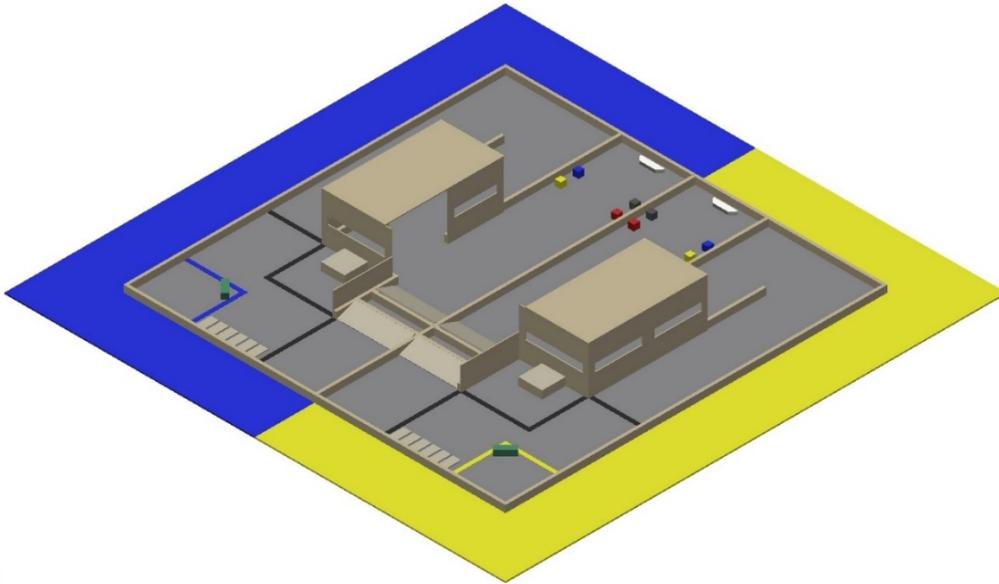


Builder Bot(s)



Date: May 28th to May 29th, 2020, Vancouver Convention Center,
Vancouver, British Columbia

FURTHER COMMUNICATIONS

QUESTIONS FOR CLARIFICATION OF THE RULES CAN BE MADE TO YOUR
PROVINCIAL TECHNICAL COMMITTEE MEMBER.

Table of Contents

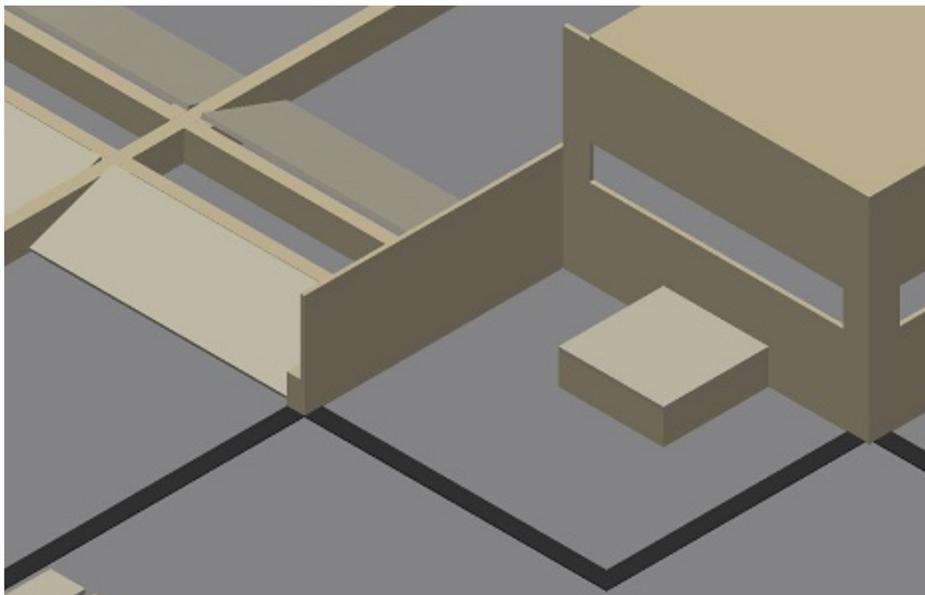
1. Definition of terms referenced in this document.....	3
2. The Builder Bot(s) Teleoperation Game Overview	3
3. The Bridge	4
4. Passageway Tunnel	6
5. Totem Poles	6
6. Totem Pole Components Source Area	9
7. Each Team’s Exclusive Use Area is approximately 8 ft. by 16 ft.	10
8. Each Team’s Home Area includes:	10
9. Builder Bot(s) Game Description	11
10. Scoring Summary.....	12
11. Marking Sheet.....	15
12. Pit Area and Court Access	16
13. Game Play	16
14. Court Layout	17
15. The Robot(s) Restrictions	18
16. Start of the Game Robot Status	18
17. Overall Team Robot Entry Size	18
18. Power Source / Management	19
19. Non-Electrical (Battery) Energy Sources	20
20. Recommended Robot Controllers	20
21. Pit Area.....	20
22. Overall Court Description:.....	21
23. Pre-inspection for Compliance with Safety and Design Rules	22
24. Autonomous Competition Overview:	24
25. Exception List to “Only what is in the box”	25

1. Definition of terms referenced in this document

- Tele-Operated Robot Elements are elements under the direct/active control of competitors during game play using one or two radios/game controllers held by the courtside competitors
- Mobile Independent Autonomous Mobile Robot Elements are elements that at the start of a game have a competitor pressing their start button or enter on a computer keyboard as the only competitor to Independent Autonomous Mobile Robot Element communication during the entire game.
- Stationary Independent Autonomous Elements are elements that have their power on at the start of games but have no direct contact with a competitor during game play. These units may interact with the team's tele-operated mobile robot with the actions of the tele-operated mobile robot triggering an active response by the Independent Autonomous Element which may be managed either by a mechanical based system (eg. A series of limit switches / no programmed elements) or a pre-programmed system (eg. Managed by an Arduino or other microprocessor) internal to the Independent Autonomous Element.

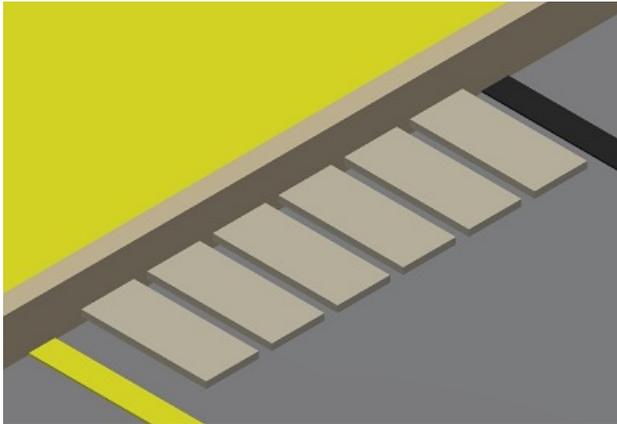
2. The Builder Bot(s) Teleoperation Game Overview

- The core game situation requires a Robot or Robots to use the components provided in their Exclusive Use Court Space to (a) Complete the building of the Bridge by putting the Road Surface Boards in place and (b) to Build the Totem Pole ON the Designated Stand or ON the Floor In the Assigned Robot Assembly Area.



