LINEAR BOOK SCANNER

Gérard Tolboom Contribution
to fine tune DanyQ's 1st Prototype
Oct-Nov 2013

Summary

Reminder

- 1st Prototype, done by DanyQ, end of Sept 2013, as a base of work
- this equipment has a 60° apex structure, with tefloned alu sheets
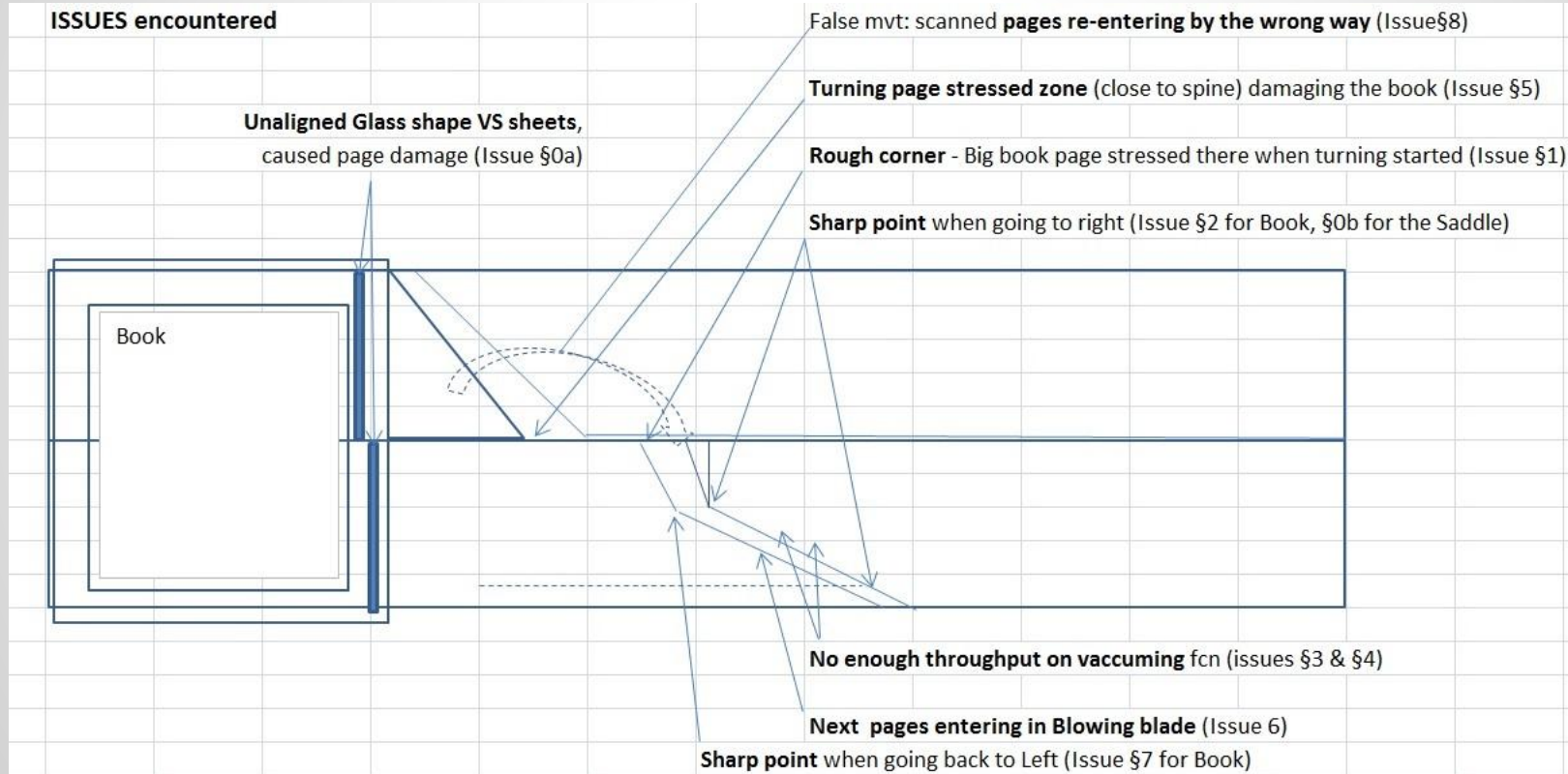- So far quality results (until shipment) were shared

