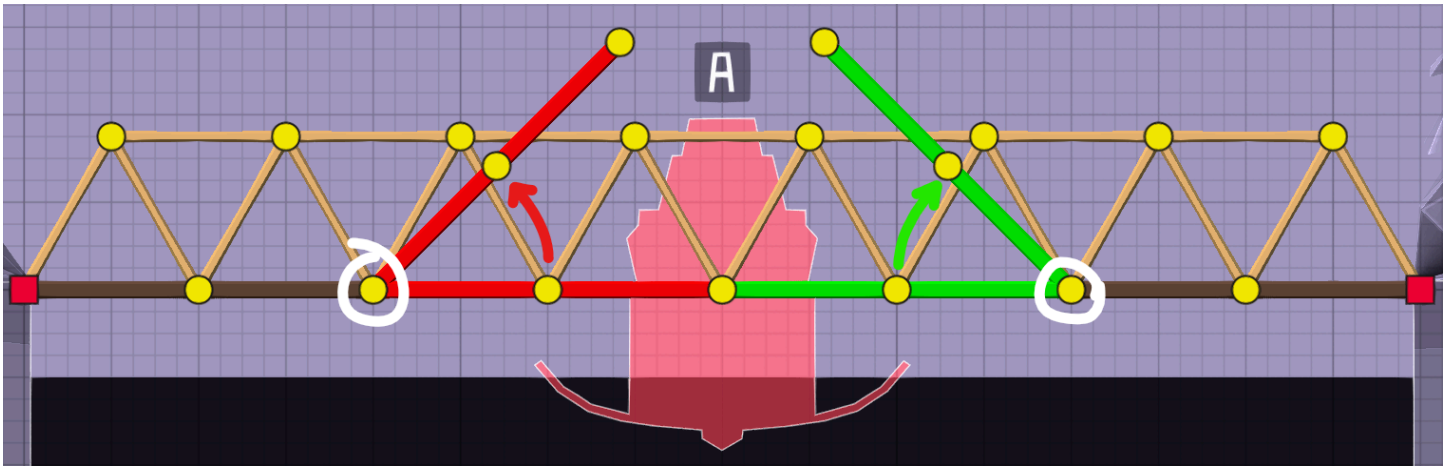
Once you have a stable bridge, you will need to “prep” the bridge so that it can be ready to be turned into a drawbridge.

Prepping a Drawbridge

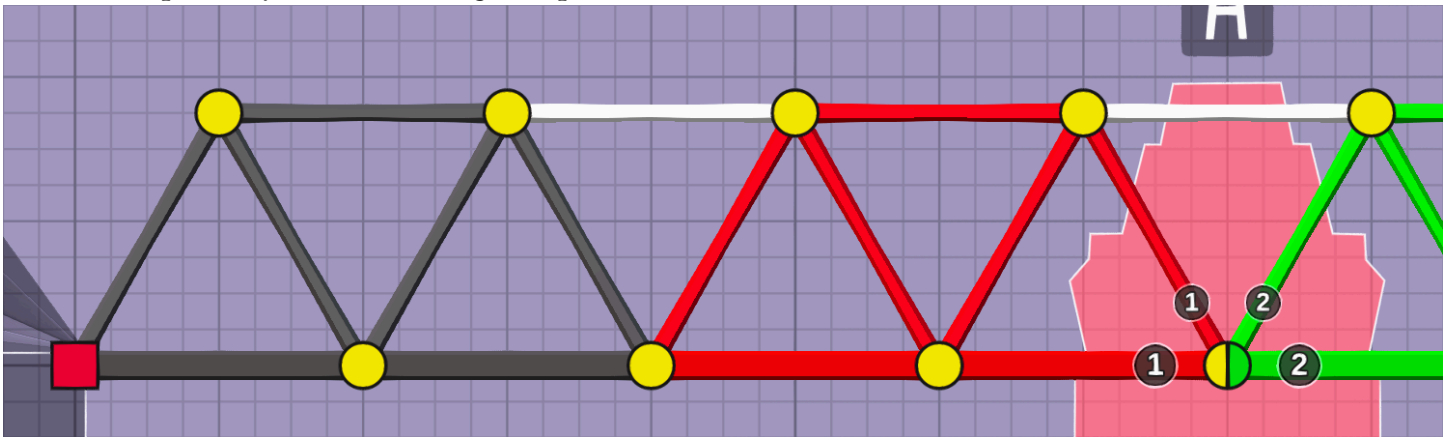
When building the drawbridge, know that it's important to know what you are envisioning to do first.

For our demonstration, we will do the simplest form of a drawbridge: one with two flaps that lift.

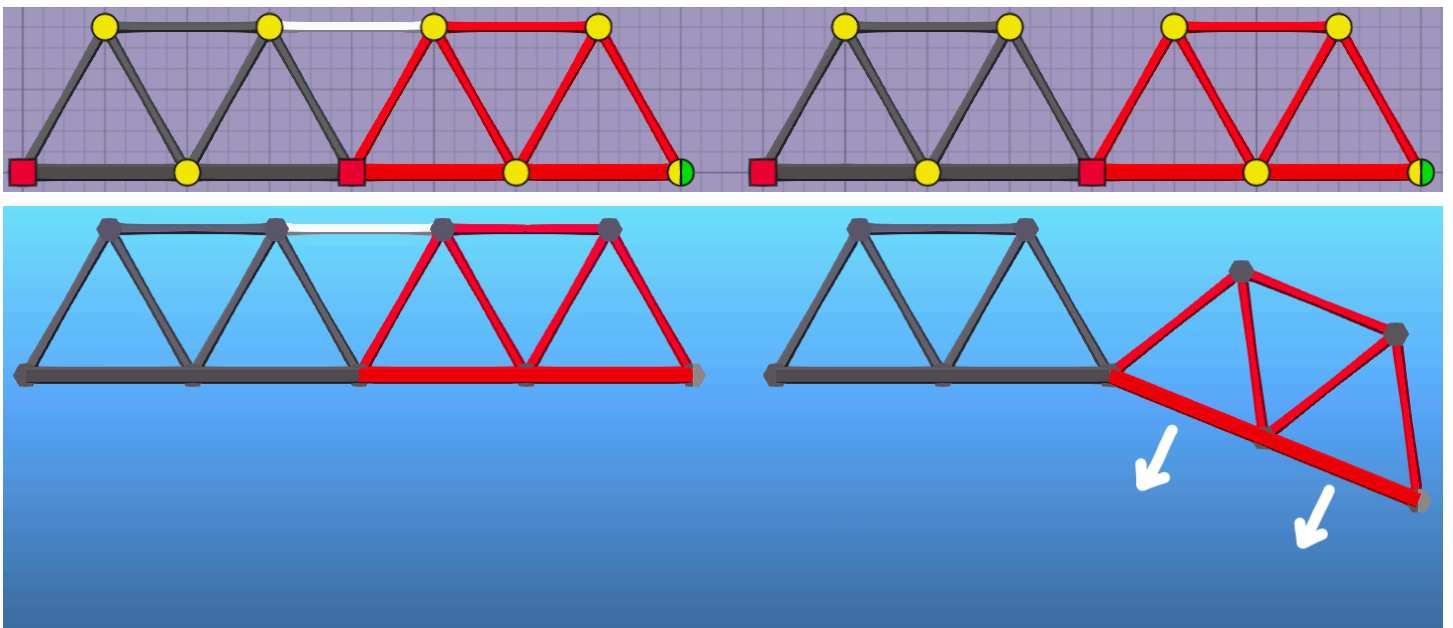
Below, you can see that we will have two sides which will be lifting up and back down. Notice that the sides lift up in a hinging motion—like that of a door—around the white circles. The circled points will be the hinging point for our drawbridges.



We will now separate the bridge into the parts that we want. The gray part of the bridge is what we want to keep sturdy. The red and green parts are what we want to move.



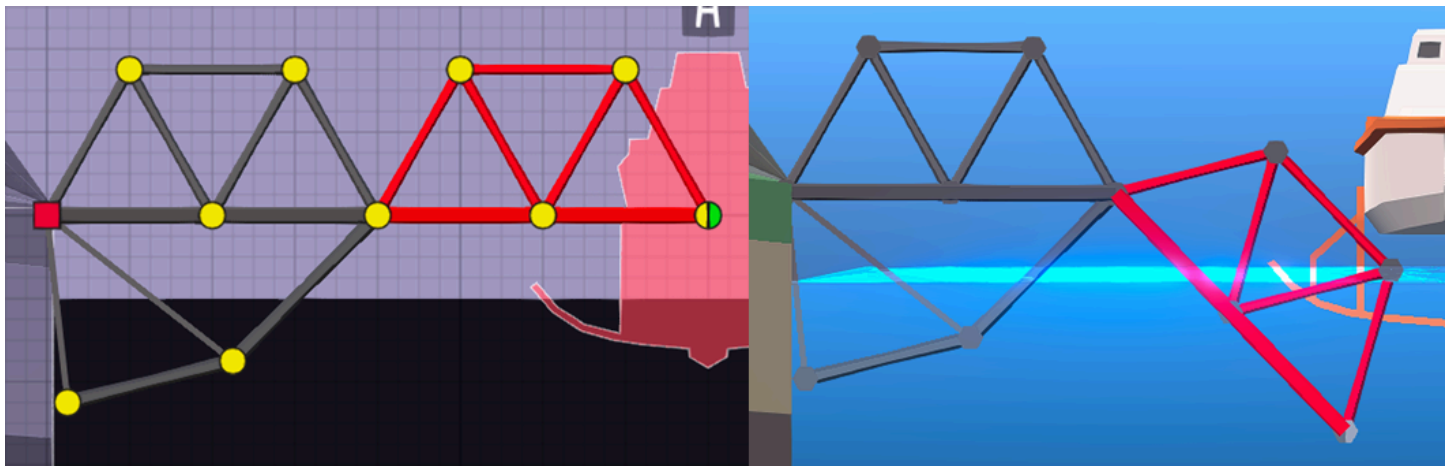
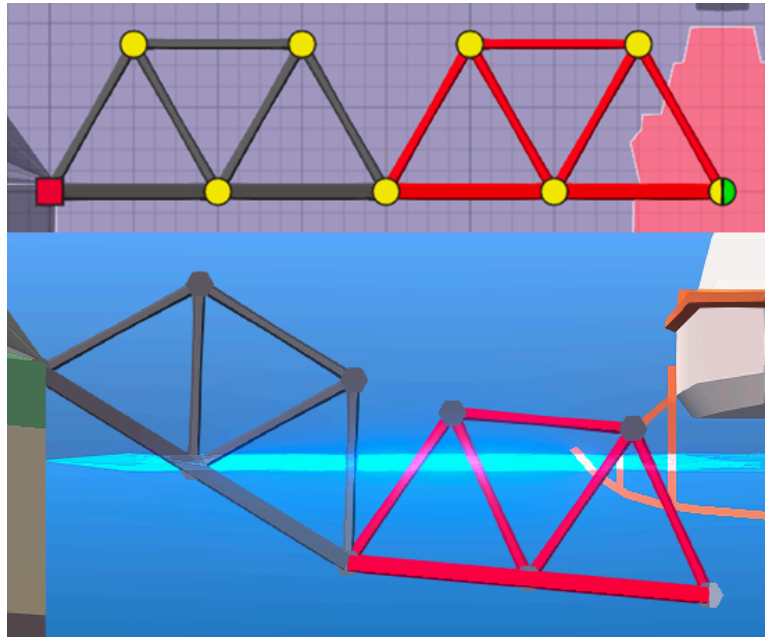
This leaves the white bars for us to remove. If we do not remove them, then the red and green parts cannot move.



However, now that we have our moving parts, there is a problem. The gray parts of our bridge can no longer stand on their own.