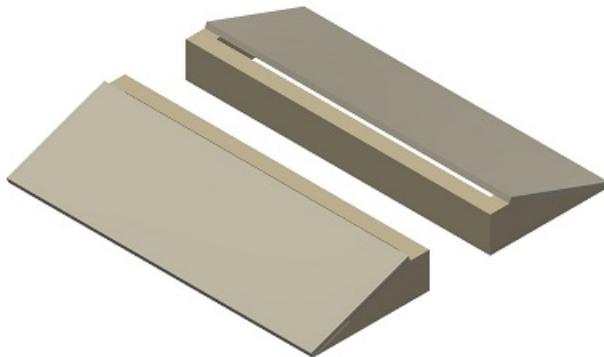
Bridge Framework and Assigned Robot Assembly Area

3. The Bridge



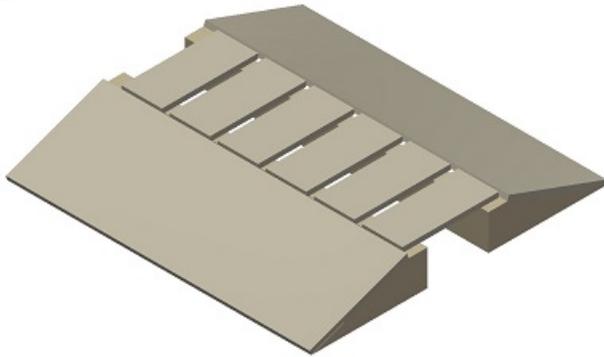
Teams have use of SIX Bridge Plates:

- (a) Each Bridge Plate is 9.5 by 4.0 by 0.5 in. and has a 4.5 by 3.0 by 0.5 in. Plate attached to the Bottom Side of the Bridge Plate.
- (b) At the start of the game the SIX Bridge Plates are sitting on the court floor along the Back Wall of each Team's Home Area.



Each Bridge Structure provides:

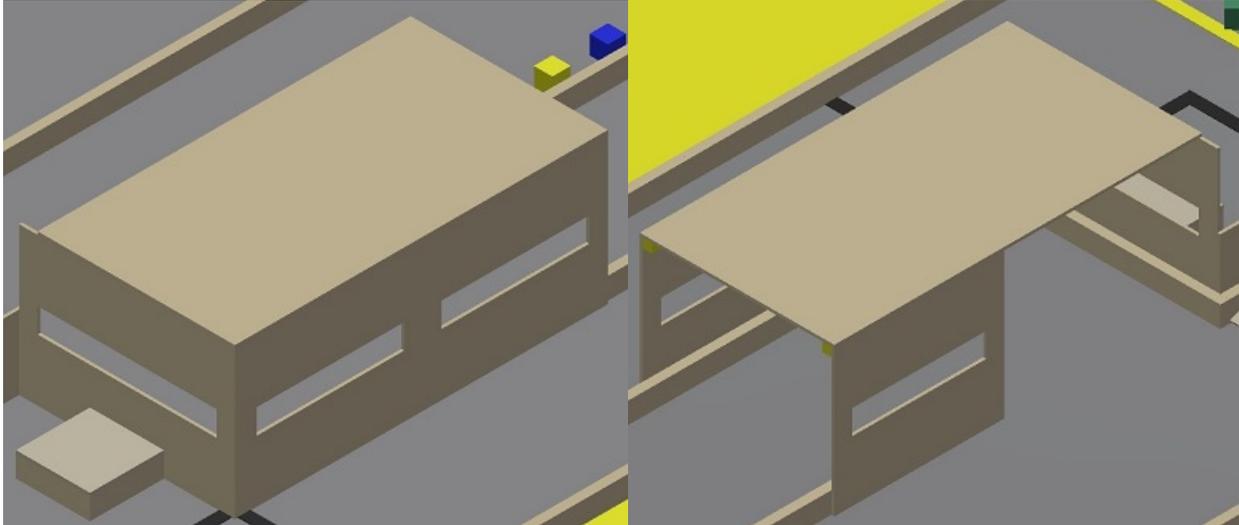
- a) A 20 Degree Entry and Exit Ramp
- b) A 6-Inch-Wide Open Gap between the Two Ramp Structures
- c) Two Beams able to support the Bridge Roadway Plates



A Fully Built Bridge has:

- a) SIX 9.5 by 4.0 by 0.5 in. Bridge Roadway Plates
- b) Plates MUST be installed Right Side Up

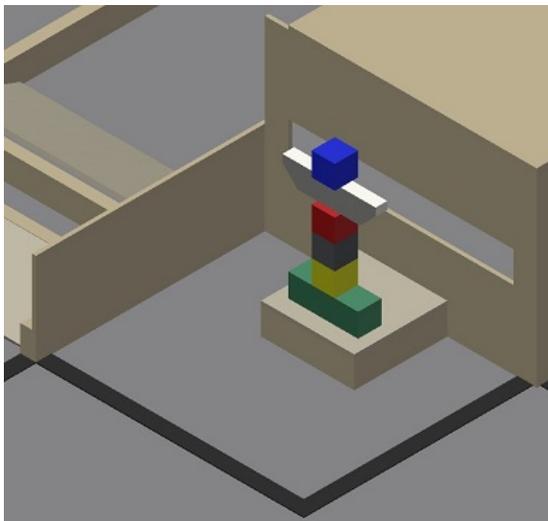
4. Passageway Tunnel



A Tunnel Structure placed in the Passageway area will restrict competitor's view of their robot at times.

The Dimension Details of the Tunnel are provided in the Appendix Section of this document.

5. Totem Poles

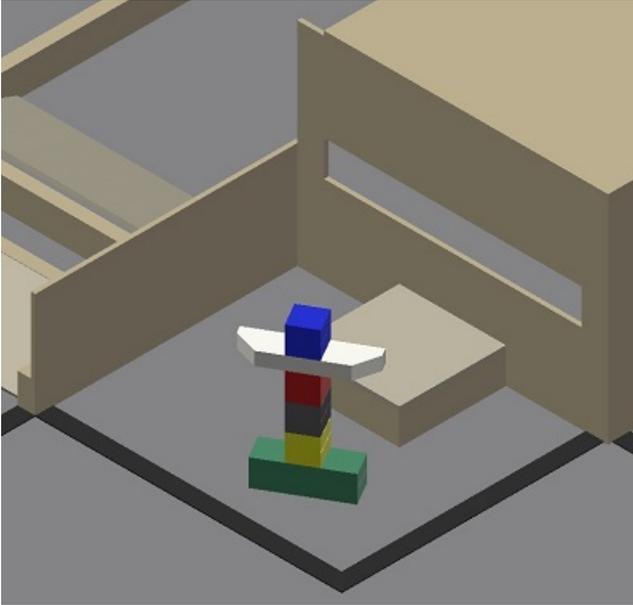


Building Totem Poles involves:

- a) Build it on the 12 by 12 by 4 In. Stand, or, build it on the Court Floor Inside the Designated Assembly Area
- b) Use ALL SIX of the available Totem Pole Components
 - A 9.0 by 3.0 by 3.0 In. Base Block
 - FOUR 3.0 by 3.0 by 3.0 In. Core Blocks
 - A 12 by 3.5 0 1.5 In. Wing Block
 - Robots must be in their Assigned

Home Area when building a Totem Pole.