Goals

- Keep the structure as it is, and implement reversible modifications
- Focus on mechanical impacting issues
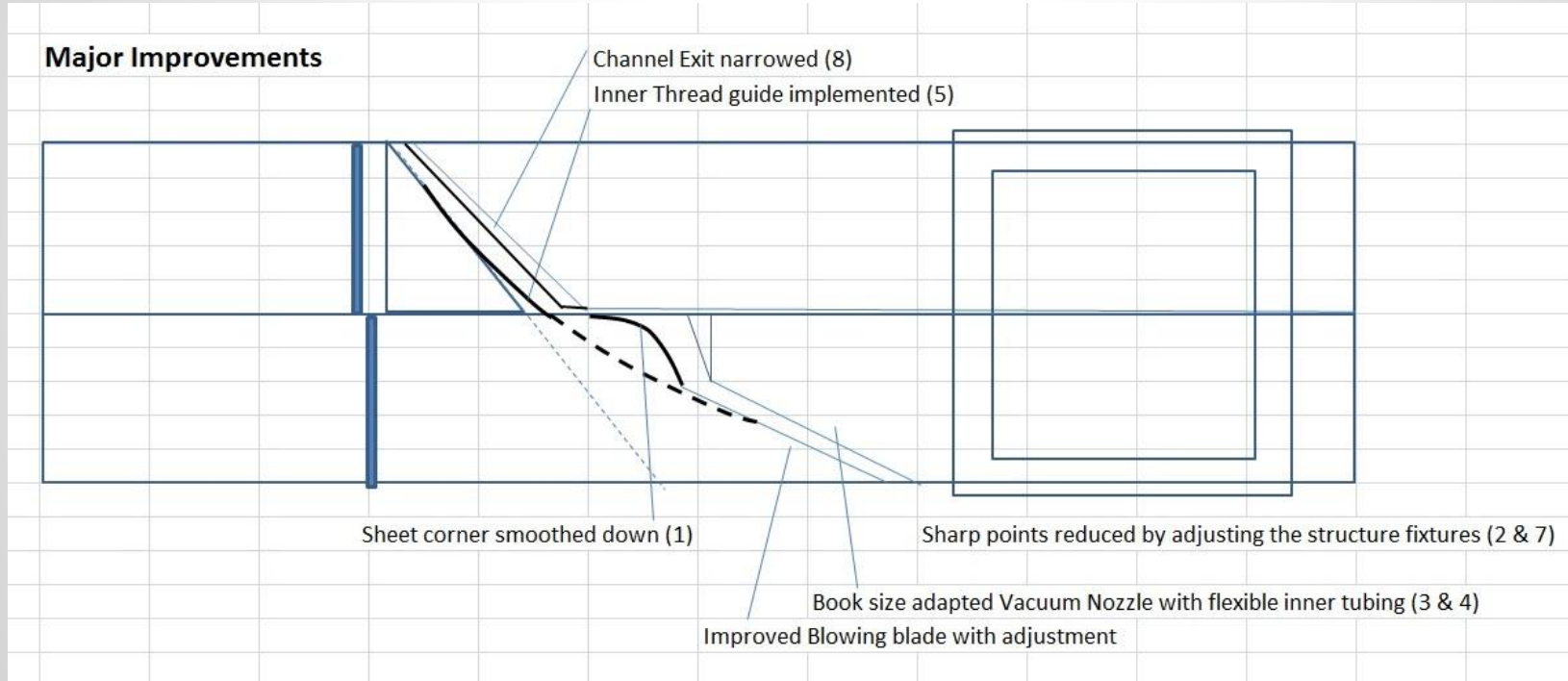- Keep in mind, minimum costing improvements

Methodology

- Reassemble the machine
- Launch mechanical testing cycles
  - Have it work, again and again, and understand root causes of book damages
  - Record them, (shared spreadsheet available)
  - Solve issues with
    - Immediate, temporal solutions
    - more long term, costless, (innovative) solutions

- Start Function analysis and step by step troubleshoot

Summary of encountered Issues

ISSUES encountered

False mvt: scanned **pages re-entering by the wrong way** (Issue §8)