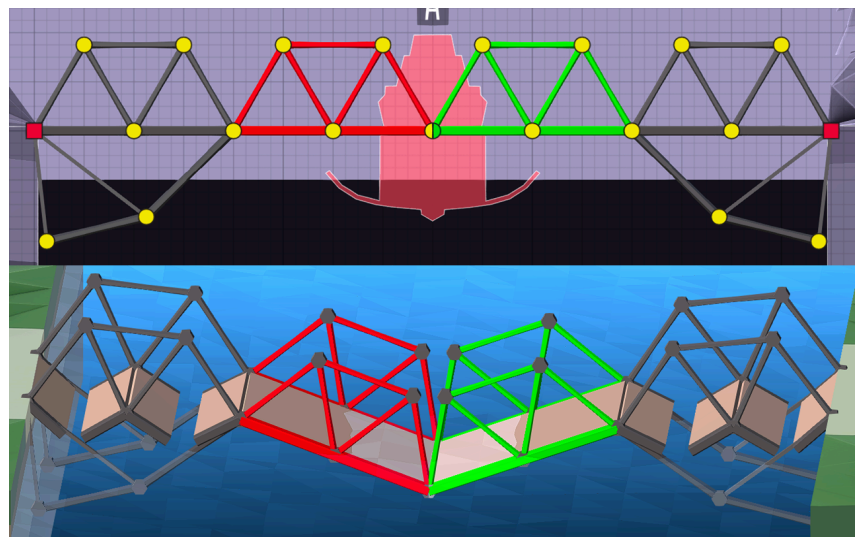
This may not always happen, depending on the type of bridge that you make. In this case, however, the gray parts relied on the rest of the bridge to stay together.

As a result, we will need to find another way to support the gray sides of the bridge. This can be done by a whole range of different methods. I am using [landbraces](#) as an example below.



An additional note: if your bridge breaks spontaneously even after reinforcing the gray portions, this is normal!

This breaking is due to the red and green flaps still staying connected together. The split joint may not have disconnected yet, depending on the level you are on. Therefore, it will rip itself apart.

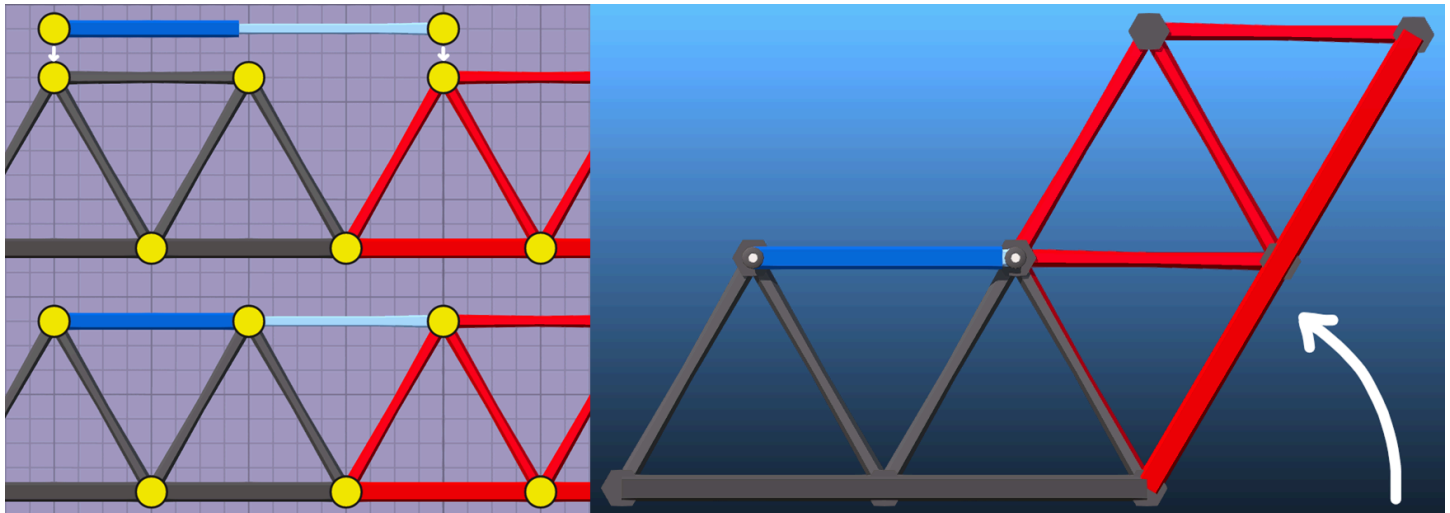


Simply remove one side to check if the parts stay sturdy, if this is the case.

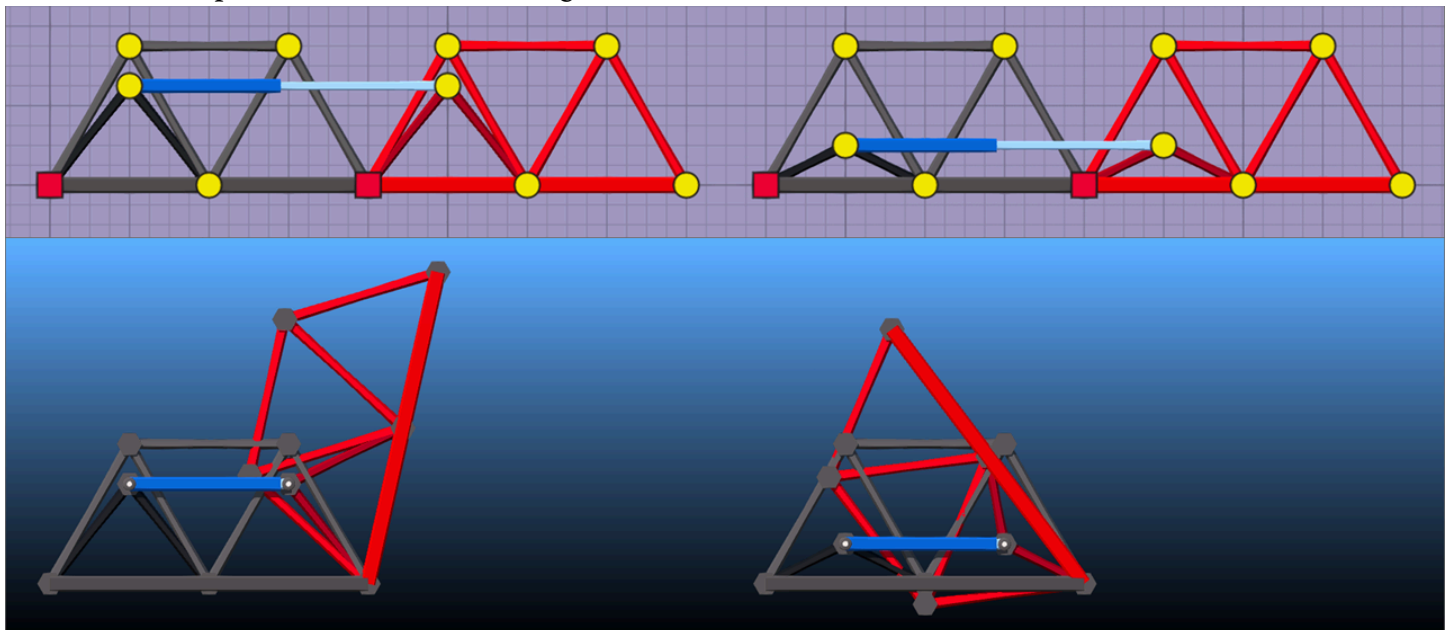
Adding the Hydraulics

Now that your bridge has been prepped, we are now at the stage that the tutorial starts you at!

There is no “best” method for powering the red part, as it depends on the context. One of the simplest hydraulic placements, however, is on the truss structure, as shown.



If this is not enough clearance for an obstacle, like a boat, you can play with different positions as to where the hydraulic is connected to change how much it retracts. Hydraulics placed at a closer distance to the pivot will rotate the bridge more!



1.2 - Core Hydraulic Principles

We have already covered in the first section how to use hydraulics in their most basic way.

Reading the Event Sequence

Knowing when your hydraulics begin and end are a very important thing to know when building a bridge.

The event sequence can be found at the bottom of the pop-up level information box. This information box appears when you first enter a level, or when you click on the information (i) icon in the top left.



Each box with a letter above it is called a “phase.”

Here, hydraulics and split joints activate on the phases with a hydraulic symbol on them.

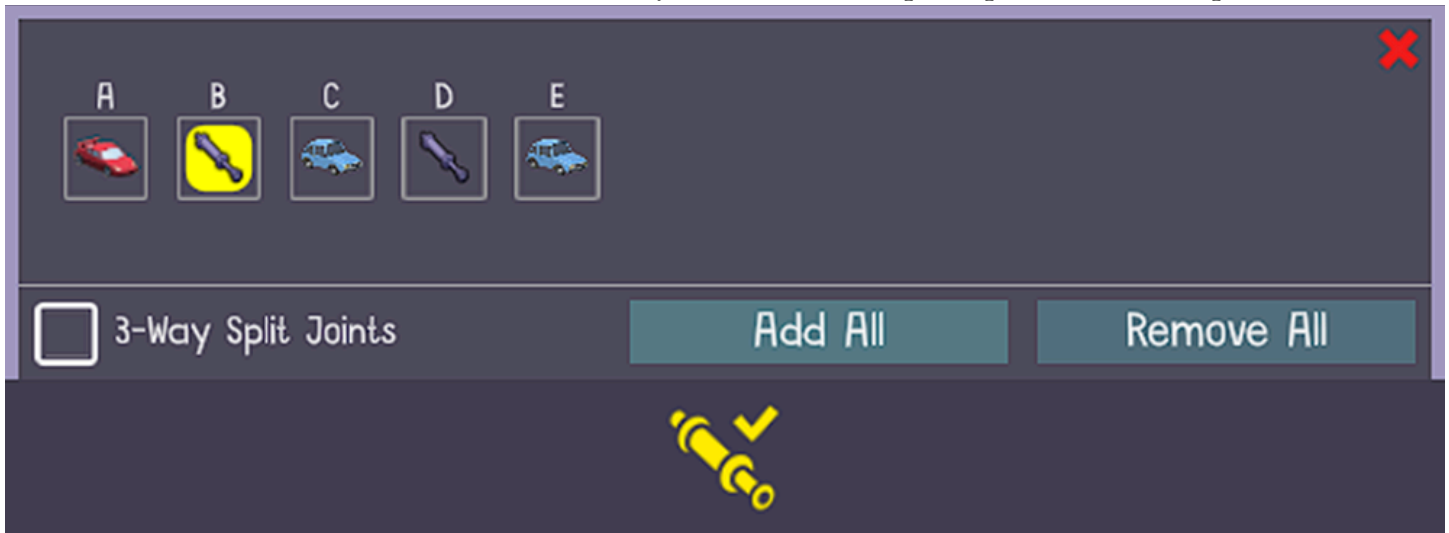
So, the event sequence is read like this:

1. Hydraulics and split joints activate.
2. Hydrofoil B goes through.
3. Hydraulics and split joints activate again.
4. Vespa D crosses the bridge.

Simple as that!

Hydraulic Controller

The hydraulic controller is available in certain hydraulic levels. It is displayed as a hydraulic with a checkmark at the bottom of the screen, which you can click to open up the controller panel.



The hydraulic controller shows the [event sequence](#), the same one that can be found in the level's information box, and is used to edit whether or not selected hydraulics or split joints will activate.

To select the desired phase that you want to edit, simply left-click or tap on the phase with the hydraulic symbol, and the box will light up yellow.

(Video Version: [Imgur Link](#))

When the hydraulic controller is opened, all split joints and hydraulics will have an outline appear.

If a hydraulic or split joint is yellow, that means that it will activate on the selected phase.

If a hydraulic or split joint is gray, that means that it will stay deactivated on the selected phase.

You can toggle between activated and deactivated mode by simply left-clicking or tapping on the hydraulic or split joint.



(Video Version: [Imgur Link](#))

Three-way Split Joints

You can see an animated demonstration of the hydraulic phase here, along with how 3-way split joints work! [\[Imgur Album\]](#)

Split-Joint Logic

Split joints in Poly Bridge 2 have a specific set of axioms that they follow. They are the following:

1. A split joint with multiple numbers is to be interpreted as having some combination of anchor and free split joints.
 - a. The anchor itself in an anchor split joint is considered to be part of the split joint system, with a connection number of 1.
2. The state of the free split joint connecting to it dictates whether or not it disconnects from an anchor. An anchor split joint's state does not affect it.
3. If a free split joint's connection(s) all have only one number, its behavior will be the same as a free, two-way split joint.
4. A free split joint beginning on an anchor split joint will keep the same behaviors of a normal free split joint.
5. A two-way split joint (free and anchor) can only have two states: both 1 and 2 are disabled at the same time, or 1 and 2 are enabled at the same time.
6. Two anchor split joints cannot connect to each other.
7. Two split joints initially connected together by a material will not connect to each other.
8. Free split joints rely on an OR system to determine if they disconnect:
 - a. If neither free split joint is enabled, they will not disconnect.
 - b. If one free split joint is enabled, they will disconnect.
 - c. If both free split joints are enabled, they will disconnect.

