UBC School of Architecture

Directed Study:

the Chair

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to: Nick Scott

on: April 19, 2002.

The Design Challenge:

The project was initiated when the UBC School of Architecture was approached by various organizations within the university (including the sustainability and planning offices) in response to a situation requiring the removal and replacement of several hundred existing auditorium and classroom seats. Constructed largely of curved Baltic birch plywood, and using formed sheet steel connectors, it was felt that, though they no longer met the current requirements of the venues they occupied, their materials and construction were considered of high enough value that discarding them would be wasteful. A small team was established within the School of Architecture to investigate possible ways of "recycling" the seats, with the potential of a design being constructed and installed in future UBC buildings. The design problem was open ended, with no specific approaches being emphasized. There was, however, some indication that the university was interested in public seating as some form of product, which informed the direction that most of the team took in their design approaches…

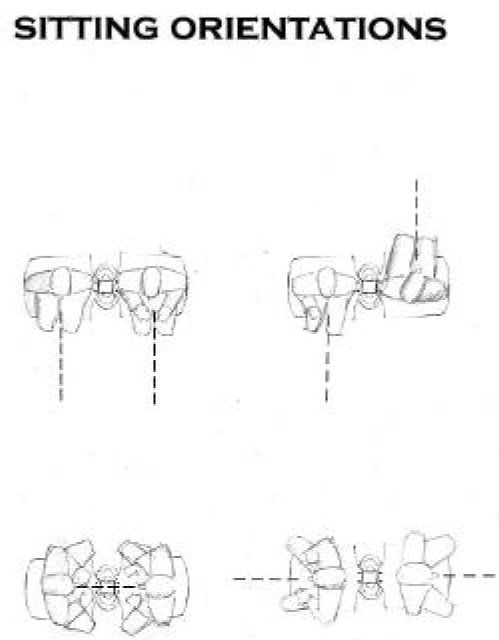
For the purposes of my exploration, I took the stance that as an installment in a university environment, it would be beneficial to give the "recycled" nature of the project some public exposure. As the raw materials are relatively distinct in character, I felt that re-using pieces particularly characteristic to the design of the original seats may help make the new product more identifiable as a "recycled" piece. Several strategies were initially explored, (including beam seating and light fixtures), with the final design being chosen on the basis of : a) meeting a seating requirement; b) having interesting but manageable design challenges; and c) being a more manageable scale to thoroughly investigate.

Proposal:

This proposal was based on the position that the laminated birch constituted the most valuable (due to current production costs) elements of the raw materials and should therefore directly inform the new product. In addition, it was felt that, though the steel could be ultimately recycled through industrial processes, the base was of some value both for its structural qualities, but also for its unique and identifiable form. As a piece of communicative value, it would make sense, then, that these pieces may be worth highlighting in some fashion. The position was also taken that it would be unrealistic to propose that all the replaced seating units would be devoted or recycled into a single type of final product. Given that, it did not seem critical to employ every component of the existing seats in a proposed final product at a 1 to 1 ratio.

The design position was also taken for this proposal that as a unit that could possibly be incorporated into new building facilities in some way, that an emphasis on aesthetics and design would supercede absolute cost effectiveness, given a relatively low volume.

The final product calls for a small, two-person sitting unit involving the coupling of two birch backrest pieces, mated to one steel base pedestal. It is felt that this assembly would be largely be suitable for areas that require more spontaneous, short-term seating. And since the significant wooden components create potential maintenance issues in outdoor climates, in addition to the relatively lightweight nature of its construction, it is felt that the product is best suited for areas indoors, or under cover of direct weather. Such areas may include building lobbies (such as in the Lasserre Building), or administration areas such as Brock Hall where large numbers of waiting people can be found. Covered outdoor smoking areas may also be suitable. Given the nature of the base, however, it requires the use of anchor bolts to fasten the unit down and provide a steady base. It therefore is perceived as a permanent installment.