- Robots cannot reach over or through a passageway wall to deliver a Totem Pole Component into the assembly area.
- Robots cannot reach over the bridge wall to deliver a Totem Pole Component into the assembly area.



c) A complete Totem Pole has SIX Levels

d) Bonus Points are awarded when the Wing Block is positioned on its' 1.5 In Narrow Face

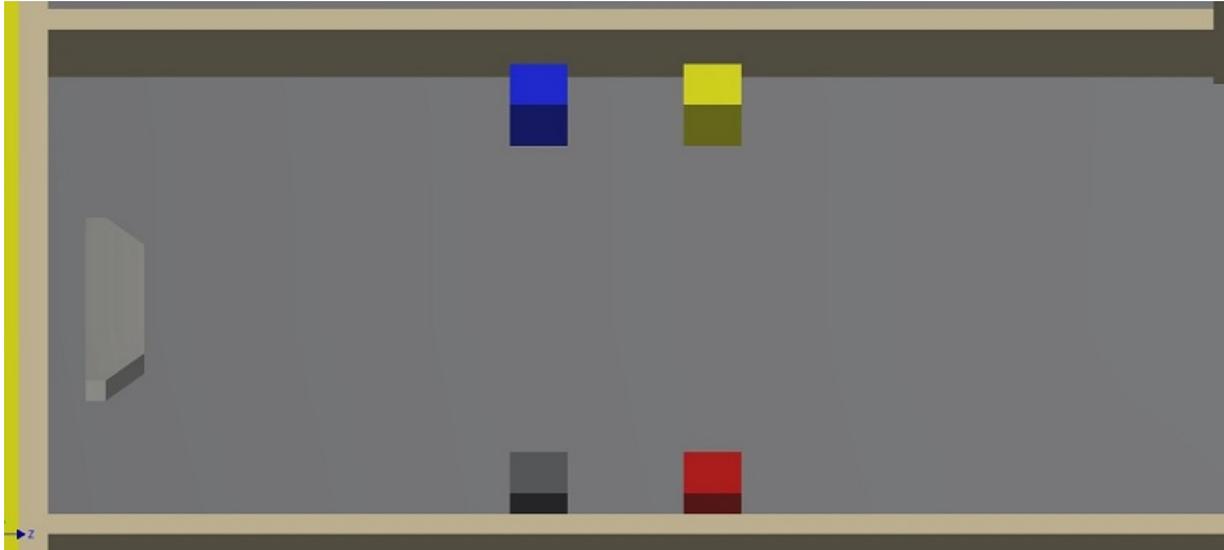
(e) **Bonus Points** are awarded when a Core Block is positioned on the 1.5 In. Wide Top Edge of a Wing Block



Note: The Totem Pole Components are:

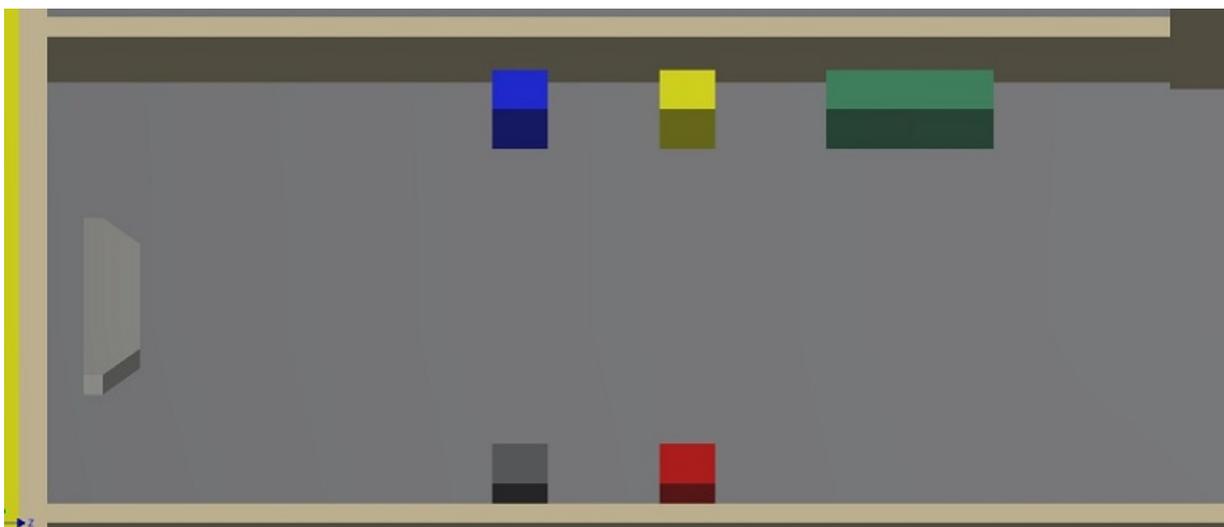
- a) Made by gluing together pieces of 1.5 In. Thick Rigid Foam Blocks, and,
- b) Will be wrapped with colored Duck-Tape.

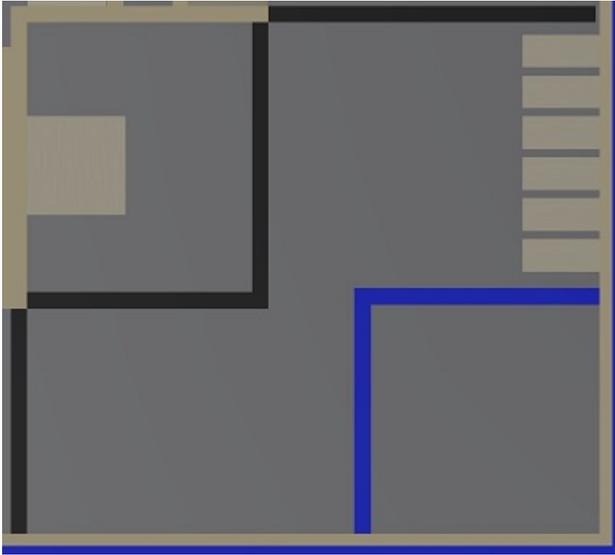
6. Totem Pole Components Source Area



At the Start of a Game the Totem Pole Components are in Team's Exclusive Use Components Source Area that are Managing the Totem Pole Base Component Autonomously will be in the Positions shown above.