Note: Axiom 8's sub-axioms can also be reinterpreted into AND logic if you view it in terms of whether or not split joints stay connected.

If you are playing Poly Bridge 1, split joint and hydraulic controller behavior is different from that of Poly Bridge 2. To understand this better, refer to Bolt986's video tutorial: [\[YouTube Link\]](#)

2 - Other Game Mechanics in Detail

Now, this assumes that you've played Poly Bridge 2 for a while now, and you've played for long enough to know your way around. However, just because you know your way around does not mean that you fully understand some of the things it gives you, and there are often a lot of things that can be confusing to comprehend immediately. This section will elaborate on, or clarify things you might not fully understand yet.

2.1 - Custom Shapes

You first encounter custom shapes on levels 1-12, hiding in the form of a rock. It doesn't appear again until you advance far into the game into World 6, where you will encounter other forms of custom shapes.

Custom shapes are pretty self-explanatory: they can be customized to whatever shape and color you want. However, we'll be explaining them a bit more here, anyways.

Collision Properties

Custom shapes have multiple options for collision. What a custom shape collides with can be determined by hovering your cursor over it.

(On the right are a couple of examples of interfaces that appear when you hover over a custom shape.)

Custom shapes have the option to collide with:

- Roads
- Joints
- Split joints and split-jointed roads (This is unlike land, where split joints can typically phase through it.)

Custom shapes always collide with:

- Vehicles
- Other custom shapes with a collision hitbox

Custom shapes cannot collide with:

- Ramps, Platforms, Hot Air Balloons



Dynamic Anchors

Some shapes have dynamic anchors on them, these are orange. they act like anchors but follow the position of the shape. all split joint axioms apply. these can be buggy as the anchor and shape can become disconnected with force.

- Static pins. static pins are what hold the shape in place. if there are no pins, the shape can fall and be pushed and pulled. With one pin, the shape can rotate around the pin, although it is unable to be moved. With two pins the shape will stay completely rigid in place. no rotation or movement.
- Motorized shapes. A motorized shape is a shape that rotates indefinitely around a pin. hovering over a motorized shape will show strength and speed.

2.2 - Reading the Event Sequence (Continued)

Section 1.2 covers this briefly to ensure the necessary context was available. However, event sequences can become much more complicated than shown earlier. It can get very tricky to know what goes on from just looking at a level, so it's good to learn how to read the event sequence! This can be found by either starting up the level, or clicking on the Level Information button (i) on the top left when in a level.

A level is staged in the following:

- **Phases start in the order of the English alphabet (A → B → ... → Y → Z)**
 - When phases pass Z, the letters will double up, and stop at ZZ. You cannot go further or the game breaks. (... → Y → Z → AA → AB → AC → ... → ZX → ZY → ZZ)
 - If multiple objects start at the SAME time, they will be stacked on top of each other in the event sequence, and will be labeled N1, N2, N3, etc. from top to bottom in the stack.
- **The level starts a new phase when...**
 - It satisfies both following things.
 - All active vehicles have collected a stop/reverse checkpoint, or their flag.
 - Any hydraulics / split joints that are active during the phase finish.
 - A trigger checkpoint is collected.
- **A trigger checkpoint acts as an INDEPENDENT TIMELINE. The phases run entirely independently.**

NOTE: This method does not 100% guarantee you if there are other auxiliary checkpoints that need to be collected before going to the flag, but those can be seen easily by looking at the level layout itself.

It is often much easier to understand what is happening at a level just by looking at the level before looking at the Event Sequence. Regardless, however, this is still a good thing to know.

Below I have provided multiple examples of event editors broken down using the procedure above.

1-6's event sequence is very simple and linear.

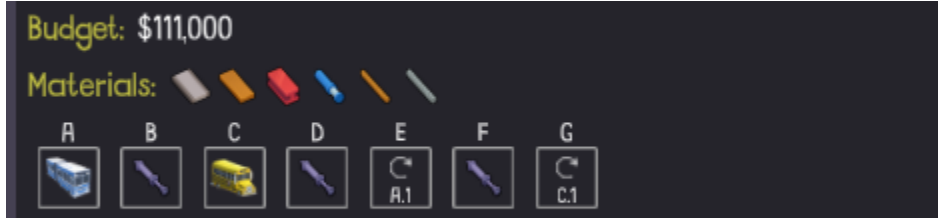


Reiterated, the event sequence would be described like this.

1. Hydraulics and split joints activate.
2. Hydrofoil B passes.
3. Hydraulics and split joints activate.
4. Vespa D starts.
 - 4.1. Vespa D goes to its flag.**

** Notice how there is a lack of a restart phase for the vehicle later on, meaning it can go straight to its flag.

5-14's event sequence is also linear. However, it also contains multiple restart phases for vehicles.



1. Articulated bus A starts.
 - 1.1. Articulated Bus A reaches stop/reverse checkpoint A.1.*
2. Hydraulics and split joints activate.
3. School bus C starts.
 - 3.1. School Bus reaches stop/reverse checkpoint C.1.*
4. Hydraulics and split joints activate.
5. Articulated bus A restarts.
 - 5.1. Articulated Bus A goes to its flag.**
6. Hydraulics and split joints activate.
7. School bus C restarts.
 - 7.1. School Bus C goes to its flag.**

* Notice how there is a restart phase for the vehicle later on, meaning it must collect a stop/reverse checkpoint before it can proceed.

** Notice how there is a lack of a restart phase for the vehicle later on, meaning it can go straight to its flag.

On the very end, 6-16 is one of the hardest ones in the main campaign to read. Once you can read this, all other event sequences will become very easy for you to read.

1. Van A1, Van A2, Van A3, and Van A4 start.
 - 1.1. Van A1 collects checkpoint A1.1*** then reaches its flag.**
 - 1.2. Van A2 collects checkpoint A2.1*** then reaches its flag.**
 - 1.3. Van A3 collects checkpoint A3.1*** then reaches its flag.**
 - 1.4. Van A4 collects checkpoint A4.1*** then reaches its flag.**

The following four timelines happen entirely independent of each other AND the main timeline.

When Checkpoint A1.1 is collected... <ol style="list-style-type: none"> 1. Hydraulics and split joints activate.
When Checkpoint A2.1 is collected... <ol style="list-style-type: none"> 1. Steam Car C starts. <ol style="list-style-type: none"> a. Steam Car C reaches stop/reverse checkpoint C.1.* 2. Hydraulics and split joints activate. 3. Steam Car C restarts. <ol style="list-style-type: none"> a. Steam Car C reaches its flag.**
When Checkpoint A3.1 is collected... <ol style="list-style-type: none"> 1. Hydraulics and split joints activate. 2. Tow Truck G1 and Boat G2 start. <ol style="list-style-type: none"> a. Tow Truck G1 reaches its flag.**
When Checkpoint A4.1 is collected... <ol style="list-style-type: none"> 1. Hydraulics and split joints activate. 2. Pickup Truck I1 and Boat I2 start. <ol style="list-style-type: none"> a. Pickup Truck I1 reaches its flag.**

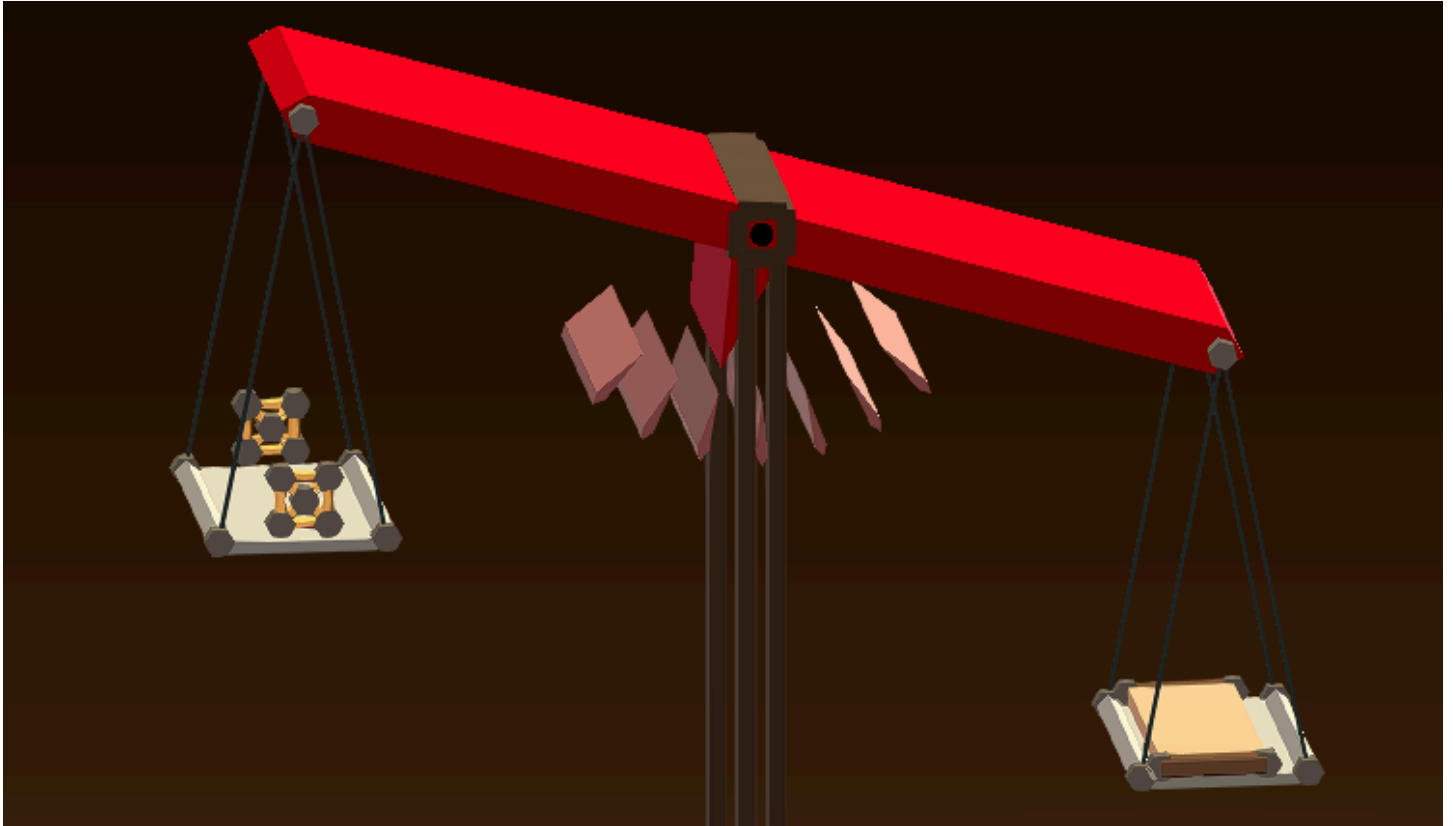


* Notice how there is a restart phase for the vehicle later on, meaning it must collect a stop/reverse checkpoint before it can proceed.

** Notice how there is a lack of a restart phase for the vehicle later on, meaning it can go straight to its flag.

*** Notice that there are trigger checkpoints.

2.3 - Understanding Mass and Weight



In colloquial language, we often say objects in the game have a weight. Note that, however, I am saying mass, instead of weight. If you have taken physics before, you know that there is a distinction between mass and weight; weight is a force, which is measured in polynewtons (pN). This will be covered later.

Mass is measured in polygrams (pg).

To convert between polygrams and kilograms: $1 \text{ kg} = 0.25 \text{ pg}$ and $1 \text{ pg} = 4 \text{ kg}$

Note: joints in Poly Bridge 1 and 2 also have a mass of 0.25 pg, so you can either measure the mass in joints or in kilograms, and the number will be the same.

Mass

To calculate the mass of a group of objects in polygrams, this is the formula.

$$\begin{aligned}
 M_{Total} &= \sum E_{Roads} + \sum J + \sum R \\
 &= 0.25 \sum l_n + 0.3125 \sum l_r + 0.5n + 0.625r + 0.25j + \sum R
 \end{aligned}$$

This may look very intimidating at first, so let's break down the formula.

First, we will solve for the mass of all of the roads.

The mass of a single road is determined by taking 1/4 of its length, then adding 1/2 pg. The mass of a reinforced road is determined by taking 5/16 of its length, then adding 5/8 pg. Put into mathematical notation, you get the following:

$$\begin{aligned}
 E_n &= 0.25l_n + 0.5 = \frac{l_n + 2}{4} \\
 E_r &= 0.3125l_r + 0.625 = \frac{5(l_r + 2)}{16}
 \end{aligned}$$

Note, the extra constant of 0.5 and 0.625 pg is NOT the mass of the joints attached to them, but are instead a part of the mass of a road itself, by default.