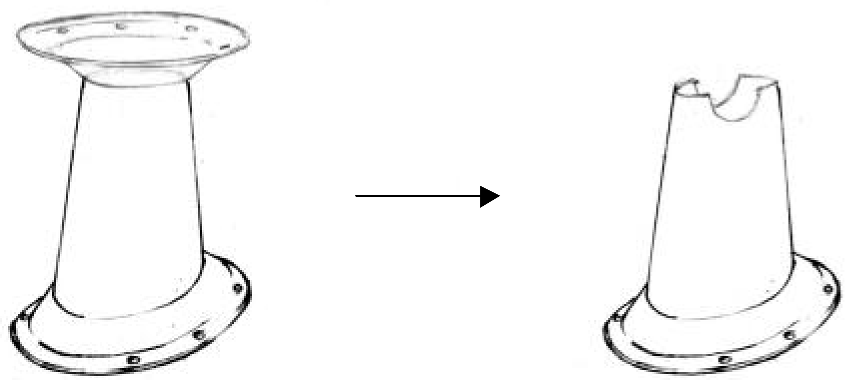


Due to the nature of the design, it allows for a range of seating positions and orientations, making an interesting contribution to the landscape of public space.

Construction:

One of the benefits of this configuration is that aside from the key pieces, the exact execution can be left open to modifications, depending on variables such as cost and aesthetic concerns. As this project constituted an initial level of exploration only into what possibilities might exist for recycling and no definitive guidelines or numbers were supplied to the team, I felt that leaving the execution of the design somewhat open-ended would be appropriate.

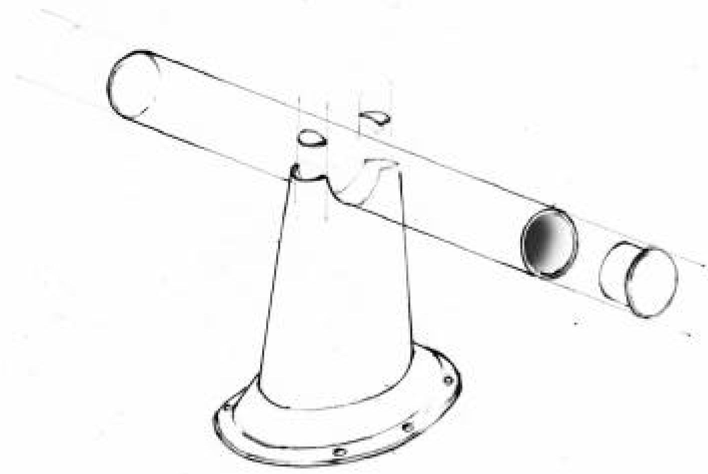
Stage 1: *Preparation*



Initial construction would involve the acquisition and preparation of the existing materials: the pedestal and two backrest plywood pieces. The pedestal would require modification to accommodate a transverse-mounted steel beam, as seen above. Various methods for performing this operation were considered, including CNC cutting, water-jet cutting, manually cutting with a hole-saw, etc. The primary factor in determining the most appropriate method would be dependant on numbers made, aesthetic quality and construction budget.

As it is felt that a proposal of this nature would likely be made in more limited quantities (perhaps 25 to 75), the initial investments required for creating jig assembly necessary for CNC or water-jet cutting may prove too costly (at $500 in labor per day, a jig may run between $1000 to $2000). Given that, however, the labor rate per unit would decrease due to the cost-effectiveness of the cutter (cuts may run to around $2 per unit), this would be a better method for higher-volume production. It was recommended that given the lower numbers of production that plasma-cutting would likely be the most cost-effective. Using a more rudimentary jig, smaller numbers could be cut without as costly an initial set-up (though with a slightly higher labor rate per unit). Disadvantages of this method would be the tolerances to which it could be cut, likely necessitating some secondary finishing (a modest, yet additional cost).

Stage 2: *Beam mounting*

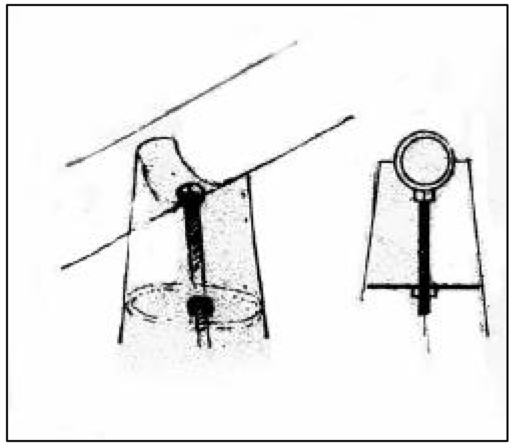


Following the preparation of the pedestal base, a (3" diameter, 1/8" wall) steel beam of approx. 27" in length forms the secondary support structure. It is not believed that any particular finish of steel is necessary (ie. galvanized, etc.) since, painted or left unfinished, it will not encounter significant moisture (if it is outside, undercover, some finish would likely be required). The approximate cost of the steel beam (tube) is relatively inexpensive (approx. $2.80 per linear foot, uncut (Rustan Metals)), with the labor component of cutting creating the primary cost. Two small, thin steel tabs would be required to cover the remaining gaps on the top of the pedestal, which could be inexpensively cut with CNC stamping, welded in place and finished. Likewise, end caps for the tube may be available as a plastic aftermarket product (from a specialized source) or could be steel caps welded in place.