Turning page stressed zone (close to spine) damaging the book (Issue §5)

Unaligned Glass shape VS sheets, caused page damage (Issue §0a)

Rough corner - Big book page stressed there when turning started (Issue §1)

Sharp point when going to right (Issue §2 for Book, §0b for the Saddle)

Book

No enough throughput on vaccuming fcn (issues §3 & §4)

Next pages entering in Blowing blade (Issue 6)

Sharp point when going back to Left (Issue §7 for Book)

Major Improvements done

Function development

Saddle cycle

Book cycle (general)

Page turning cycle

      Page capture

      Page selection (only one at a time)

      Page exit

Calibration

Function devt > Saddle cycle

- No modification done there. all fine
- Movement accidents were minimized by
  - adjusting fasteners on the sheets onto the base (a useful tool for that is a long aluminium ruler to check what shocks might occur and reduce the height variation from one part of the shape to the next one)
  - A tip, provided by Jeff, is to let the book a bit flexible within the saddle fixtures so that the 2 "systems" self adapt with variations, without blockage and/or torn pages.
- Eventually, changed it for the white plastic -available- model : better in Calibration step (no more vertical stripes, better white/color pages)

Function devt > Saddle cycle

Function analysis > Book Cycle

Around 2000 cycles achieved, and still learning!

- 8 types of issues identified
- Each one, more or less influenced by book size, weight, material condition
  - Pressure (or lack of) on set of pages "in contact" with the machine, due to
    - Book number of pages > Weight (from 0,6 Kg...to 1,1, and more?)
    - Moving weight, from one side (not scanned yet) to the other one!

      especially affecting outcome at start & end of cycles
  - Book prior bent blocks/pages, and page rigidity

to be confronted with designed solutions (air vacuumed and air blowed limits of effect)

Book movements

no -physical- hurting area should be met during the cycle

featuring *Torn Pages issues*

- this brought to engineer better fasteners (external fasteners for all sheets)
- book guidance was smoothed (since big books blocked on the ramp)
- internal parts adjustment was -still is- a tricky operation, and should bring to further design slight modification

Book movements

Page turning cycle > Catching function

Drawbacks: too much leaks, and losses, not enough focused on the page corner, featuring : *Duplicates issues*

- Local zone vacuuming Head/nozzle was designed

  sliding in rails and moved by an external handle (no set-up, nor any dismantling)

- Major gain : Efficiency improvement,
- Complementary gain : less power requested, thus less noise and temp. elevation in the closed room :)
- Quality : Each size of book properly picked up > Cycles should be finished correctly (last set of pages captured, for all book sizes)

Catching page function features (½)

Local Nozzle

- focusing the vacuuming power to the page corner area
- feature position adjusted to book size corner area through an external handle

Catching page function features (2/2)

Rear view :

- Flexible tubing (and reduced diameter)
- Openings made in alu bent fixture

- Movable nozzle (sliding in rails)
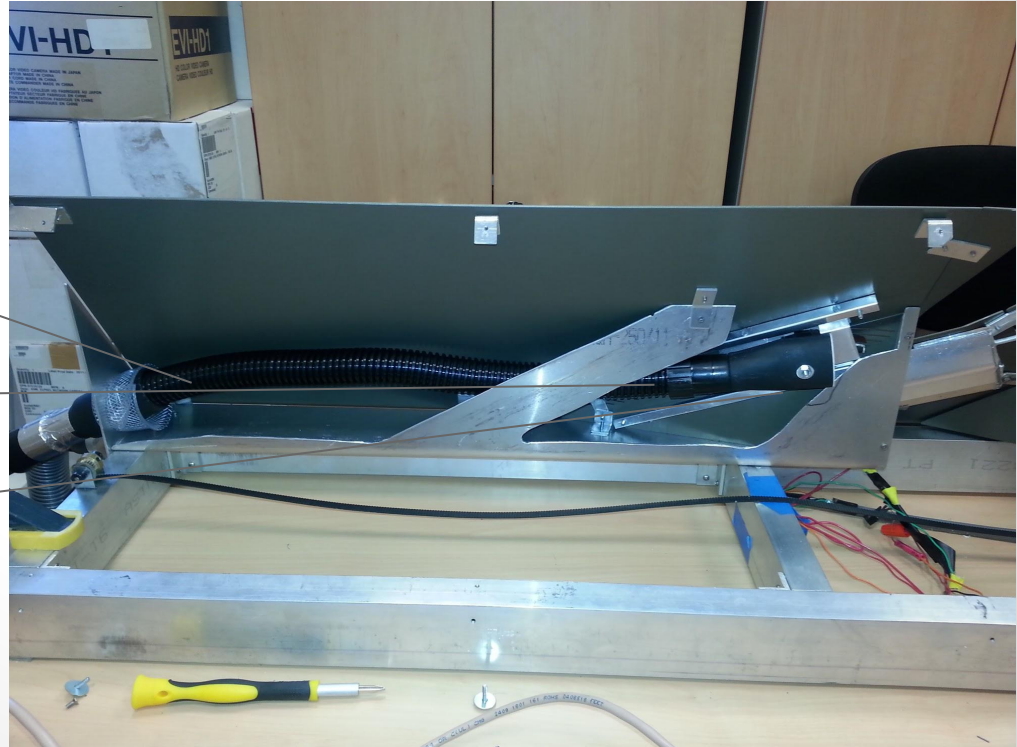
Page turning cycle > channelling function