Which means that, yes, the mass of a 0-length road and reinforced road (not including joints) is 0.5 pg and 0.625 pg respectively. That doesn't really make any sense if you think about it, but that's how the game's programmed, so just go with it. ^_(`)_/^

This can be generalized by separating the components of the roads' weights into the constant and the part dependent on its length.

After this, you eventually get the formula derived below, which lets you solve for all of the roads together.

In case you are not familiar, the “ Σ ” symbol is the greek capital letter sigma, which stands for “adding all _____ together” in mathematical notation.

The diagram shows the formula for the mass of all roads, ΣE_{Roads} , with labels for each term:

- ΣE_{Roads} : Mass of all roads
- $0.25 \Sigma l_n$: Total length of all regular roads
- $0.3125 \Sigma l_r$: Total length of all reinforced roads
- $0.5n$: Total number of regular road segments
- $0.625r$: Total number of all reinforced road segments

Second, solve for the mass of all of the joints, by counting the number of joints, then multiplying by 0.25.

Note: split joints that have two numbers will mean that there are two overlapping joints, and split joints that have three numbers will mean that there are three overlapping joints; these additional overlapping joints count to the weight.

Third, solve for the mass of all other rigidbodies. Rigidbodies include custom shapes and vehicles. The stats of vehicles and custom shapes are provided if you hover your cursor (tap on mobile) on the object of concern.

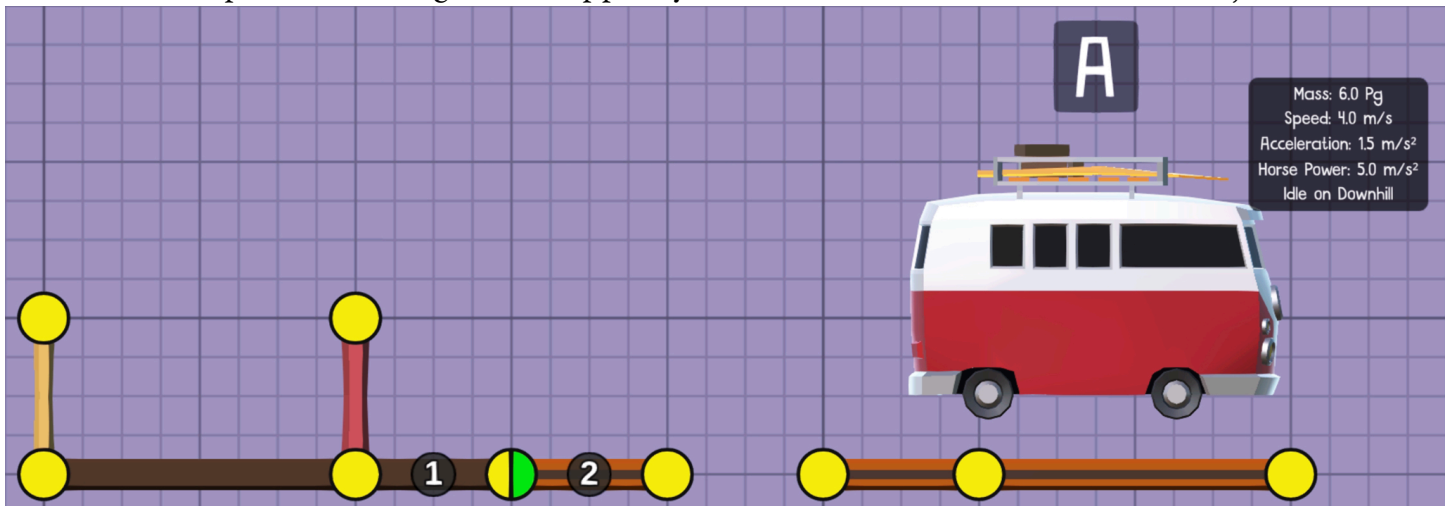
So, in summary, the complete formula says:

- Take the length of all normal roads together, and multiply by 0.25 (1/4)
- Take the length of all reinforced roads together, and multiply by 0.3125 (5/16)
- Take the number of normal road segments, and multiply by 0.5 (1/2)
- Take the number of reinforced road segments, and multiply by 0.625 (5/8)
- Take the number of joints (accounting two for a two-number split joint, three for a three-number split joint), and multiply by 0.25 (1/4)
- Add the mass of the rigid bodies together.
- Add everything together.

$$\begin{aligned}
 M_{Total} &= \sum E_{Roads} + \sum J + \sum R \\
 &= 0.25 \sum l_n + 0.3125 \sum l_R + 0.5n + 0.625r + 0.25j + \sum R
 \end{aligned}$$

Total mass of all roads $\rightarrow \sum E_{Roads}$
 Total mass of all joints $\rightarrow \sum J$
 Total mass of all rigid-bodies $\rightarrow \sum R$
 Total mass $\rightarrow M_{Total}$
 Total length of normal road $\rightarrow \sum l_n$
 Total length of reinforced road $\rightarrow \sum l_R$
 Number of normal road segments $\rightarrow n$
 Number of reinforced road segments $\rightarrow r$
 Number of joints $\rightarrow j$

Here is an example of this being done. Suppose you want to find the total mass of all objects here:



The process of solving it is as follows:

Total length of normal road = 3 meters

Total length of reinforced road = 4 meters

Number of normal road segments = 3

Number of reinforced road segments = 3

Number of joints = 8 normal joints + 1 split joint with 2 numbers = 10 joints

Total mass of all rigid bodies = 1 Van = 6.0 pg

Plug in all of these values to get the final mass:

$$\begin{aligned}
 M_{Total} &= 0.25 \sum l_n + 0.3125 \sum l_R + 0.5n + 0.625r + 0.25j + \sum R \\
 &= [0.25(3)] + [0.3125(4)] + [0.5(3)] + [0.625(3)] + [0.25(10)] + [6.0] \\
 &= \boxed{14.375 \text{ pg}}
 \end{aligned}$$

So, the mass of all of the objects is equal to 14.375 polygrams, or 3.59375 joints (kilograms).

Weight, Force, and Maximum Bearing Load

Not to be confused with [mass](#).

The weight of objects is measured in polynewtons (pN). This is solved using one of the first physics formulas people learn: $F = m a$. Multiply the object's mass by the acceleration of gravity, which is 9.81 m/s^2 .

For convenience's sake, however, we often refer to the "weight" of something by its mass instead, as vanilla gravitational acceleration is constant everywhere, and so the numbers are often cleaner, and any calculations using the value of mass instead of value of force simply scale proportionally.

Nevertheless, there is a bit of use in understanding force. Within the code, the maximum bearing loads for the materials are the following, from weakest to strongest:

Wood	Normal Road	Spring	Rope
200 pN	225 pN	240 pN	300 pN
Reinforced Road	Steel + Hydraulics (Inactive)	Cable	Hydraulics (Active)
375 pN	500 pN	550 pN	2500 pN

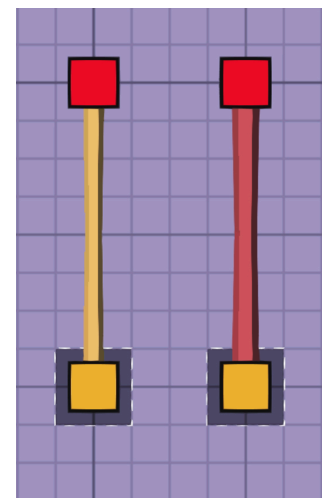
From this, you can solve one of the most classic experiments that people use in an attempt to test the strength of materials, which is to suspend a custom shape by the specific material, by dividing the maximum bearing force by the gravitational acceleration.

These are the following maximum bearing weights calculated, accurate up to 6 decimal places. (Subtract 0.25 pg to account for dynamic anchor joints.)

Wood	Normal Road*	Spring**	Rope
20.387360 pg	22.935780 pg	24.464832 pg	30.581040 pg
Reinforced Road*	Steel + Hydraulics (Inactive)	Cable	Hydraulics (Active)
38.226300 pg	50.968400 pg	56.065240 pg	254.841998 pg

* Both road types also need to bear their own weight, so depending on the length and orientation of the road, you will have to subtract some amount of poly-newtons as listed.

** Springs do not keep their rigidity like the other materials, and instead stretch and compress. This makes verifying this more difficult due to accidental material overstressing, but doable.



Technical Poly Bridge

The previous unit covers many of the things that are somewhat useful while playing Poly Bridge. This unit will now cover lesser used things that are rarely touched by the typical layman player, but are well utilized by more experienced players in the Poly Bridge community.

3 - Classical Jank

Jank is a slang term (derived from janky, also a slang term), to refer to anything that usually refers to something that is poorly made, unreliable, or badly executed. This isn't quite what jank means in Poly Bridge, however.

Poly Bridge jank is the term used to refer to atypical strategies used for beating levels, often developed out of the necessity for getting extremely low budget designs. Some of these strategies use unorthodox building strategies, while others use glitch exploits with the physics engine. This chapter will cover classical jank, which contains strategies that use mild to no physics glitch exploitation.

[Section is incomplete at the moment. Please be patient, thanks!]

3.1 - Dangling Road

Dangling road (also known as: Dangle / Noodle)

[Section incomplete]

3.2 - Banana

[Section incomplete]

3.3 - Smithy Bridge

[Section incomplete]

3.4 - Swing

[Section incomplete]

3.5 - Spring Cannon

[Section incomplete]

3.6 - Sliding Road

[Section incomplete]

4 - Modern Jank

Chapter 3 covers classical jank, which don't abuse the physics engine heavily. Modern jank, however, contains glitch exploitations galore!

Although we will not explain *why* these glitches work—as we still don't have a full comprehension of them—this chapter will still cover the details of what we do know about each glitch exploit, and how to perform each one.

4.1 - Falling Road

Falling road (abbreviation: FR) has become one of the most iconic exploits in both Poly Bridge 1 and 2. Poly Bridge 1's FR relies on taking a piece of road and moving it high into the sky. The game does not have a terminal velocity for the roads, so they can accelerate indefinitely until they hit something. In this case, a car can be placed in the way of the FR, and the force imparted by the FR is enough to launch the vehicle to the goal.

In Poly Bridge 2, an attempt to fix this was made by capping a boundary where bridge pieces could be placed and forcing a maximum cap of its velocity. This did solve the initial falling road problem, but since then, other forms of falling road have emerged.

4.2 - Stuck Falling Road

Stuck Falling Road (abbreviation: SFR) is a form of falling road that, to the layman, seems most reminiscent of the classic falling road in Poly Bridge 1. However, the behaviors of Poly Bridge 2's SFR and Poly Bridge 1's FR are fundamentally different.

SFR - Mechanics

[Section incomplete]

SFR - Types of SFR

There are four sections which vehicles fall under with SFR: normal SFR, limited SFR, wheel SFR, or not SFR'able.

[Section Incomplete]

SFR - Normal SFR

Normal SFR refers to SFR's that are powerful and have good versatility.

The vehicles which fall under this category are the truck, flatbed truck, tanker truck, container truck, firetruck, school bus, steamcar, van, tow truck, pickup truck, buggy, chopper, and vespa.

[Section incomplete]

SFR - Limited SFR

Limited SFR refers to SFR's that have limited power, and/or versatility.

The vehicles which fall under this category are the dump truck, bulldozer, ambulance, limo, model T, taxi, rally car, and compact car.

[Section incomplete]

SFR - Wheel SFR

Wheel SFR refers to SFR's that are only possible with interactions with the wheels of the vehicle.

The vehicles which fall under this category are the monster truck and sports car.

[Section incomplete]

SFR - Non-SFR'able

Of all the vehicles, the remaining vehicle that has yet to have a useful SFR is the articulated bus.

[Section incomplete]

4.3 - Precise Falling Road / Mass Falling Road

4.4 - Torque

4.5 - Stuck Spring Road

4.6 - Flip Cannon

4.7 - THE

4.8 - Hydraulic Cannon

4.9 - Stuck Hydraulic Road

4.10 - Stuck Platform Yeet

4.11 - Magnetism and Stuck Car Yeet

4.12 - Stuck Falling Car / Stuck Road Car

4.13 - Stuck Long Road / Illegal Length
Materials

5 - Practical Mechanisms

When you dive deeper into the game's workshop, you'll start to find some pretty crazy hydraulic levels out there, which go far beyond what the main campaign provides. This chapter will cover a slurry of different tips and tricks collated together.