Attachment of the beam to the pedestal structure is of importance. There are two possible methods, again depending on budget and aesthetic concerns:

a) The most straightforward method would involve TIG welding of the interface between the pedestal and beam along its length. This could be done relatively cheaply and cleanly, resulting an a visible, yet subtle weld. It would also be the method of choice it the pedestals were plasma cut, as the weld could fill discrepancies of fit between the two pieces.

b) However, if a cleaner, more minimalist look is required, then a possible solution to avoid TIG welding is using a post-tensioned system requiring a plug or anchor fitted within the pedestal, joined via threaded rod to a nut welded to the bottom of the tube. Overall strength may be compromised to some degree unless it is reinforced with TIG welding. This could be made very subtle, however, if no additional metal is added to the weld, giving it the appearance of a brazed joint (a very close initial fit would be required for this technique, however). Overall, this may prove to be the more costly of the two, especially with both an anchor and TIG.



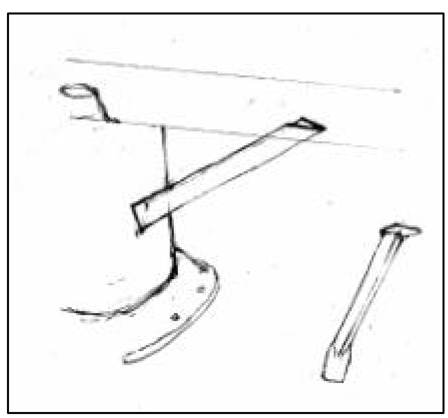
Stage 3: *Mounting support stays*

Given the expected loading on the beam, it's not expected that the pedestal and joint will be sufficient in resisting it. Therefore, an additional support structure is required. This could be constructed out of relatively thin-gauge steel rod, cut or bent and welded into place. This step is also perhaps the most variable in how it may be executed. Principle determinants in method adopted are again dependant on cost and aesthetics, but also on *structural capacity.* It may be necessary to physically construct and test the structural integrity of each method prior to volume fabrication.

Several designs were explored:

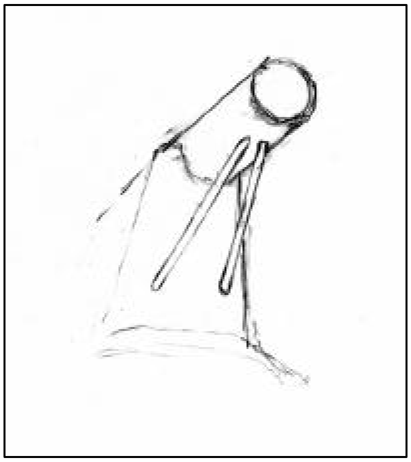
a) <u>V-channel support</u>

The initial approach, this consisted of a single, V-channel welded to both the beam and the pedestal. Though economical, concerns were addressed over aesthetic appeal, but the transfer of loading onto the side of the pedestal at a single, concentrated point. As the pedestal wall is fairly thin, caution must be used when adding side pressure to prevent buckling. Another iteration that helped reduce this somewhat was to stamp the ends of a thinner channel flat, creating a

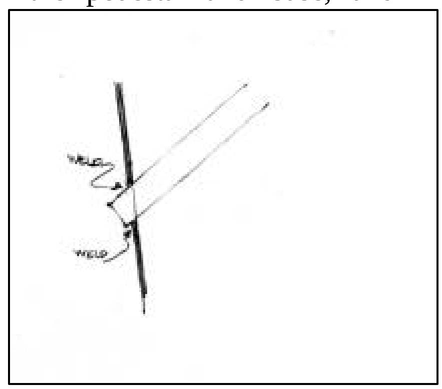


broader base which could facilitate welds further apart. This would require an extra step and the likelihood of a jig to perform the stamping.