At the Start of a Game the Totem Pole Components are in Team's Exclusive Use Components Source Area that are Managing the Totem Pole Base Component using Teleoperation will be in the Positions shown below.





a) A Starting Square (Blue Tape Lines) and Each Team's Complete Robot Entry MUST fit onto the 30 by 30 Inch Starting Square defined by Outside Edge of the Tape Lines and the Corner Court Walls.

b) A Totem Pole Assembly Area defined by Black Tape Lines, one Tunnel Wall and the Side of the Bridge Wall with a Fixed in Position 12 by 12 by 4 in. Assembly Stand included in this space.

c) A Row of Six Bridge Plates positioned along the Court Wall.

d) Robot's will be deemed to be 'In their

Home Area' when the all the Robot's wheels or tracks are past either of the two tape lines that define the two entrances to the Home Area.

9. Builder Bot(s) Game Description

- Games will involve Two Teams at a time.
- Both Competitors are allowed unrestricted movement around the perimeter of their Team's Assigned Court Area.
- Teams can utilize a Maximum of TWO Tele-operated Robots.
- Teams may also have one Independent Autonomous Element as part of their entry (which must fit into the overall size limitation at the beginning of the game).
- Teleoperated Robots may NOT be in possession of any Bridge or Totem Pole Components at the Start of a game.

Note: Competitors will participate in BOTH the Builder Bot(s) Game and the Built On-site Autonomous Robot Tasks during BOTH Competition Day.

10. Scoring Summary

Scoring will be done at the end of each 4 min. match:

10.1 Bridge Building Points

- Four points will be awarded for each Bridge Roadway Plate put into position on the Bridge Framework Structure

10.2 Totem Pole Component Delivery Points

- One point will be awarded for Each Totem Pole Component Delivered onto the Floor of the Robot Assembly Area
- Two points will be awarded for Each Totem Pole Component Delivered onto the Stand in the Robot Assembly Area

10.3 Totem Pole Building Points

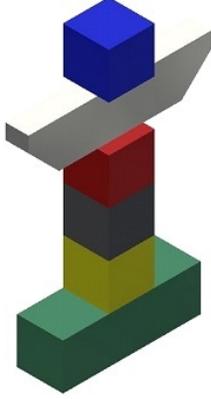
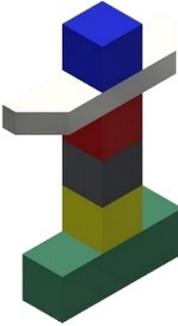
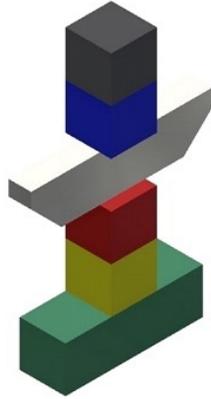
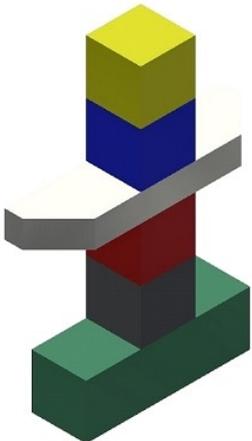
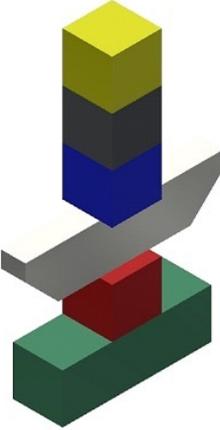
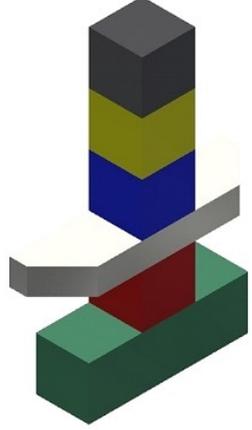
- A complete Totem Pole has a Maximum of SIX Levels and the point value awarded increases as you move up through the layers. Example: A Core Block positioned on Layer One has less point value than a Core Block positioned on Layer SIX.

Note: The points awarded based on the Layer a Block is placed in a Totem Pole are displayed in the Robot Marking Sheet Sample. Marks assigned increase by **ONE point per layer** as you move up the Totem Pole Structure.

- Totem Poles built on the Floor have a lower overall points value than Totem Poles built on the provided Stand given each component in an 'On the Floor Totem Pole' carries a Delivery Value of One Point while each component in an 'On the Stand Totem Pole' carries a Delivery Value of Two Points.
- Wing Blocks positioned on their Narrow Side will be awarded Bonus points.

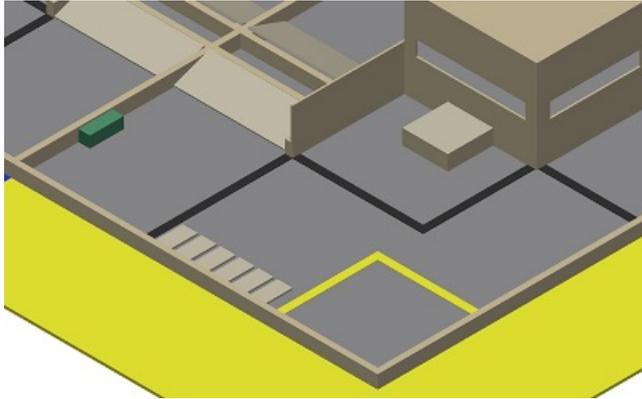
Note: Bonus points will be awarded for Core Blocks positioned on the Narrow Side of a Wings Block or On a Block that is On the Narrow Side of a Wings Block.

Note: Robots may possess a **Maximum of ONE Totem Pole Component** at a time. However, there is **NO RESTRICTION** on the Number of Bridge Roadway Plates that a Robot may possess at a single time during a game.

Totem Pole Scoring Options	
Wings On Narrow Edge	Wings On Wide Side
	
	
	

The six Totem Poles shown represent samples of 'Complete Totem Poles' however, Teams will be awarded points for Partially Built Totem Poles with components (Blocks) positioned IN any pattern as long as they are on top of the Base Block.

10.4 Totem Pole Base Block Delivery



If an Autonomous Robot is used to deliver the Totem Pole Base Block, then the following Game Situation Applies:

a) The Base Block will be positioned along the Center Wall just outside the Team's Home Area.

b) An Autonomous Robot delivering the Base Block to the Assembly Area Floor will be awarded 8 Points.

c) An Autonomous Robot delivering the Base Block onto the Top of the Stand in the Assembly Area will be awarded 12 Points.

d) A Teleoperated Robot retrieving the Base Block from the Components Source Area delivering the Base Block to the Assembly Area Floor will be awarded One Point.

e) A Teleoperated Robot retrieving the Base Block from the Components Source Area delivering the Base Block to the Assembly Area Floor will be awarded Two Points.