Issue : Turning page reaches this "corner" (since area close to spine often blocks there and let the book damaged)

Solution for the page is to follow the new rail, and to get the spine of the book less stressed

Channelling function

alu rail
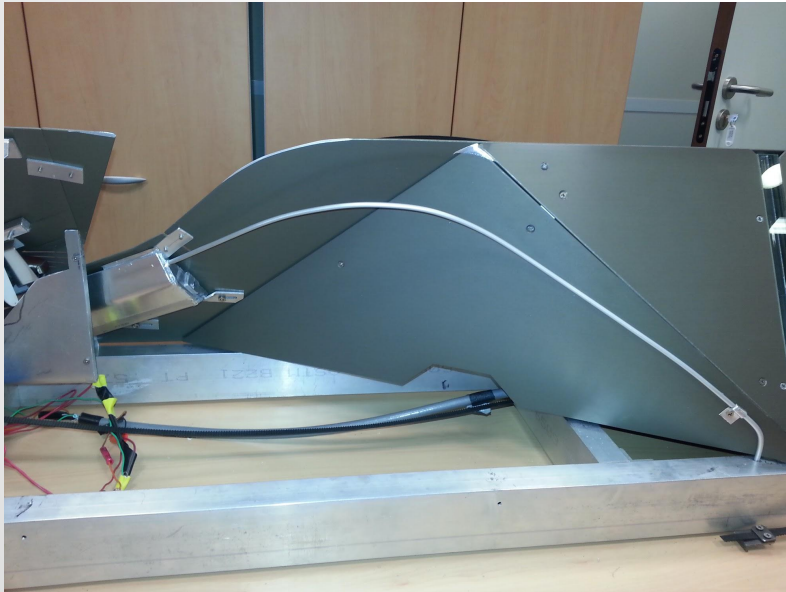
Page selection function (Goal : only one at a time)

featuring *Missing Pages issue*

- Leaks reduced or cancelled
- Flow directed to a narrow blade, only 3 mm width, and adjusted outside of any hazardous page cycle (2nd, 3rd one could enter there)
- fixed solution

Page exit channel

Space had to be reduced since book pages re-entered by this way.

- 1st trial was not enough with big book scanned part weighting down the sliding pages
- 2nd add was done on last runs. seems to work.

  (modification of the machine 'll consist in let the sheet slide on same distance to come closer)

Outcome : quick cycle video

2 little videos there :

https://www.youtube.com/watch?v=ZS_6nYnXWvs

https://www.youtube.com/watch?v=ZnKRGJRGqZs

- Focused Vacuuming zone sub system
- Guiding page alu thread until channel exit
- Enhanced effect blowing blade
- New structure fasteners (more freeness in positionning)
- Avoiding re-entering solution through exit channel
- New (white) saddle adoption