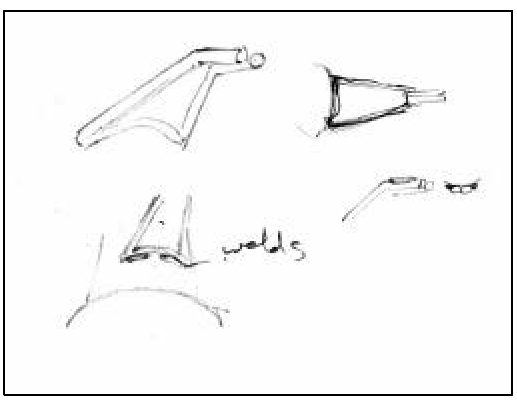
b) <u>Dual stay support</u>

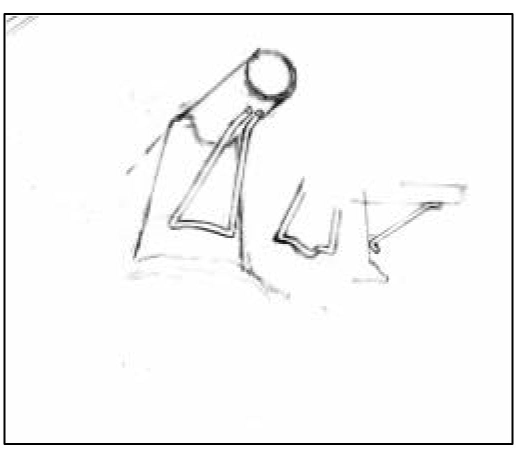


The next step in its evolution was the use of a dual support configuration, aimed at not only improving aesthetics, but distributing forces over a larger area across the base. Challenges presented by this iteration are the interface between the pedestal and base, and continued point loading issues. Again, the most obvious connection could be made with a TIG weld at the joint, performed cleanly, but could also be relatively easily done by penetrating the side of the pedestal and welding from behind, creating a cleaner joint.

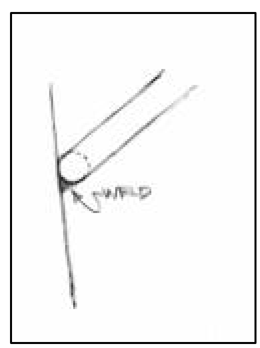


c) <u>Formed single rod</u>

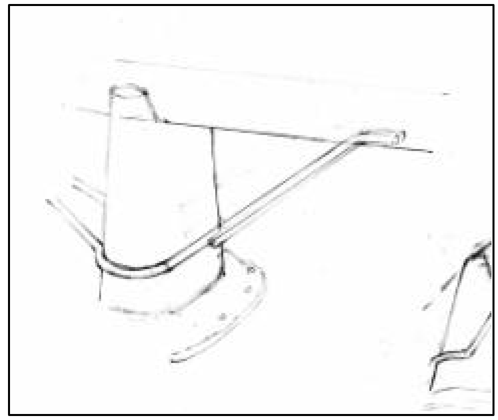




To alleviate the continued point – load concern, another strategy is to utilize a continuous steel rod formed to create a “saddle” of sorts, wrapping around the side of the pedestal. The ends could elegantly terminate in a parallel fashion and welded to the underside of the steel tube. For aesthetic reasons, welds could be made on the underside of the “saddle”, where they would be less visible. Such an area would be ideal if one were to finish the assembly in a two-tone paint scheme, avoiding a visibly messy welded junction between two differently finished pieces.

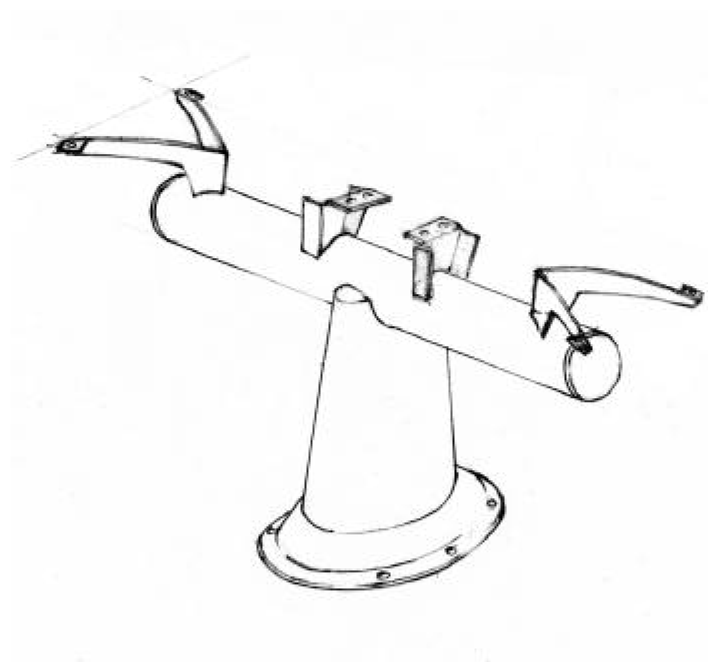


Another possibility would be to take advantage of the saddle and add a bit of a formal “accent” such as a knob that extends down and away from the pedestal. Again, it is an issue of cost, though once a jig is prepared (approx. $500-$750), the labor time per unit is quite inexpensive ($2-$5).