11. Marking Sheet

2020 Skills Canada Vancouver Robotics Build a Bridge and a Totem Pole Scoring Sheet															
Bridge Plates		Plate 1	Plate 1	Plate 2	Plate 3	Plate 4	Plate 5	Plate 6							
Bridge Plate Points Awarded															
4 Points per Bridge Plate															
Bridge Building Points Total															
Totem Pole Components		Base Block Delivered by Aut Bot		Base Block Delivered by Telop Bot		Core Block 1		Core Block 2		Core Block 3		Wings Block		Core Block 4	
Component Delivery to Assembly Space		On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand
Points Value		8	12	1	2	1	2	1	2	1	2	1	2	1	2
Points Awarded															
Totem Pole Components Delivery Points Total															
Component Position In a Totem Pole Assembly		Core Block or Wings On Level 2		Core Block or Wings On Level 3		Core Block or Wings On Level 4		Core Block or Wings On Level 5		Core Block or Wings On Level 6		Wings On Narrow Edge		2 Points Per Block On Narrow Wing Edge	
Totem Pole Assembly Location		On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand	On Floor	On Stand
Points Value		1	2	2	3	3	4	4	5	5	6	2		Max 6	
Points Awarded															
Totem Pole Build Points Total															
Total Game Score															
Team Name:					Competitor Signature:										

12. Pit Area and Court Access

- A pit area is provided so that students may make repairs and improvements to their robots between games. (Note: Teachers are not permitted in the pit area once the competition has started).
- Teams MUST bring their Robots into the skill area at Orientation. Teams are NOT allowed to remove their robots from the skill area during the over-night periods between Orientation Day, Competition Day 1, and Competition Day 2 of the contest.
- Laptops may be removed overnight by competitors.
- The pit area and contest court may be available to teams to work or practice during lunch breaks if an NTC committee member is present.

13. Game Play

- Teams may participate in a 'Round Robin Tournament' leading to a 'Seeded Double Elimination Playoff Tournament'.
- Builder Bot(s) Tournament Standing will be based on total number of points scored in all games played by each team.
- Teams will play a balanced number of Tournament Games.
- Teams will participate in an equal number of Games in the Round Robin Tournament.
- There may be Builder Bot(s) Playoff Games
- Tournament games will last 4 minutes
- The amount of time between games will be determined by the number of participants. This information will be provided to teams at the start of the tournament.
- Between tournament games, battery changes and repairs to robots may be completed at the team's assigned Pit Area Worktable.
- During the competition, protective safety glasses are expected to be worn while performing material removal tasks (cutting, drilling, etc.).
- During game play, referees will have ultimate authority over game rulings, and will have full authority over team conduct in the court area.
- Damaging the court area is prohibited. If a robot's design causes damage to the court elements, then it will not be allowed to compete until it can operate without causing damage. Games missed due to this situation will be forfeited. NOTE: Damage involves BREAKING court components. Robots bumping into court components and causing them to shift position without breaking any court element will NOT be viewed as damaging the court. It is expected that all court components will be fixed firmly in place so that the court is a Neutral Factor in the competition.

- Games will start on time. Teams are responsible to know when their games are scheduled. Teams arriving late will be allowed to use the remainder of the time in the game. Competitors cannot enter onto the court surface or adjust their robot during a game.
- If a robot is mal-functioning and represents a hazard to participants, other robots or itself in the opinion of the Referee, then, the referee may stop the clock, and may authorize the shutting off the robot during a game. Disabled robots or parts of robots not generating any safety concerns will be left on the court until the game time expires.
- It is a Team Decision what roles team members will fill. Drivers are the competitors holding the robot controller(s) and asserting direct control over a Tele-operated robot.
- The Spotter would be the competitor providing navigational guidance to the driver.
- Competitors may change roles while a game is in progress.
- Competitors (Driver/s and/or Spotters) can move freely in their Assigned Courtside Team Area throughout the game.
- Competitors may not enter an opponent team's Assigned Courtside Team Area at any time during game play.
- At the start of a game, robots are expected to be in their Designated Starting Position Square.
- Robots arriving AFTER a game has started will be allowed to enter the game and use the Time remaining in the 4 min. game.
- Robots must not leave the contest court at any time during a game.
- It will be a referee's ruling that decides if an 'End of the Game Component Placement' took place before or after the game-ending buzzer sounded.
- If a Bridge or Totem Pole Component falls out of the court, it may not be retrieved and will be considered out of the game for the remainder of the game time.
- Scoring will take place after the End of the Game Buzzer
- No aerial (flying) robots are allowed.

14. Court Layout

Please note: Although great pains will be made to keep the court in compliance with the drawings, some inaccuracies in construction may occur. **Please make your robot designs allowing for a possible ½ inch tolerance.**

- The open court surface will consist of the good side of Plywood Sheets **OR** the facility floor **OR** the smooth side of Masonite Sheeting.

- Detailed court information has been included in the Appendix Section of this document.

15. The Robot(s) Restrictions

All tele-operated Robots must pass a pre-competition inspection for compliance with the safety and design rules before they will be allowed to participate in tournament games.

Note: Robots must remain in compliance with these rules throughout the competition. If teams fall out of compliance with these rules, then they will not be permitted to compete and will forfeit all their scheduled games until they have corrected the problem.

16. Start of the Game Robot Status

When a robot's main power is turned on prior to the start of a game the robot must be in an overall 'Idle State' and the following conditions must exist:

- Robots must be stationary
- Robots must be in their designated Starting Square Location (denoted by a tape square).
- If Team Entries involve multiple Robots / Mechanisms, then all of them must be fit within starting location (denoted by a tape square) and must be positioned to not exceed the allowed total 4 cu ft. volume per Team.
- All systems may be ON.
- Air System Circuits may be fully charged to 100 PSI and their compressors can be ON.

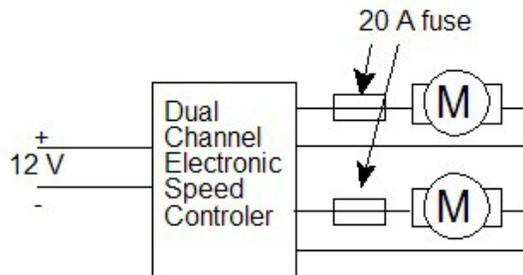
17. Overall Team Robot Entry Size

- Complete Team Entries must fit within the 30 by 30 inch starting square at the start of each game.
- Complete Team Entries must not exceed an overall size of 4 cubic feet (6,912 cubic inches) at the start of each game.
- Team Entries may expand to a larger size once a game has started.

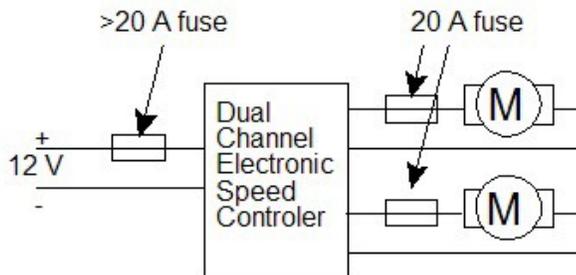
18. Power Sources / Management

- The total voltage in any individual circuit cannot exceed 24 Volts.
- The maximum continuous power rating allowed in any circuit branch is 240 W, which will be limited by voltage and fuse selection. A larger main fuse can be used to provide protection for motor controllers. To calculate power in any given circuit, use the following formula: Power (Watts) = Voltage (Volts) x Current (Amps)

Acceptable Circuit Protection: (ESC is NOT protected by fuse)



Recommended Circuit Protection: (ESC IS protected by fuse)



- Teams are reminded that it is the purpose of a fuse to protect the students themselves and the equipment in their circuits. Teams must develop circuit diagrams and calculate the appropriate values for all circuits on their robot. Teams must submit a wiring diagram of their robot's circuits.
- Each current branch path from the battery must include either an in-line fuse, resettable fuse, circuit breaker, or be connected to a dedicated fuse in a rack.
- Batteries must be complete sealed commercial battery packs.
- ALL Robots must be able to be turned off with a single motion.
- Robot Controller receivers may be in an independent circuit.
- No explosive materials of any kind may be used (ether, gunpowder, acetylene etc.)