6 - Climbers

Climbers (also known as: walkers, crawlers)

Recreational Mechanics

We have previously covered content that is commonly used by players of almost all levels, from the layman to the experienced, in this game. However, this unit focuses on developments and techniques used by a very small group of players who rest at what could be considered the endgame of Poly Bridge. Here, the primary objective is no longer to bring vehicles to their destinations, but to see what is possible using Poly Bridge.

[Section is incomplete at the moment. Please be patient, thanks!]

[Please Add On To This List If You Think of something!! I Can't Remember It All Myself!!]

7 - Unorthodox Power

[Section is incomplete at the moment. Please be patient, thanks!]

8 - Computation

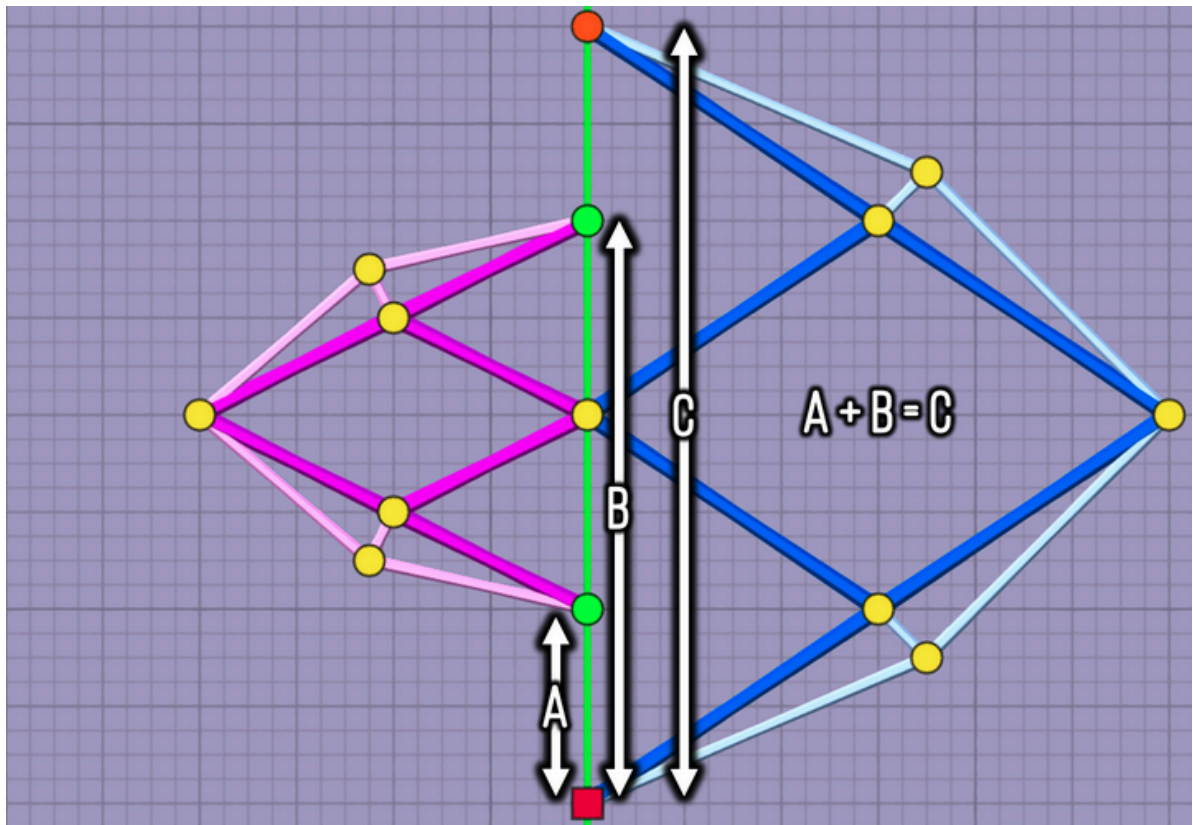
When trying to build more complex structures, it can sometimes be necessary to perform simple mathematical or logical operations, be they adding or subtracting lengths, executing if-else statements or rotating and scaling certain vectors. For this purpose, this section will delve into the basics of arithmetic, computers, vectors and functions. Please note that some of these will be expanded on in later sections of mechanical constructions.

1. Continuous linear inputs and outputs

One of the simplest but simultaneously most useful methods of computation is linear addition: When you add two distances together. So while the use cases of these mechanisms will become more and more.. situational as the section progresses, this one is still fairly important to have down for more advanced designs:

Addition / Subtraction:

To add two lengths together, they first have to lie on the same line. In case they don't, you'll need to rotate one of them to point in the direction of the other. Please refer to **Vector manipulation → Rotation** to learn how to make that happen. By then though, most of the work is already done.



The linkage for linear addition consists only of two pantographs. It works via a very simple concept: While adding is somewhat abstract, it can be used to compute a very real thing: Midpoints. The midpoint of the green inputs is $\frac{A+B}{2}$. This is the purpose of the first pantograph. The second one then doubles it, getting rid of the division by two and achieving the end result. Subtracting with this is also simple: You run it backwards, using $C - B = A$.

But this isn't the only use of this linkage. What it's actually doing isn't adding two lengths, but two vectors which just so happen to point in the same direction. However, if we point them in different ones, we get the more general vector addition linkage. This one works the same as the first one. The midpoint of the two inputs gives the center of the parallelogram formed by the four vectors (here in green). The blue pantograph then reflects the origin about that midpoint, creating the output. The math works out the same, with $\frac{A+B}{2} * 2$ still holding true, but with A and B being 2D vectors this time.

- Continuously rotational inputs to continuously linear outputs
 - Sine / Cosine / Tangent
 - Circular inversion
- Binary inputs and outputs
 - Logic gates
 - Adders / Subtractors
 - *Multipliers / Divisors?*
 - *SR latches?*
- Vector manipulation
 - Rotation
 - Constant angles (SRs with triangles)
 - Variable angles
 - Scaling
 - Dot products
 - Cross products
 - Linear transformations of 2D spaces

9 - Custom Shapes

- Constant rotation to constant linear
 - Plotting functions
 - *What else (Actual question towards whoever is reading this)?*
- Basically all of 507 mechanical movements

10 - Other Linkage Developments

Inversors

- Relation (i.e. prove that they are cognates)
- Circular inversion
 - Ellipses <--> Lemniscates
 - Cassini ovals <--> 90° rotated biased cassini ovals
 - Circles <--> Circles / Lines
- Straight-path projection into circles
- Strength differences of configurations
- *Proof that they work in the first place!! (still to do)*

Approximation linkages (1% of dwell-pathlength as max deviation from desired path)

- Trig approximation
- Circle approximation
 - Antiparallelogram dwell
 - Coupler curve dwell
- Point approximation
 - Already covered in first linkage repository
 - Optimizing for link efficiency
- Line approximation
 - Already covered in first linkage repository
 - Roberts linkage generation / optimization
 - Chebyshev generation / optimization
- Conic approximation
 - Chebyshev polynomials
- Derivative approximation
- Other functions (Exponentials, Factorials, Logarithms, etc.)

Antiparallelograms

- Rolling ellipses
 - On lines
 - On other ellipses
- Math
 - Rotational / Linear multiplication
 - Rotational / Linear addition

High-level overviews of more complex mechanisms

- 3D projection
 - Telescopic roads
 - Projection of rotating objects in static view
 - Projection of points in rotating view
 - Quaternion rotation (*In the works*)
- Bridge art
 - WECLOME
- Bézier curves

Applying mechanisms to reality

- 3D PLs

- Supporting structures / avoiding link collisions when building mechanisms IRL
 - Plane separation
 - Passable structure supports
- Transmitting constant rotation across nonparallel planes
- Avoiding unwanted degrees of freedom
 - Ball joints vs. Hinge joints
- Efficient placement of counterweights

Advanced Constructions

Mathematical constructions are a way to create shapes or objects using only basic tools and rules. One of the most well known forms of mathematical constructions is known as [straightedge and compass construction](#), in which you use two tools to draw circles and lines, and the only rule is that you can only draw circles and lines relative to intersections.

Poly Bridge has a unique set of tools and rules for constructions in the form of applications, which we will cover below.

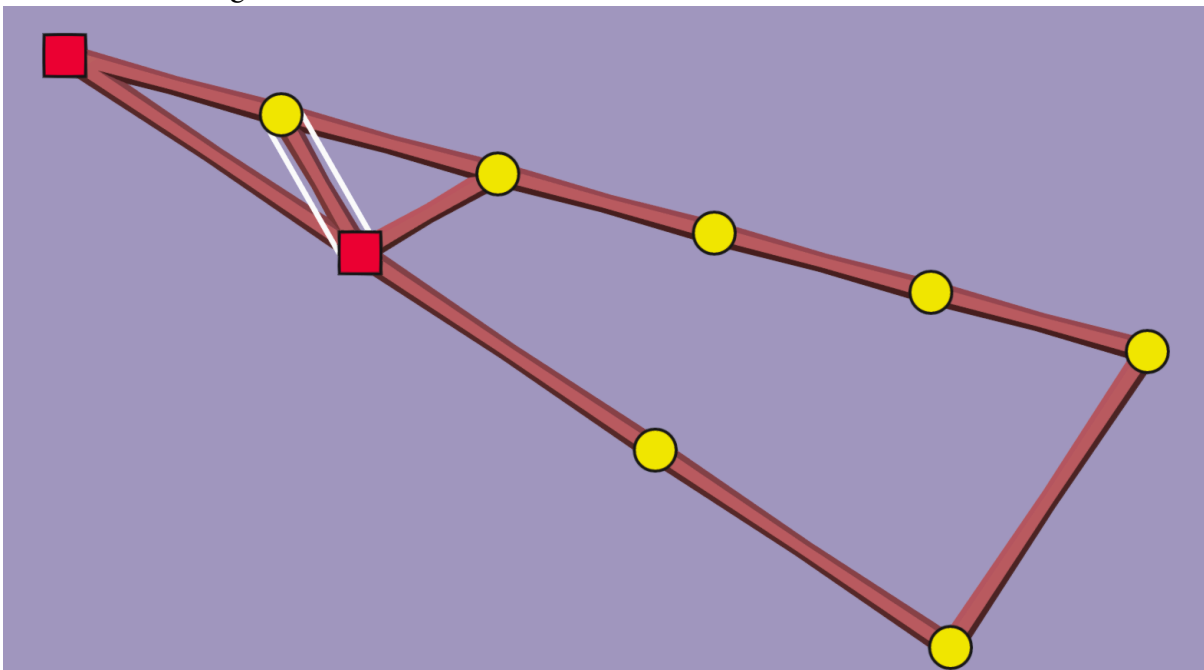
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11 - Hydraulic Constructions

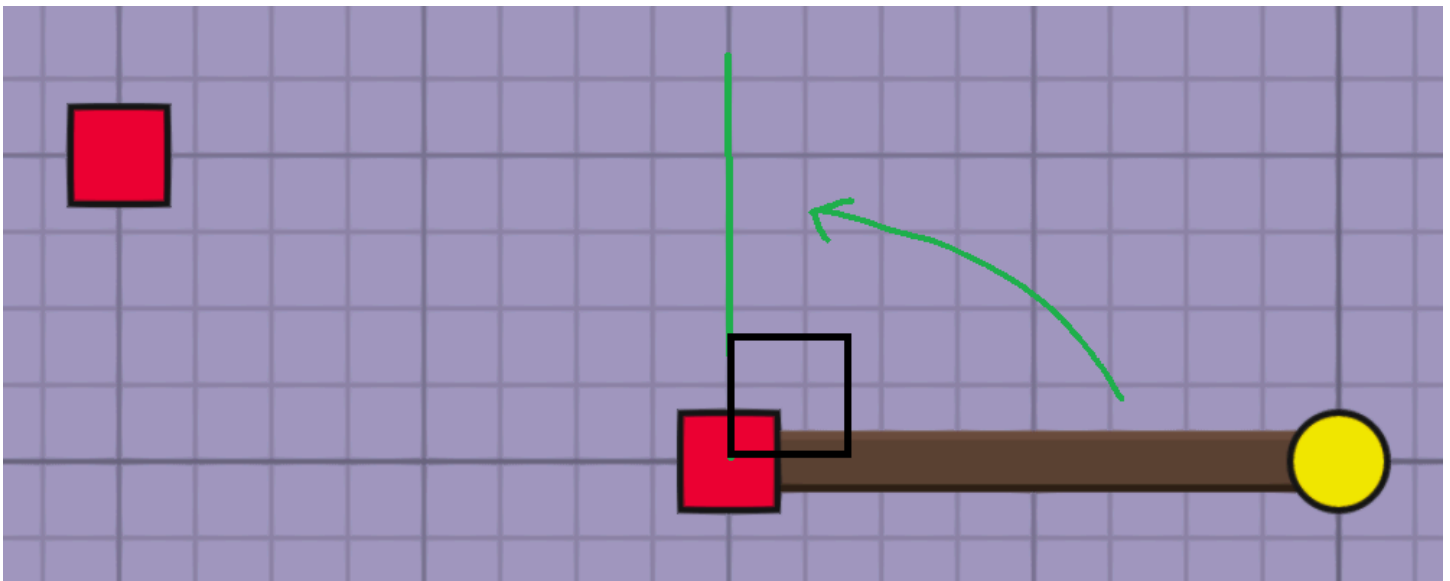
In solving hydraulic levels, you'll end up needing to move a node from one position to another or rotate a bridge section by some angle. In addition, the greatest strength is usually generated if the bridge section snaps into place with split nodes. While tweaking nodes and hydraulics can find a working solution and in some cases is the only way, this section introduces hydraulic math which results in exact movement.

