There are three problems that must be addressed: span, overhang, and a roof joint. LionForce requests a design that will allow for a 20’ span across the living room, a 4-ft overhang around the windows to provide shade and reduce electricity costs, and an insulated wall-to-roof joint. The following decision table provides weights for several categories and ranks various design ideas according to how well they meet these criteria. This table does not provide just one design solution, however, because it incorporates solutions to all three problems in one table. The numbers can be used to compare ideas, but not to directly rule out an idea since they are not necessarily directly comparable.

Our categories are divided into: Cost, Environment, Aesthetics, Versatility, and Ease of Construction. Ease of Construction received the highest weighting because it is a major goal of our project to reduce construction cost and time. Our design will be useless if it cannot meet this constraint. Versatility means ability to solve multiple problems at once, since we have three separate problems of span, overhang, and the roof joint. Versatility also refers to the ability of the design to conform to different designs and adjust to varying circumstances. The high weight shows that versatility is valuable, since it reduces costs for the combined designs and is simpler. Cost received the next highest weighting because our design cannot be implemented if it costs too much. A main goal of the house we are contributing to is to be environmentally friendly. Therefore, the designs we produce should be consistent with this goal and reduce the amount of waste produced during the construction process. Aesthetics has the least weight because our design must first function well before being aesthetically pleasing. It is likely that the roof joint produced will not be visible to the homeowner after construction anyway. However, solutions to the span and overhang problems might be visible on the finished house, so aesthetics is included to ensure the design does not detract from house enough to drive potential homeowners away.
The costs of each design rank as follows, in ascending order: The wedge with extension was considered the least expensive because it would require the least material and it would not need any special modifications (e.g. the use of an expensive saw to cut through the material). The next design is the female and male interlocking members, for the same reasons as above, although it would require more material than the wedge. The aluminum fabricated wall-roof joint would also be fairly inexpensive because it would not require very much material, although the materials may be slightly more expensive than the previous two designs. The temporary extendable overhang would be more expensive than the preceding designs because it would require the implementation of a complex mechanical system to make it retractable. The trusses across the roof would be expensive because they would require a large amount of material. The double roof system would be the most expensive because it would require the overlapping of panels on the roof.

The temporary extendable overhang was deemed the most environmentally friendly because it would only require an extended overhang around the windows. The female and male interlocking members design would also be very environmentally friendly because it minimizes waste.
The wedge also minimizes the amount of waste in that it does not require a lot of material. The aluminum fabricated wall-roof joint would require cutting metal and would increase waste. The trusses would require a lot of material, so that design was given a low score. The double roof system was given the lowest score because it would be inefficient in transporting rainwater and collecting it.

Each design in the Aesthetics criteria was given the same ranking except for two designs. They ranged from 1 – 6, lowest – highest. Listed below are the explanations of results for the different designs. The aluminum fabricated wall-roof joint was given an aesthetic ranking of 5, because it is discrete. After construction it will blend in well with the walls and roof. Therefore the overall aesthetic appeal of the house will not be negatively affected by the aluminum fabricated wall-roof joint. The female & male interlocking members design was also given a 5 for the same reason. The truss design was given a ranking of 5 because it can either be hidden or displayed artistically. The wedge with extension design was also given a 5 because it is not visible. The double roof system design was given a ranking of 2, because it could be unattractive. The temporary extendable overhang design was given a ranking of 1, because it is an unusual design that might look odd, and out of place.

The trusses design would be easily pre-fabricated before reaching the site, so it was given the highest score. Each roof panel could still be installed in the exact same manner as the current LionForce home construction method. This is because the addition of a truss will probably have a minimal effect on the current roof panel shape. The fabricated roof wall joint, the female and male interlocking panels, and the wedge with extension designs would all be easily pre-fabricated. One construction problem for the wedge extension design is that there are separate pieces from the roof/wall panels. Construction time would greatly increase because the designs must be installed separately from the panels. As a result the female and male interlocking panel design was ranked 5th because the design requires no separate installation on site and may reduce on-site construction time when filling the air gap. The fabricated roof-wall joint and the wedge extension are fairly similar ideas that would be installed in a similar manner. The wedge would require less pre-fabrication construction and detailing, making its rank higher than the roof-wall joint. The double roof system received the lowest rank because the design almost doubles the amount of material needed for the roof panel system and must be installed as a separate piece on site. Installing the double panel would require the panel to be hoisted in the air for installation, making it difficult and potentially a safety hazard to install. A temporary extendable roof would potentially require the use of a mechanical system to retract it seasonally and require intensive factory fabrication, so it was given the lowest score. None of these designs have been tested.

The wedge extension received the highest ranking of all in versatility. Adding a wedge potentially solves all three design issues: it increases the overhang and span, it varies the roof pitch, and it fills the air gap. If designed properly, the installation of a wedge may fill the air gap at the top of the wall, while the extension from the wedge provides increased support for a lengthened overhang. Solving the overhang issue in many cases will also
increase the overall span. A central truss in the roof panel strengthens the roof system; increasing the run of the roof span, increasing possible pitch variation, and increasing overhang. Although it does not solve the issue of the air gap, the design can be implemented with multiple other designs that solve the air gap issue. This is due to the fact that the truss might not change the current roof panel design significantly. The fabricated wall-roof joint idea, similar to the wedge, is a small additional piece at the top of the wall that fills the air gap. However, it does not add much support for the roof span/overhang. The idea could still be used with the addition of one of the roof span solutions. The female and male interlocking panels follow the same logic as the fabricated roof wall joint, but rank lower because it would be more difficult to vary roof pitch with this design. The double roof system and the temporary extendable overhang only solve the overhang/span issue. The double roof design has the extra problem of supporting multiple roof panels, making it rank it the lowest.

The wedge extension plan, with a total of 500 points, scored the highest. This solution gained the most points in the versatility category, in which it was ranked the highest. This score means in large part that the idea would be easy to combine with other solutions in order to maximize the number of objectives that our final design meets. This makes it a very agreeable solution to the actual joint interface problem that Lionforce faces. The female-male interlocking members solution received the second-highest score overall. Although it lost points in versatility in comparison with the simple wedge and extension, this idea scored well in all other categories. If the wedge idea were to face difficulties during the design process, this could be a viable alternative. The last solution to the wall-to-roof joint—the fabricated joint made out of aluminum—lost points in both environment and ease of construction due to the nature of the materials required and the tedious design and manufacturing process that it would incur. Out of these options, it would seem at this point most optimal to combine the wedge solution with designs that may address the issues of span and overhang.

The temporary extendable overhang design would address only the issue of overhang length. This solution scored relatively low at 255 points, mainly due to low scores is versatility, aesthetics, and ease of construction with a mediocre score in cost. It does not seem like a plausible alternative at this point, but it did not score low enough to be ruled out for combination with other ideas. The most likely solution to both the span and overhang issues appears to be the truss network that would support the roof both inside and outside of the house. This solution scored well with 425 points and had a high score in versatility, meaning it would be easy to adjust to any specific house design and combine with a wall-to-roof joint solution.

The double roof system scored the lowest with only 100 points. This is not surprising as it scored low across the board with no ranking higher than 2 (6 being the best and highest). Much of this is due to the extensive resources in both material and labor that would be required to carry out this solution. However, this solution would address both the span and overhang issue if enacted.
The final design has not been chosen, as it will probably be a combination of the ideas discussed. This table will be used to draw additional conclusions during subsequent design meetings.