19. Non-Electrical (Battery) Energy Sources

- Pressure based energy sources (air or other) may be pre-charged to a maximum of 100-PSI pressure in their reservoirs (cylinders) at the start of each game.
- Air pressure systems using Competitor-made or modified air pressure hardware are NOT permitted.
- All pressurized tanks on robots must have a pressure gauge to indicate the stored pressure and a form of automatic overpressure safety relief system.
- The pressure tanks and related gauges / controls must be shielded from damage due to collisions or flying target objects.
- The stored pressure in the tank must not exceed a maximum of 100 PSI at any time.
- Tension-based energy sources (elastics, springs or other) may be in either a relaxed at rest state or in a tense / compressed state at the start of each game.
- Laser devices are prohibited.

20. Recommended Robot Controllers

- It is recommended (not required) that all teams use 2.4 GHz “non-crystal” control systems on Tele-operated Robots.
- Teams are allowed the use of an unlimited number of channels, but only two separate tele-operated robots. Teams assume full responsibility if any interference is to occur with their respective communication systems that could render the robot(s) useless.
- Tele-operated Robots may not transmit audio/visual information to off the robot devices. (Ex: Having a camera transmit images real time to a computer near the driver, etc.)

21. Pit Area

- Competitors MUST wear safety glasses when doing fabrication work involving material removal processes (grinding / cutting).
- Only registered competitors are permitted in the contest space.
- Designated teacher/industry team advisors are permitted in the pit area only to inspect the worktable setup of their team prior to the start of the tournament.
- Designated teacher/industry team advisors are not allowed in the pit area during tournament play.
- Teachers and industry advisors are not permitted to handle tools or robot parts. Students must affect all repairs and modifications on their robot.
- Teams will be provided with a pit area workspace on a standard project table. Depending on the number of teams and availability of space, teams may have to

share a 60 by 30-inch table.

- It is required that teams fabricate a tabletop stand for holding their robot(s) in the pit area. This stand or these stands should hold the robot(s) securely and be capable of preventing the robot(s) from driving on or off the table in the case of either deliberate motor testing during repairs or due to random, unexpected motor activity.

22. Overall Court Description:

- The Court Playing Surface will be a 16' by 16' square.
- Individual Exclusive Use Team Spaces are 8' by 16' rectangles.
- The Perimeter Court Walls will be made using 2 by 6-inch planks.
- This wall will as a result will be approximately 5.5 inches tall.
- The court surface may vary between melamine, concrete, hardboard, or plywood.

23. Pre-inspection for Compliance with Safety and Design Rules

- Mandatory Wiring Diagram provided.
- Tabletop Robot Stand
- Overall volume $\leq 4 \text{ ft}^3$ or $6,912 \text{ in}^3$
- No explosives/combustibles
- No lasers
- All batteries are sealed commercial batteries in good physical condition
- Batteries wired in series should be the same amp hour rating (ex. both 1500 mAh) and batteries in parallel are of same voltage (ex. both 12 volts).
- Batteries securely mounted
- Total voltage in any individual circuit does not exceed 24V
- No circuit **branch** exceeds 240W (Voltage x Fuse Current Rating, easily accessible)
- All circuits have a fuse or breaker (breakers must have **DC rating**) and all Fuses / Breakers must be readily accessible.
- Mandatory Pressure System Circuit Diagram provided.
- No Competitor-made or modified air pressure hardware being used.
- Only commercially manufactured Pressure Tanks (cylinders) can be used.
- Pressure indicator
- Pressure in tanks does not exceed 100 psi
- Over-pressure safety valve
- Pressure tanks and related gauges and controls are shielded from damage due to collisions
- Robot can be turned off with a single motion.** Radio receivers / Logic circuits may be independent of the kill switch.
- Control unit to support operator to robot communication are being used.
- Demonstration of robot functionality

Additional concerns:

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Robot Evaluator Signature

Team Representative Signature

24. Autonomous Competition Overview:

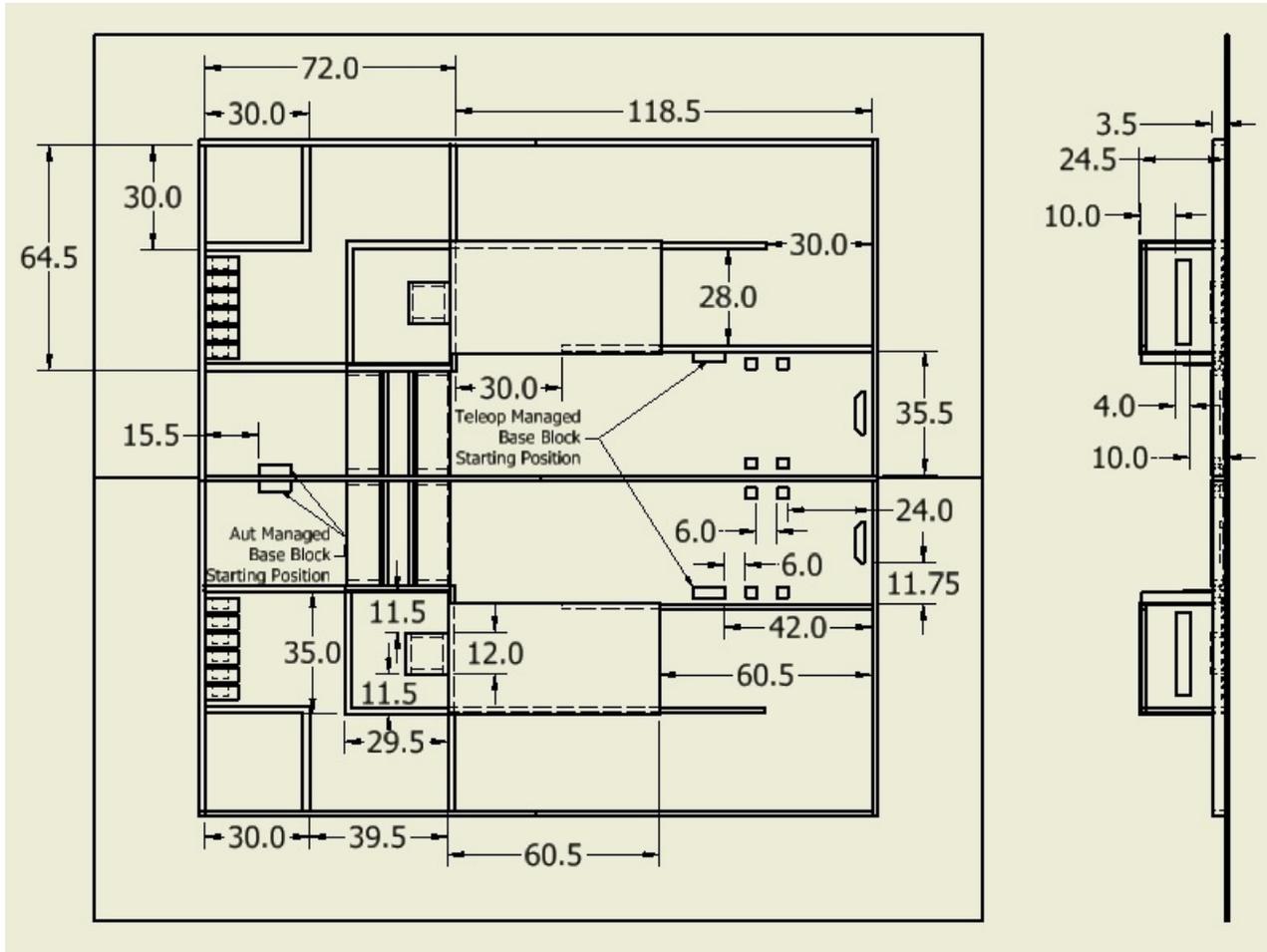
- Competitors will be provided, at no cost to the teams, with a kit distributed to them through their provincial/Territorial office.
- The autonomous robots must be disassembled on arrival.
- A description of the Competition Component Collection will be posted on the Skills/Compétences Canada Website.
- Competitors will demonstrate their robot's performance in a court to be defined at the Skill area.
- At the orientation meeting, Competitors will be told the specific Robot Behaviors their Built On-Site Robots need to complete.
- The suggested performance items listed below reflect the type of core isolated robot performance elements competitor robots will need to complete
 - Follow wall perimeter,
 - Navigate a maze,
 - Navigate around obstacles,
 - Follow a colored tape line on the floor,
 - Locate and touch an object
 - Pick up a small object and move it to a new location
- Competitors MUST understand the list above represents Samples ONLY and does not present a final or complete list of the potential robot behaviors they might be asked to create.
- Teams need to develop an understanding of the performance capabilities of ALL components in the Competition Collection and prepare to be able to use any of these components effectively.
- Competitors need to be prepared to go beyond the initial single stage performance requirements to multi-stage performance requirements as the culminating end of the competition experience.
- Build On-Site Autonomous Tasks Equipment: Competitors will be required to build their autonomous robot solutions using ONLY the contents of the provided to all teams 2020 Skills Canada Component Collection. If a Robot Component is not provided in the common to all 'Box of Component's' then it cannot be installed on the Competitor's Autonomous Robot.
- Teams will have time periods where they have shared access to the various Autonomous Performance Court Environments to conduct their Task Solution / Preparation Activities
- Teams will have a select number of Marked Attempts at each of the Autonomous Performance Tasks as time permits. The number of attempts will be predetermined at the start of the competition.

- Marked Autonomous Task Attempts will be conducted on a 'By the request of the Teams Basis with a requirement that Teams complete ALL Autonomous Task Preparation Activities by an announced at the start of the competition Fixed Time: Example: All Autonomous Task Preparation Activities must end by 3:45 PM on Competition Day 2.
- Team Marks will be based on their Best Performance out of their attempts.

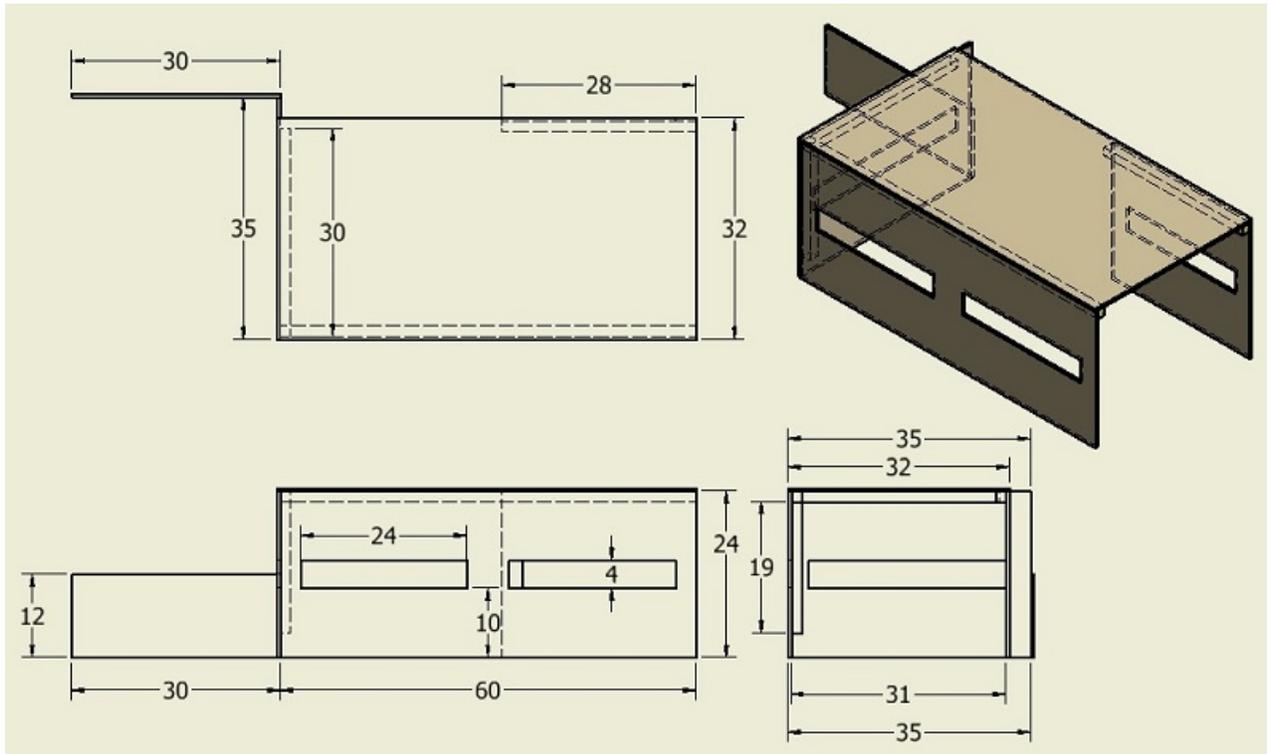
25. Exception List to “Only what is in the box”

- Laptop/Computer, mouse, and keyboard, power cord, usb cable, software drivers
- Sample code, Arduino IDE or similar program
- Measuring tape, allen keys, small wrench or pliers
- Paper, pen, pencil, calculator to record measurement
- Replacement parts for the originals ie. Cable ties
- Large and/or small storage containers