11.1 - Atypical Perfect 90 Constructions

Method 1: Given an anchor and a pivot (in this case anchor), you can construct a hydraulic and linkage that moves 90 degrees like such.

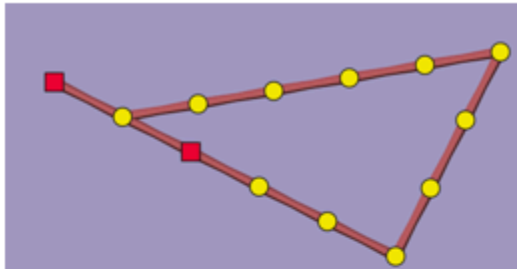
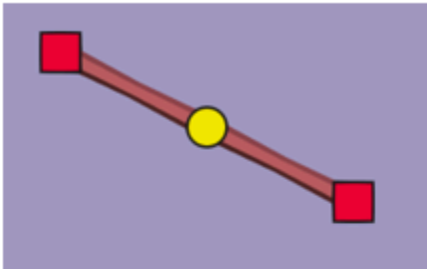


Method 2:

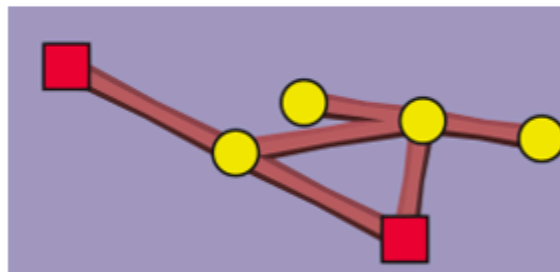
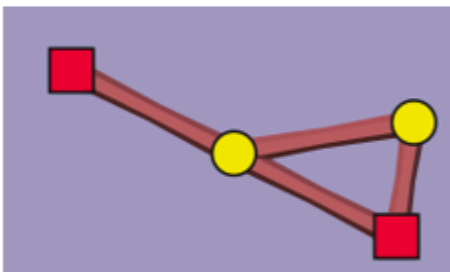


Constructing a "non-quick-return" perfect 90

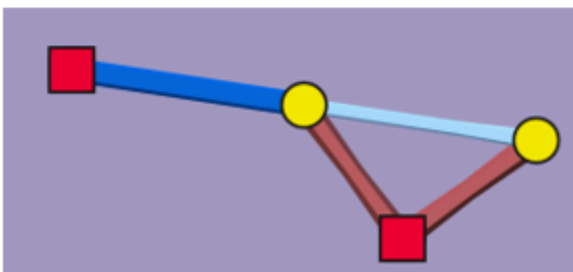
1) Given two anchors, half the distance and build a 3,4,5 triangle from the midpoint with the 4 side inline



2) Connect the anchor to the 1/5 and build a "T"



3) One side of the T is the start and the other is the end. Connect Hydraulic and Crank.



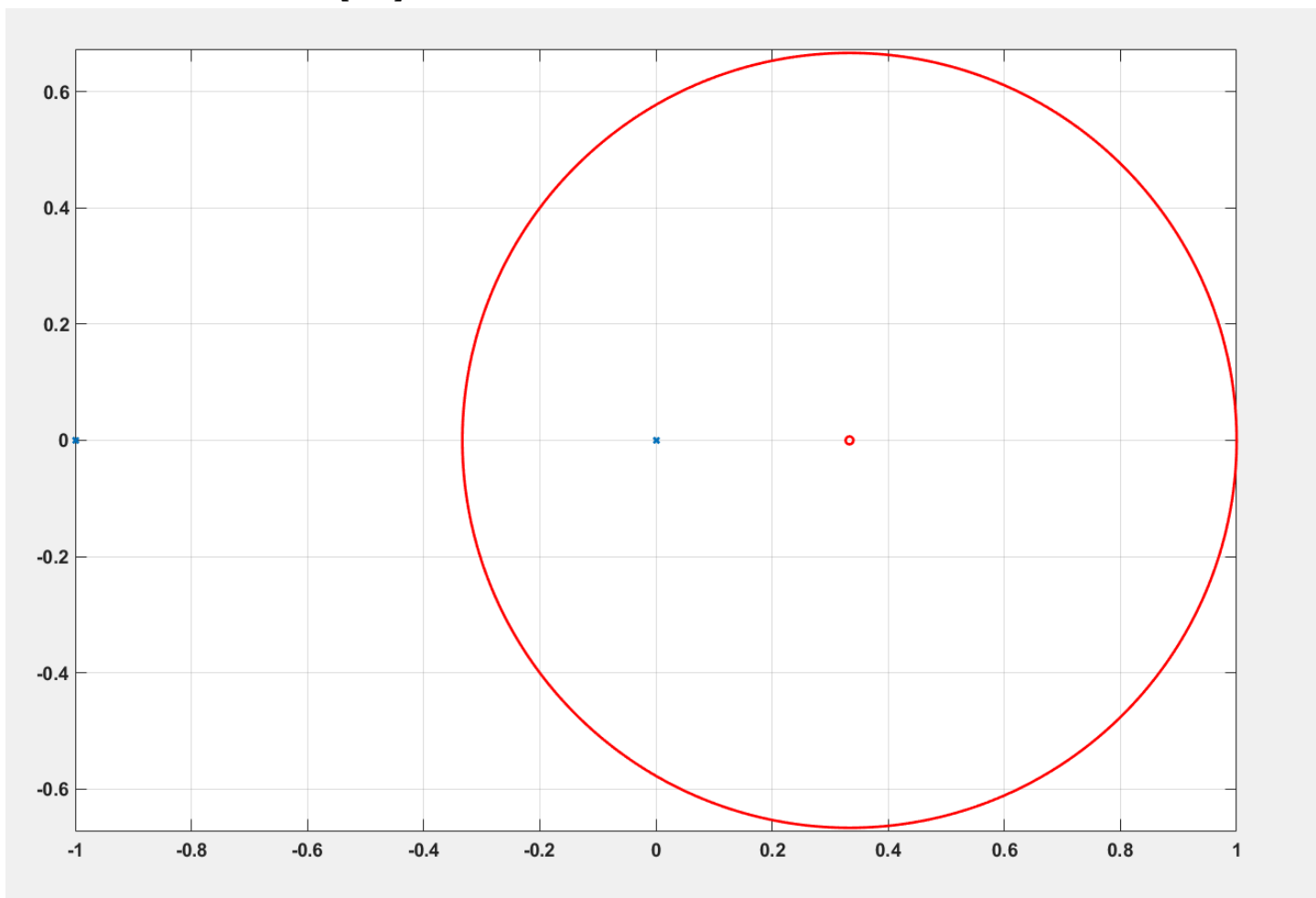
11.2 - Contracting Hydraulic

The problem of finding the placement of a hydraulic given a starting and ending location of a node can be reduced to finding the points for which the ratio of the distance to the starting location and the distance to the ending location matches the hydraulic length ratios. Given the default contraction ratio of the hydraulic, The initial length will be 2 times the final length. So the ratio of the starting distance and the ending distance must also be 2. It turns out that all points that have a fixed ratio of distances to another two points (excluding a ratio of 1) form a circle. For a ratio of 2 and distance d between the points, the solution circle has the following constraints:

Center: $d/3$ from the ending location in the opposite direction of the starting location

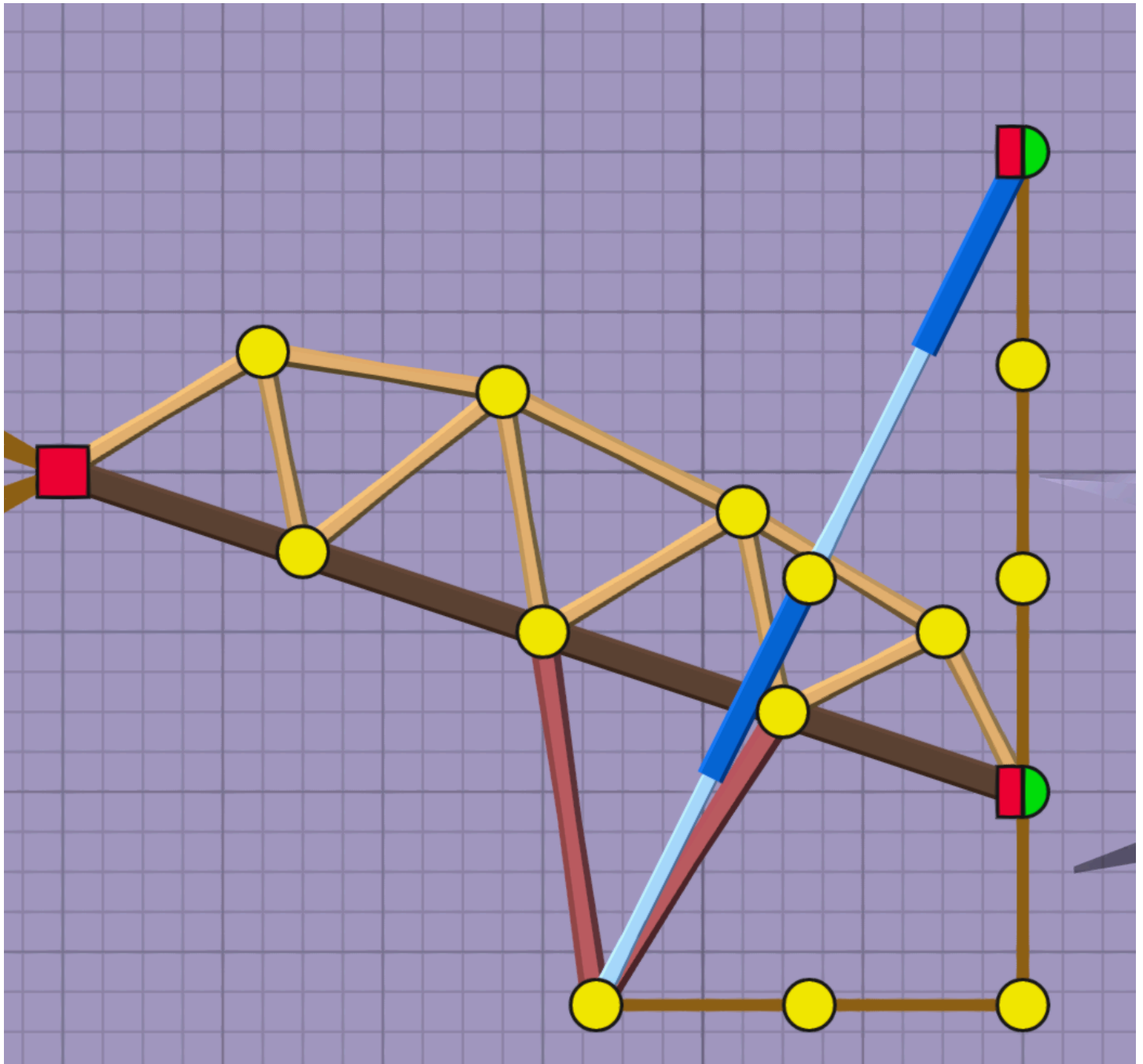
Radius : $(2*d)/3$

In the example plot below, the starting location is at $[-1,0]$ and the ending location is at $[0,0]$. With a $d=1$, the circle center is at $[\frac{1}{3},0]$ with a radius of $\frac{2}{3}$.