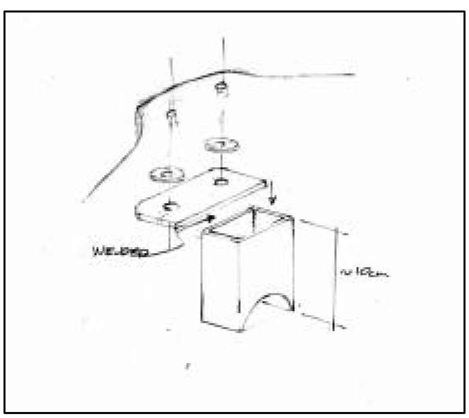


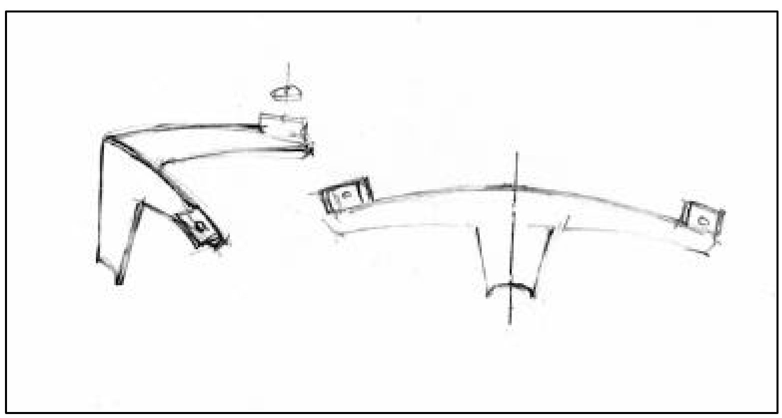
A final iteration of this should solve all point loading issues, yet suffers somewhat aesthetically. This involves the formation of two continuous support stays that extends from one side of the beam to the other, wrapping around the base. This would essentially allow a much greater point of contact, with the opportunity for a continuous weld around the base. Overall cost should not differ from that mentioned above, as the process of manufacture is roughly the same.