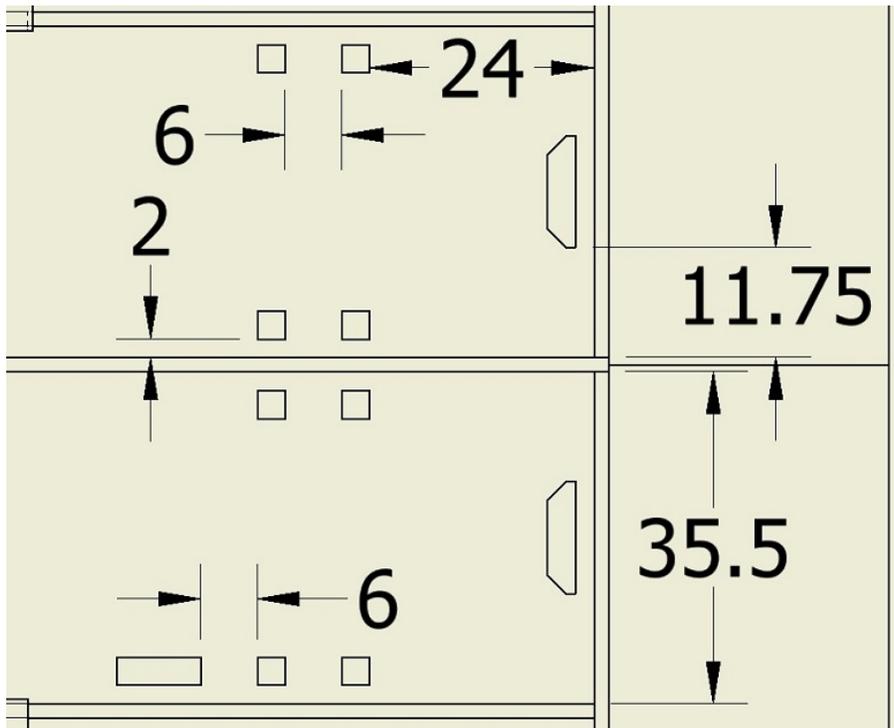
Totem Pole Court Layout Details



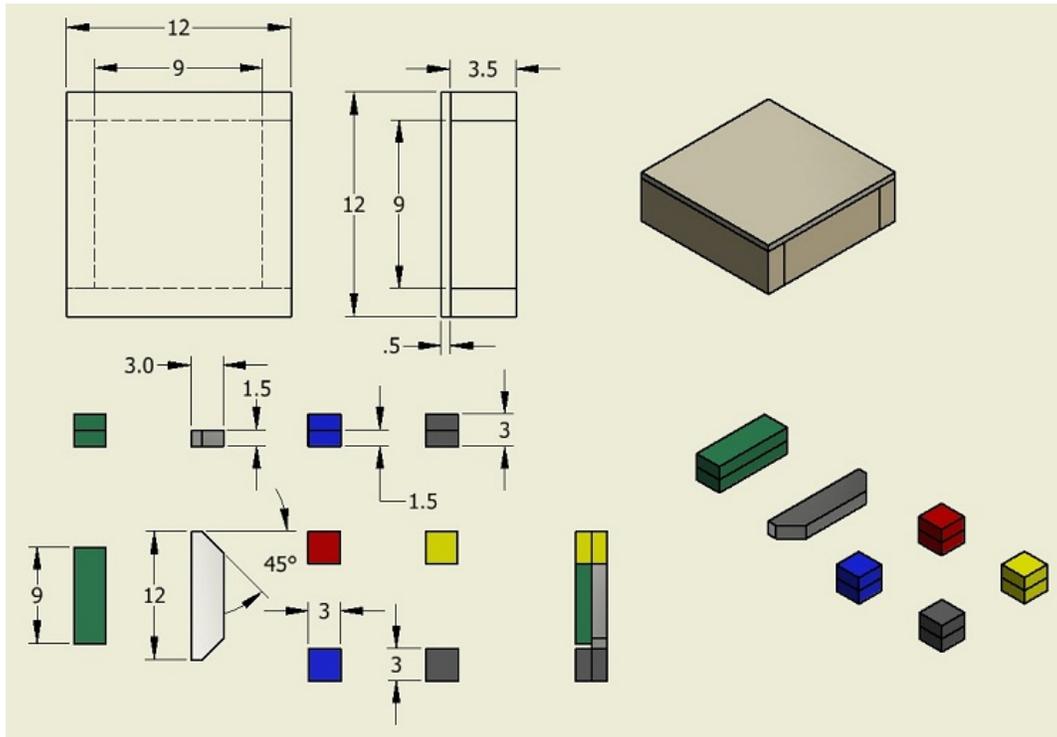
Passageway Tunnel Details



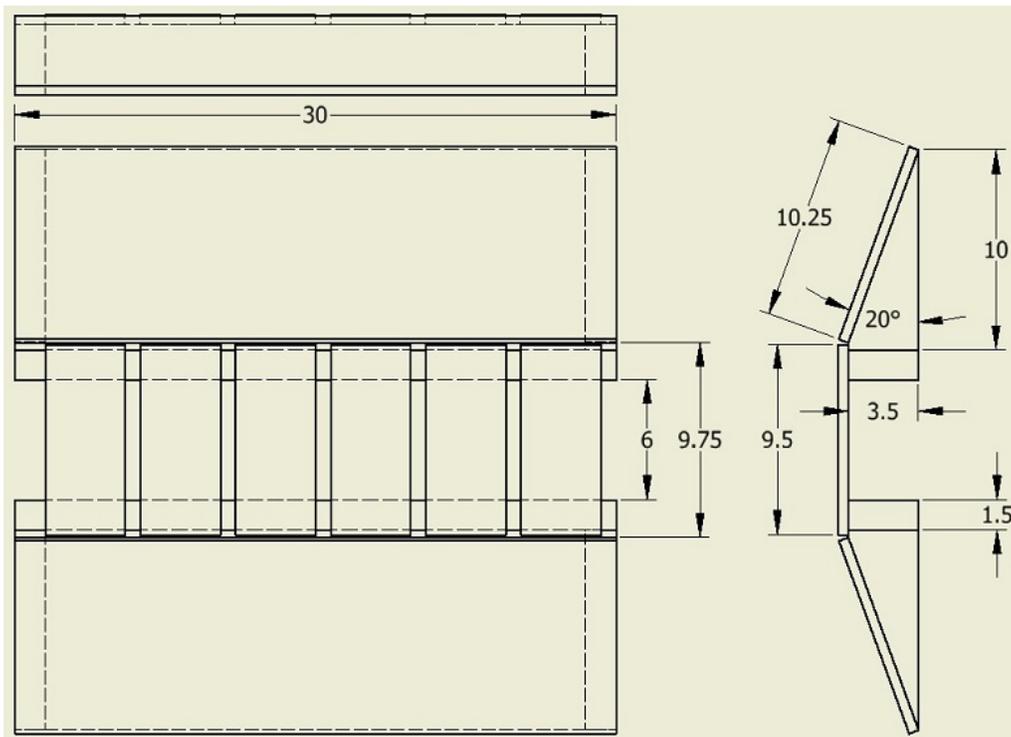
Totem Pole Components Source Area Details



Totem Pole Components and Assembly Stand Details



Bridge Support Structure Details



Bridge Plate Details