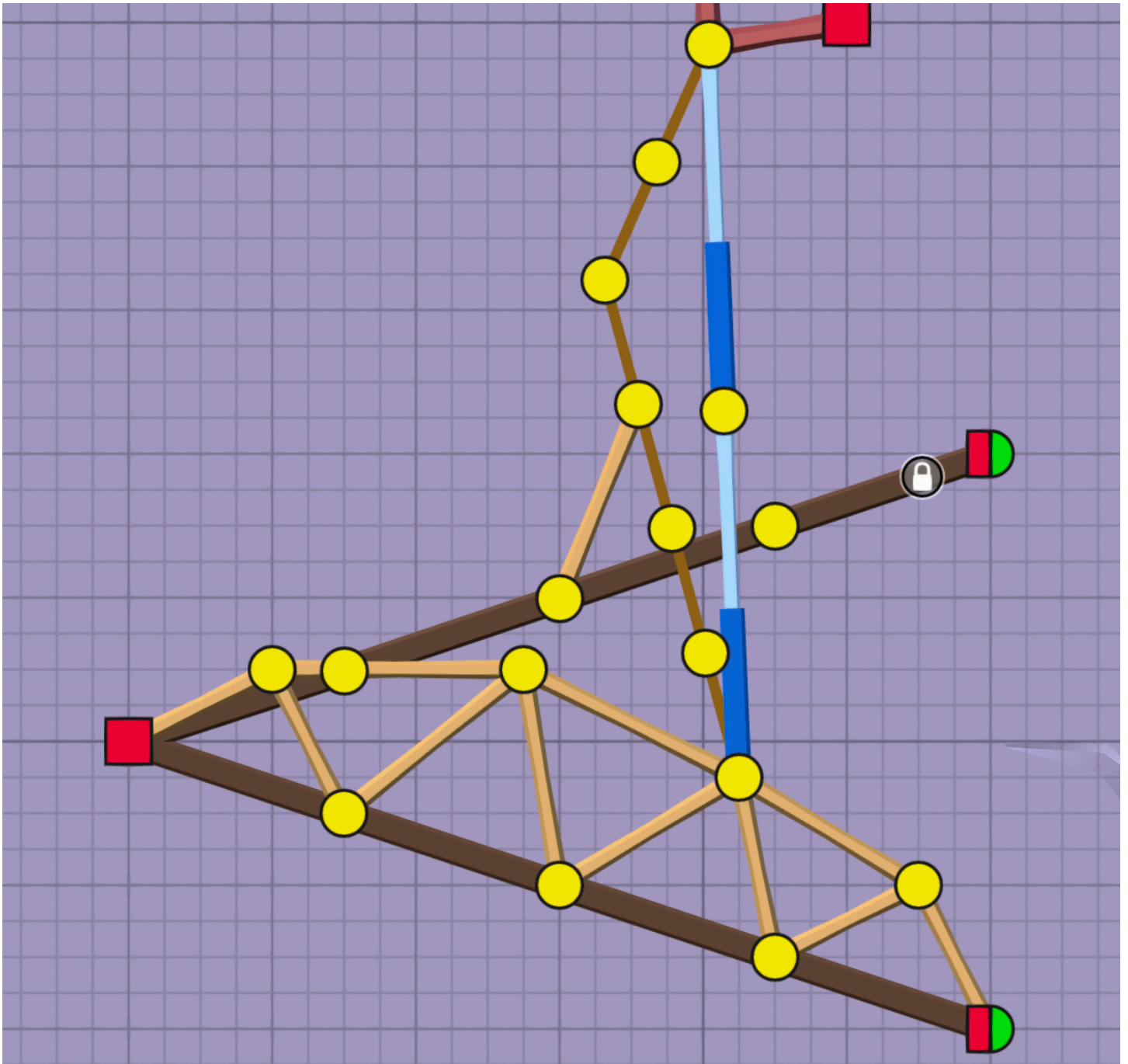
In Poly Bridge, the trace tool can construct the $d/3$ and $(2*d)/3$. Below the bridge needs to rotate between the two slip nodes. The trace tool is used to generate the three ropes between the starting and

ending locations which are $d/3$ in length. The circle center is generated by copying one of the ropes. A point on the circle is generated by copying two ropes and rotating. Connecting the point to the bridge and with hydraulics to the ending location/node the construction is complete. In this example, any rotation of the rope placing the new node above the line connecting the pivot and the starting location would fail as the hydraulic would have to pass through a collinear state with the bridge.

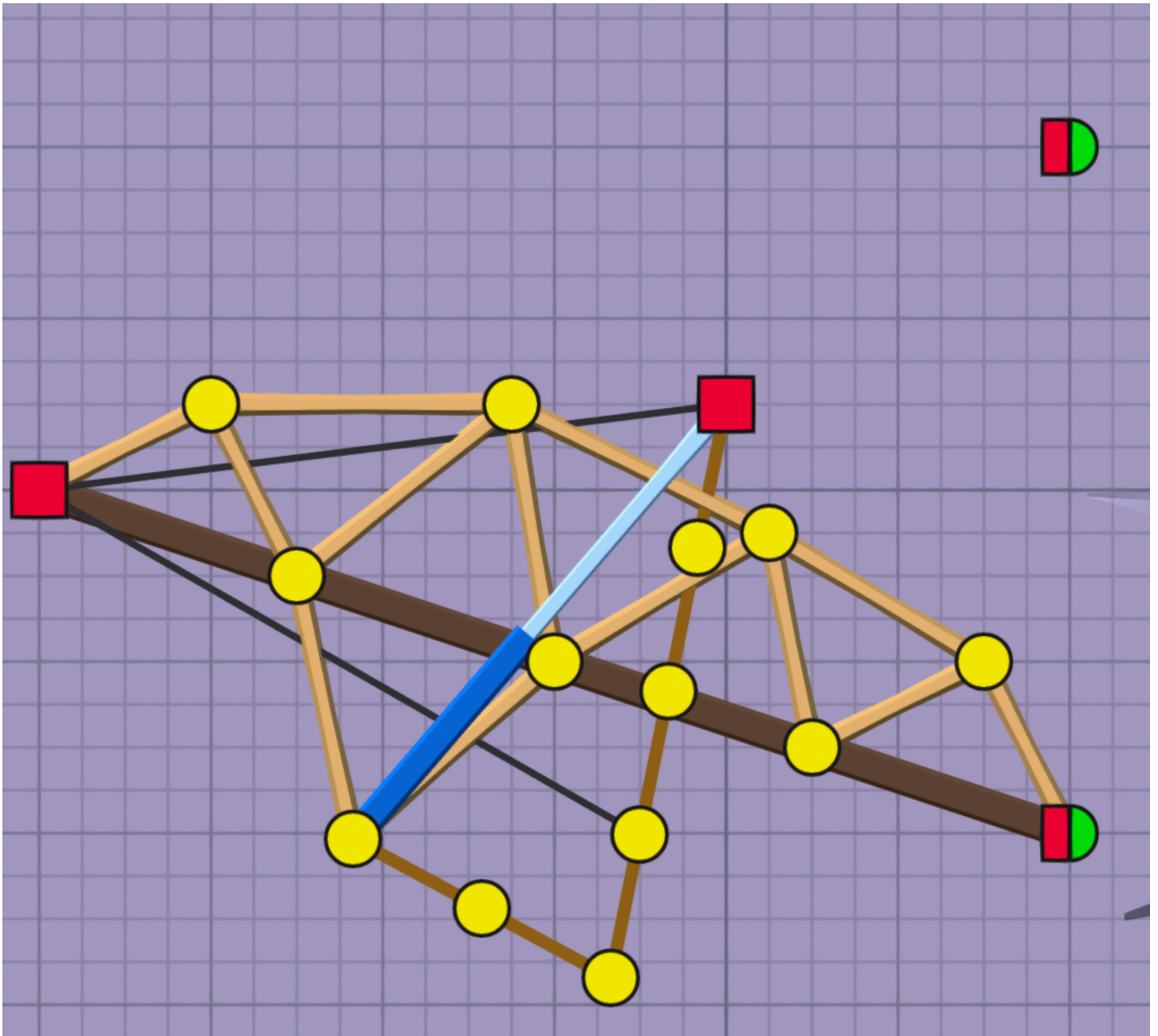


The above example showed constructing a hydraulic construction based on split nodes on the far end of the bridge. There are two other scenarios to consider. First scenario is if a particular bridge connection is desired. In this scenario, the same hydraulic math can be used, but the ending location must be solved for. If the rotation is a whole number of degrees, the ending location can be solved by

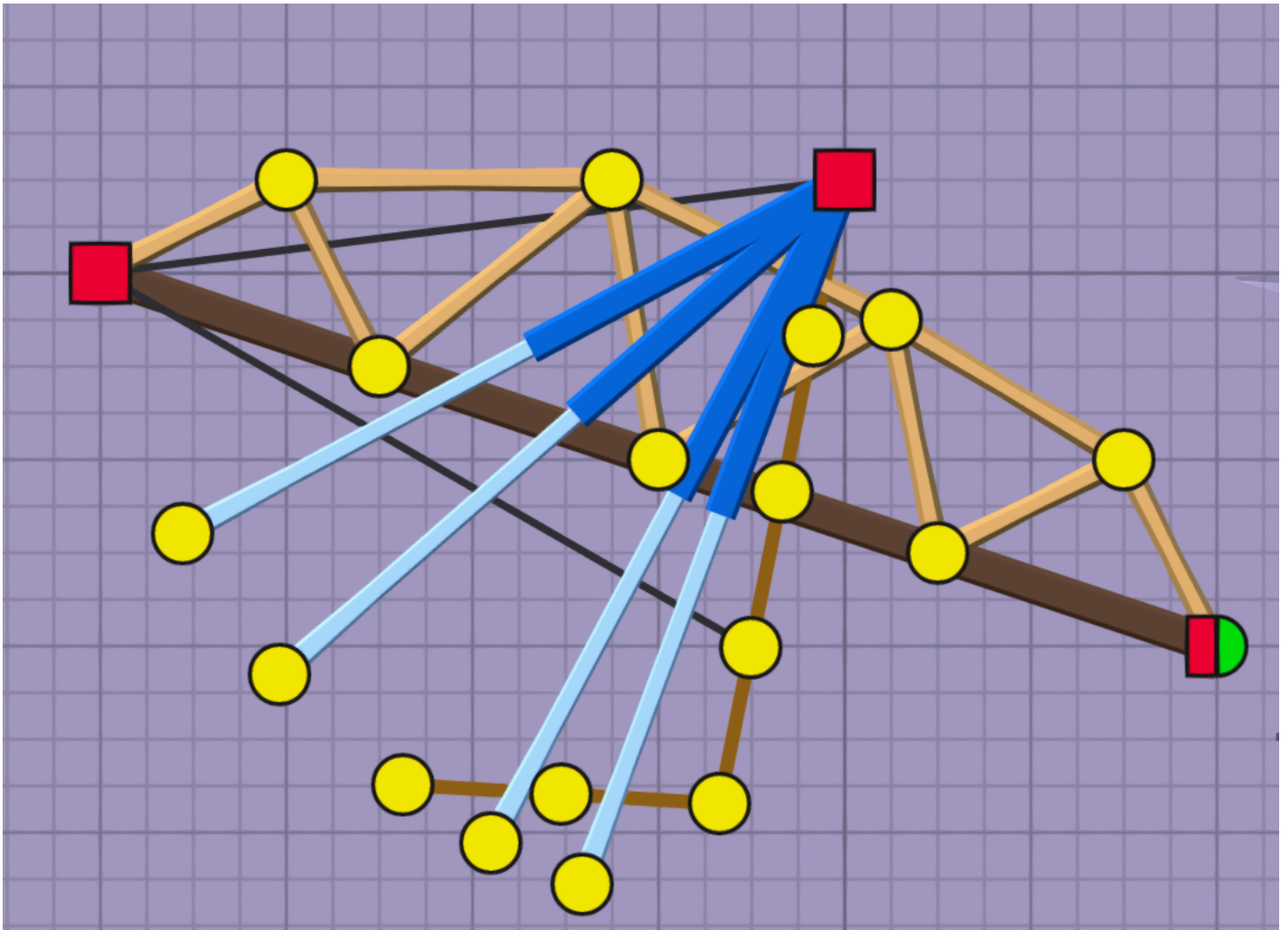
rotating the whole bridge using the in-game rotation tool. If the rotation is not exact, the ending location would be solved using the adding angles node construction in a later section. Below shows an example construction.