Stage 4: *Seat mounts*

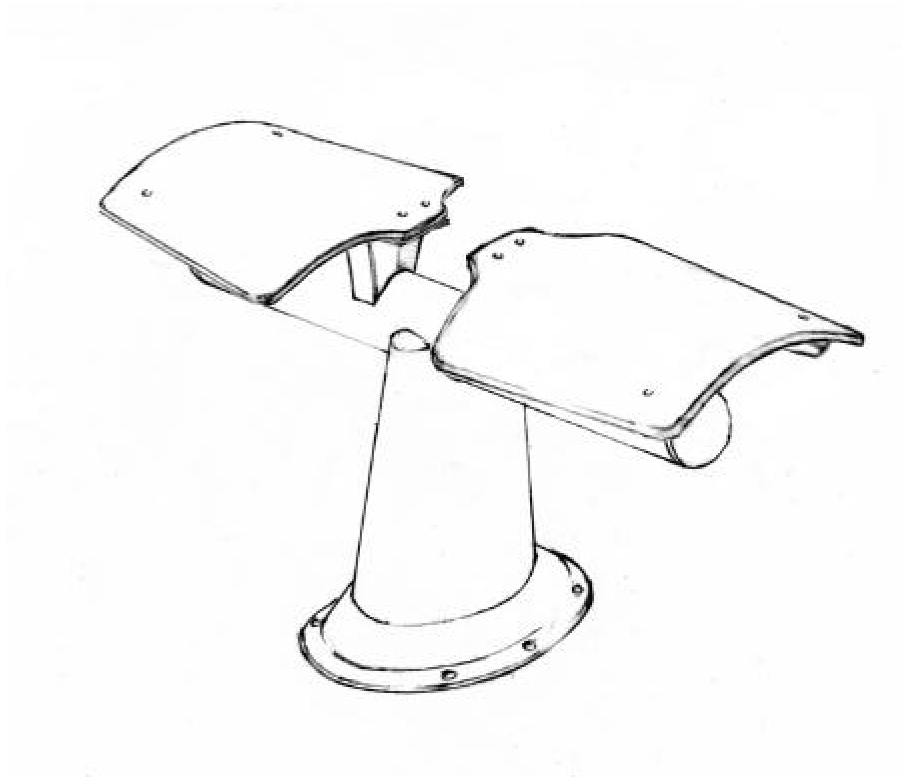


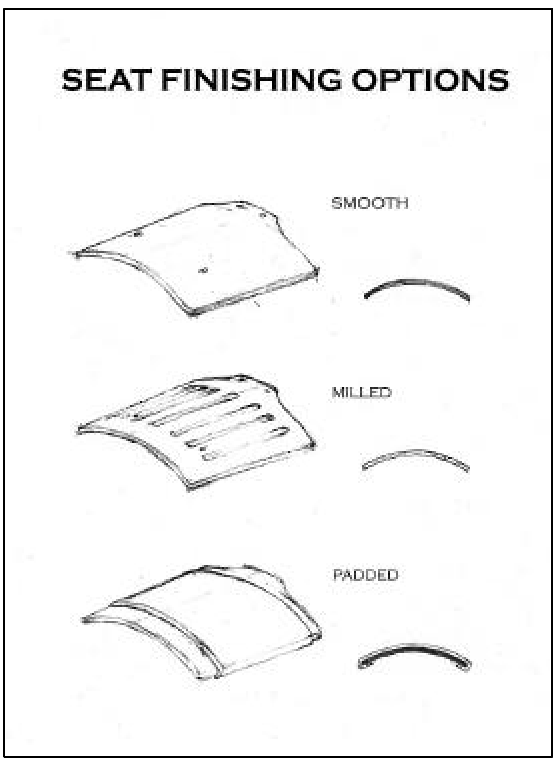
The following stage involves the fabrication and mounting of the final supports for the seat pieces. Though initially it was felt that they could be CNC stamped and folded, limitations to the thickness of metal which could be CNC stamped may necessitate water-jet cutting as a more viable method. Again, as an automated process, once an electronic pattern is produced, the labor is relatively inexpensive. Further refinement of the mounts led to a modified design for the inboard elements, resulting in each consisting a single cut section of rectangular tubing (approx 1/8" wall), with a relief cut for the beam made by a hole saw. This would simplify the construction process by not necessitating additional folding of potentially thick steel, as the horizontal plate would likely need to be ¼". In this way, the horizontal plate could be cut and welded on. All mounts would then be TIG welded onto the beam.





Stage 5:
Mounting plywood seats





The final stage of fabrication is the finishing and mounting of the seat panels. As they have been salvaged, they will likely necessitate stripping off (by sanding) the existing layer of varnish and refinishing. Again, remaining consistent with the notion of this furniture item representing its recycled heritage, I do not feel it particularly necessary to hide previous holes or marks entirely, but to clean up to a degree that it looks tidy. Four of the existing drilled holes would be reused for mounting, with others putty-filled. There are several treatments that could be performed on the surface, depending on the expected usage and context in which they are placed. Possibilities include simple refinishing with new lacquer, the addition of a thin, padded strip for slightly longer-term or more comfortable seating, or even CNC milling, adding the potential for more aesthetic flair.

Reflection:

When we were initially approached with the problem facing the removal and possible destruction of auditorium seats, the problem posed was an interesting and engaging one. However, it soon became clear that there was no overall strategy informing our directions or decision making, and we were left on our own to develop this. Though it definitely helped us become aware of the role designers face when approaching such tasks, it would have been more beneficial for all parties concerned had their been a more developed approach. However, being the first venture of its kind involving this problem, this is not entirely unexpected. As with most things such solutions must evolve, and as possibilities emerge, objectives gel, and the process evolves.

In response to concerns that we were not addressing the challenges of the problem adequately (as came up during a guest review), it should be noted that given the issues that were (or weren't) established in the beginning of the course (the nature of the final product), an early lack of materials to work with, in addition to an initial bias towards public seating, our approaches what we deemed to be an objective of the course.

Despite these, this has been an extremely valuable course, and has opened our eyes to the realities behind design, something we're exposed to far too seldom in our design-oriented schooling. I would definitely suggest that the course be offered in the future, and with some time, could develop very rigorous and specific objectives that would benefit any who dare to engage with them…

I would like to extend my thanks to all parties involved, with special mention to Toby and Rob at Toby's Cycles and Metalwork, and Steve Costa at Cana Brass for their experience, enthusiasm and time.