Results (1 / 2)
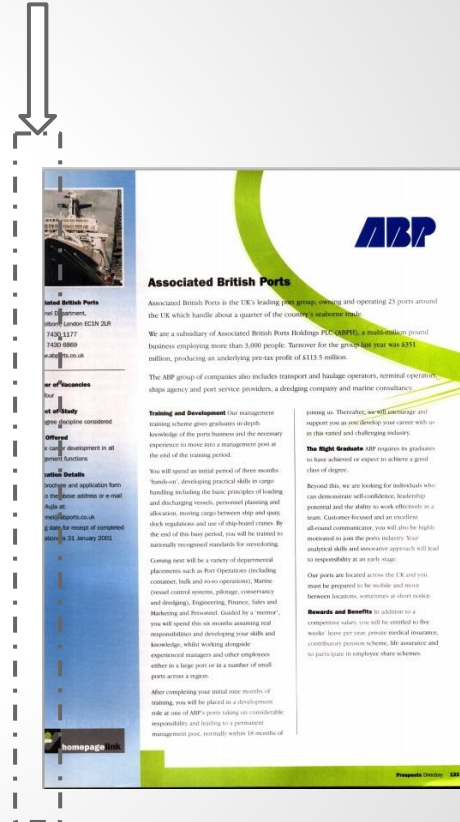
Until Nov 20th : only mech tests were conducted
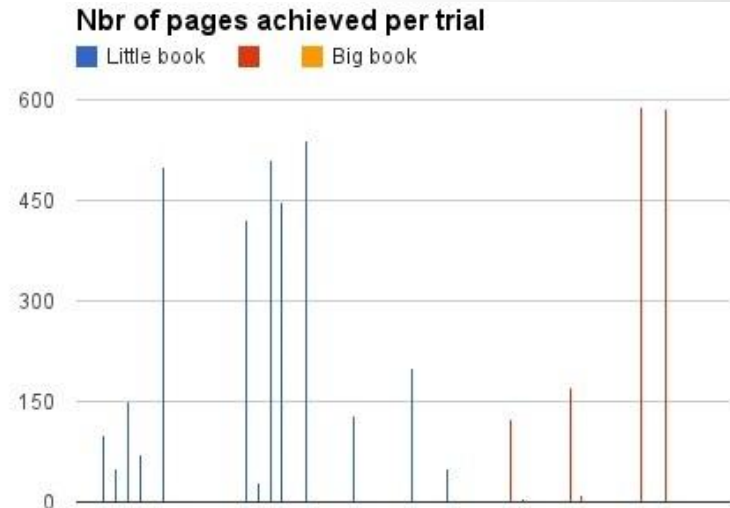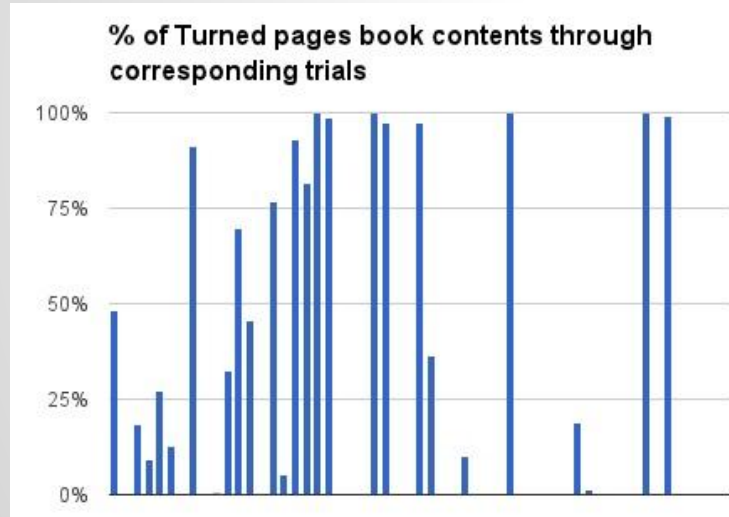
Results (2 / 2)

As of Nov 20th :

 1st books scanned !

- Calibration seems ok

- Gutter / central crop
    won't be addressed
    with this prototype
     configuration   :)

Challenges

- Next step : scan in mass prod conditions,
- Through continuous improvement, troubleshoot relevant issues
- Suggest "serial" design and assembly instructions,

Q&A

Questions welcomed !