The second scenario is if the construction starts with the fixed connection is known. The same hydraulic construction can be used if the problem is viewed from a different frame of reference. If the problem is viewed from the perspective of an observer standing on the bridge, the bridge would look stationary with the world rotating in the opposite direction. For the previous example where the bridge is moving up, the bridge frame would have the world rotating down. Below the cables represent the starting and ending world locations from the perspective of an observer standing on the bridge. Ropes mark out the hydraulic construction.



As a note if a particular length hydraulic is desired, the solution would be the intersection of two circles (one is the hydraulic math and the other is the desired length). This can be calculated or constructed (see Node Constructions) or estimated. Below shows the hydraulics of the desired length placed near the solution to place an exact hydraulic solution that is near the desired length.



11.3 - Expanding Hydraulic

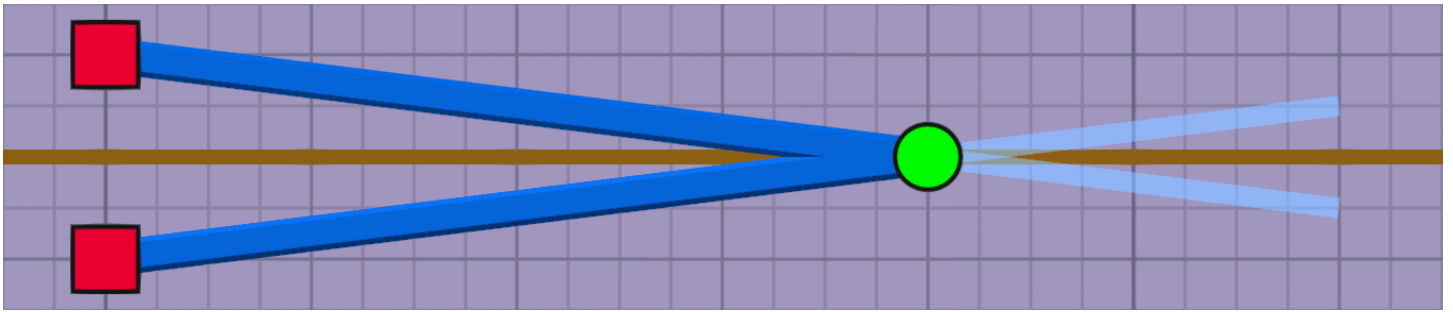
[Section is incomplete at the moment. Please be patient, thanks!]

11.4 - Four Bar Linkages

In this section, we will cover examples of solving for a solution to a four bar problem given different constraints.

11.5 - V-shape Hydraulics

In this section, we will cover construction examples of V-shaped hydraulics. V shaped hydraulics can either generate straight line motion or three position motion.

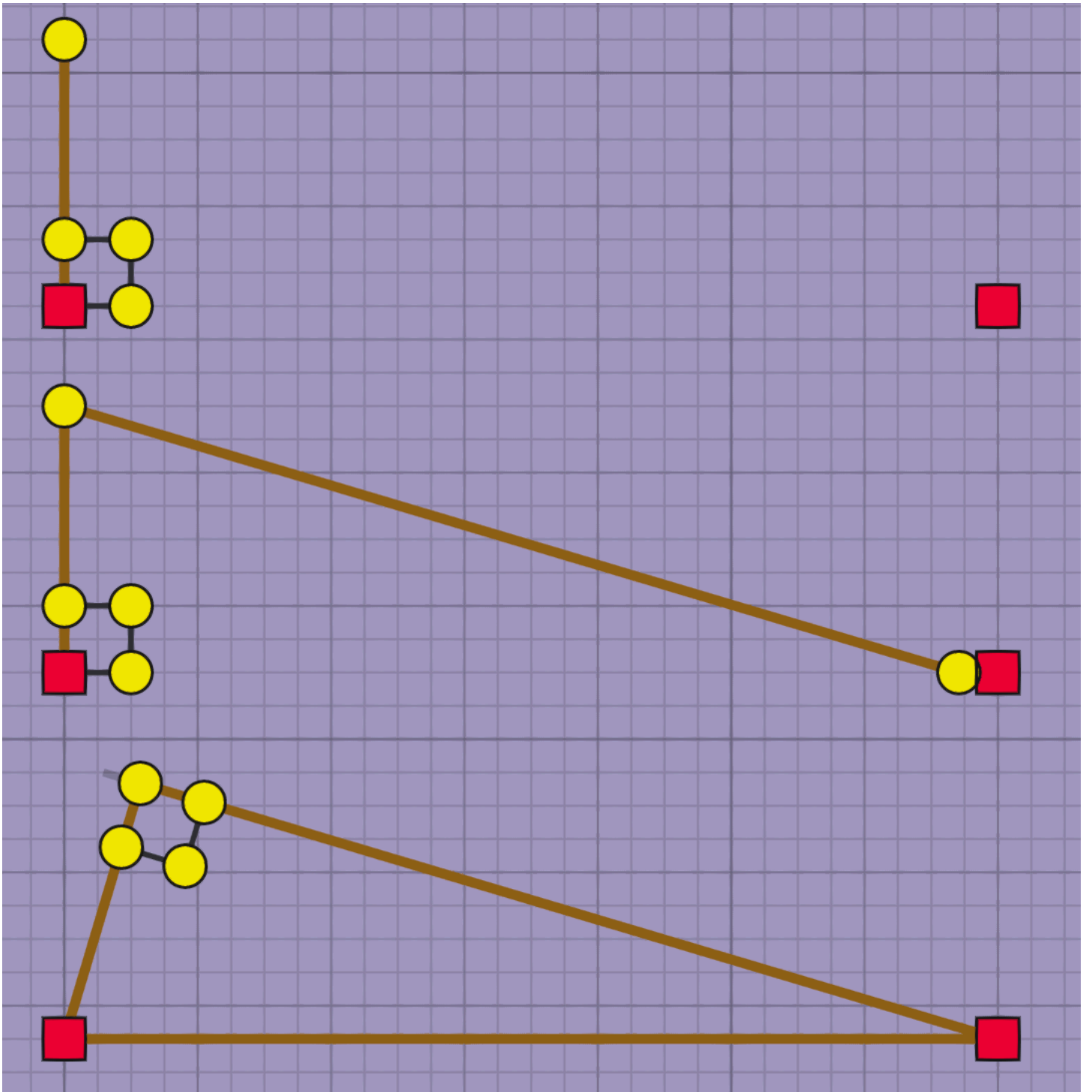


12 - Point Constructions

[Section is incomplete at the moment. Please be patient, thanks!]

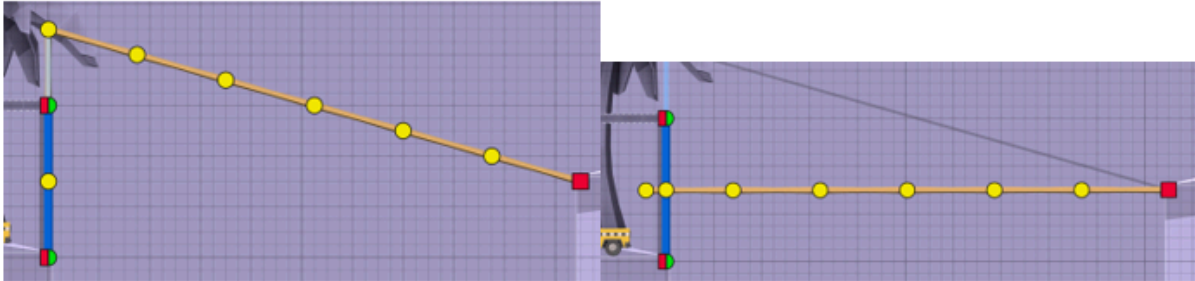
When building things in Poly Bridge, sometimes the grid just isn't enough. Perhaps you can finagle your points into roughly the right spots that you want.

But as you start to create more and more sophisticated systems, being able to have a versatile set of tools to construct points entirely off the grid reliably can not only unlock many different designs, but also allow you to rethink how to approach systems as a whole.

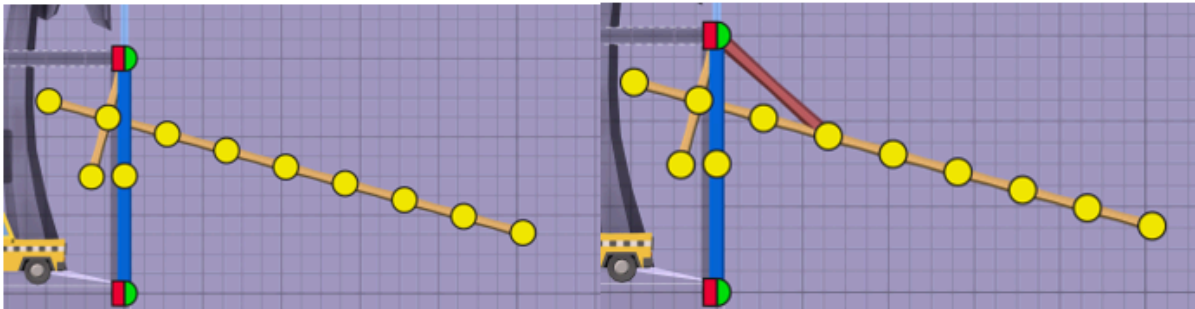


Using the reference of a person standing on the bridge:

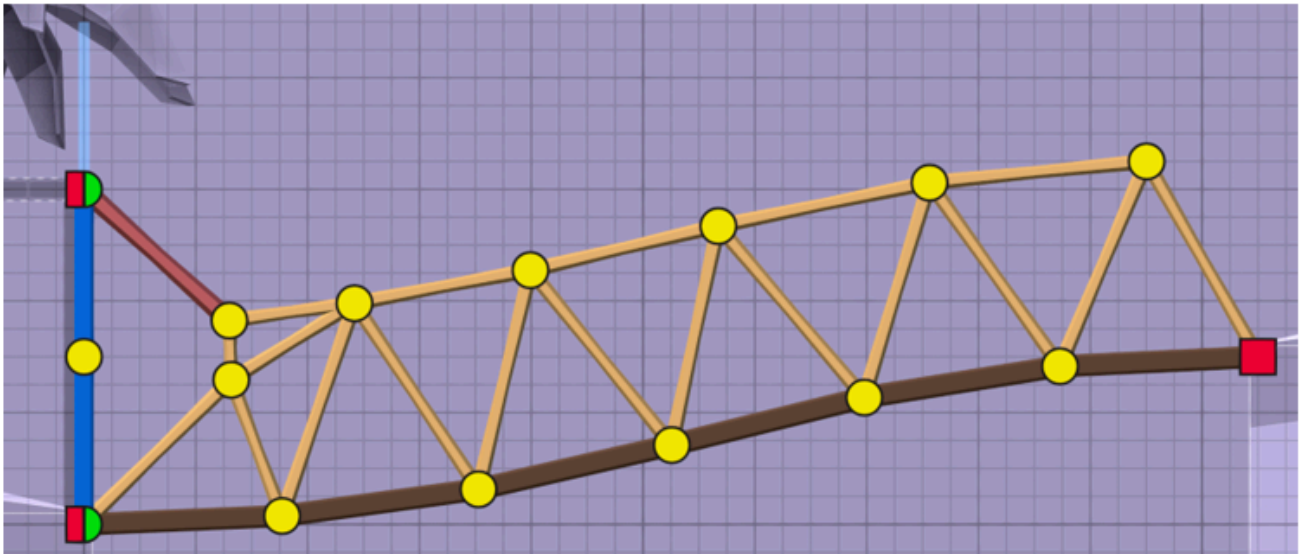
- 1) Rotate the final position of the floating node to the final position with respect to the bridge



- 2) Then find any point on the perpendicular bisector and connect to the starting point of the node.



- 3) Test with a bridge!



12.1 - Line-Line Intersection

12.2 - Line-Circle Intersection

12.3 - Circle-Circle Intersection

12.4 - Circle Inversion of a Point

12.5 - Adding or Transferring an Angle

12.6 - Parallel Line through a Point

12.7 - Transferring a Line Segment

12.8 - Tangent Line through a Point

12.9 - Circle Center from Three Points