

# The `flushend` package

Sigitas Tolušis  
`sigitas@vtex.lt`

v3.2 from 2016/06/21

## 1 Introduction

The package is used to balance columns on any page in twocolumn mode. By default it is switched on at the end of document. It is expected to work with footnotes, top floats and column break before one line section title.

## 2 Usage

Just load the package to balance the last page: that's all. To balance some page in middle of document use command `\flushcolsend` at that page.

<code>\flushend</code>	This macro switches on column balancing on the last page. It is used by default.
<code>\raggedend</code>	This macro switches off column balancing on the last page.
<code>\flushcolsend</code>	This macro switches on column balancing on the current page.
<code>\raggedcolsend</code>	This macro switches off column balancing on the current page.
<code>\atColsBreak</code>	<code>{\tokens}</code> Adds <code>\tokens</code> in place of the original column break (made without balancing). <i>Example:</i> <code>\atColsBreak{\vskip-2pt}</code>
<code>\atColsEnd</code>	<code>{\tokens}</code> Adds <code>\tokens</code> at the end of right column. <i>Example:</i> <code>\atColsEnd{\vfil}</code> .
<code>\showcolsendrule</code>	It can be used just for debugging: adds rule to the bottom of columns.

## 2.1 Package options

<code>ancient</code>	It is used to switch on old version of balancing algorithm.
<code>modern</code>	It is used to switch on new version of balancing algorithm.
<code>autobase</code>	It is used to guess <code>\baselineskip</code> value on original columns break. On failure just use <code>\atColsBreak{...}</code> .
<code>noautobase</code>	It is used to switch off the previous option behaviour.
<code>spread</code>	It adds extra glue to the rightcolumn trying to balance.
<code>nospread</code>	It skips adding extra glue to the last column.
<code>removelastbox</code>	It tries to remove an empty box (some more material) from the last column bottom.
<code>keeplastbox</code>	It skips removing anything from the last column.
<code>debug</code>	Adds rules to the bottom of columns (just for debugging) and leftcolumn break place. Adds some additional log info.
<code>nodebug</code>	Skips putting debugging lines.

## 3 Implementation

```

1 \newif\if@auto@baselineskip \@auto@baselineskiptrue
2 \newif\if@ancient@balance@version \@ancient@balance@versionfalse
3 \newif\if@right@column@spread \@right@column@spreadtrue
4 \newif\if@remove@lastbox@at@balancing \@remove@lastbox@at@balancingtrue
5 \newif\if@balance@debug \@balance@debugfalse
6 \DeclareOption{autobase}{\global\@auto@baselineskiptrue}
7 \DeclareOption{noautobase}{\global\@auto@baselineskipfalse}
8 \DeclareOption{ancient}{\global\@ancient@balance@versiontrue}
9 \DeclareOption{modern}{\global\@ancient@balance@versionfalse}
10 \DeclareOption{spread}{\global\@right@column@spreadtrue}
11 \DeclareOption{nospread}{\global\@right@column@spreadfalse}
12 \DeclareOption{removelastbox}{\global\@remove@lastbox@at@balancingtrue}
13 \DeclareOption{keeplastbox}{\global\@remove@lastbox@at@balancingfalse}
14 \DeclareOption{debug}{\global\@balance@debugtrue}
15 \DeclareOption{nodebug}{\global\@balance@debugfalse}
16 \ProcessOptions

17 \newskip\flushend@@lastskip@a
18 \newskip\flushend@@lastskip@b
19 \newskip\flushend@@lastskip@c
20 \newcount\flushend@@penalty@a
21 \newdimen\flushend@@lastkern@a
22 \newdimen\var@@temp@spread
23 \newdimen\var@@temp@a
24 \def\top@@skip@@limit{.7\topskip}

```

```

25 \newdimen\flushend@@page@rule \flushend@@page@rule\z@
26 \def\showcolsendrule{\global\flushend@@page@rule=.4pt}

\top@@floatbox@min {\float size} This value is used to catch possible float on right column top.
27 \gdef\top@@floatbox@min{4\topskip}

28 \newbox\flushend@@varbox@a
29 \newbox\flushend@@varbox@c
30 \newbox\flushend@@tempbox@a
31 \newbox\flushend@@tempbox@c
32 \@ifundefined{@viper}{\newbox\@viper}{}
33 \@ifundefined{hold@viper}{\newbox\hold@viper}{}

34 \newtoks\atColsBreak \atColsBreak={}
35 \newtoks\atColsEnd \atColsEnd={}

36 \@ifundefined{fmt@box@adds}{\def\fmt@box@adds#1{#1}}{}
37 \@ifundefined{fmt@vbox@adds}{\def\fmt@vbox@adds[#1]#2{#2}}{}

```

`\remove@lastbox@at@balancing` It is used to remove empty box at the right column end.

```

38 \def\unskip@three@kern@penalty{%
39   \unskip\unkern\unpenalty
40   \unskip\unkern\unpenalty
41   \unskip\unkern\unpenalty
42 }
43 \gdef\remove@lastbox@at@balancing{%
44   \unskip@three@kern@penalty
45   \if@remove@lastbox@at@balancing
46   \else
47     \expandafter\null
48   \fi
49   \bgroup
50     \setbox\z@\lastbox
51     \ifdim\wd\z@>\z@
52       \box\z@
53     \else
54       \aftergroup\unskip@three@kern@penalty
55     \fi
56   \egroup
57 }

```

Macros used in debug mode.

```

58 \def\show@@box#1{%
59   \bgroup
60     \showboxbreadth=20000\showboxdepth=20000%
61     \showbox#1\relax
62   \egroup
63 }
64 \def\wlog@balance@debug#1{\if@balance@debug \wlog{#1}\fi}
65 \def\log@box@info#1{<box\the#1>(\the\ht#1+\the\dp#1)x\the\wd#1}
66 \let\show@@box@next\@gobble

```

To get more or less proper result we need to know about footnotes at the left column end, top floats at the right column top, skips and so on. This part of the package is responsible for such analysis.

```

67 \gdef\analyze@lastbox@box#1{%
68   \setbox\flushend@@varbox@a\vbox{%
69     \unvbox#1%
70     \global\flushend@@lastskip@a\lastskip
71     \unskip
72     \global\var@@temp@a\lastkern
73     \unkern
74     \global\flushend@@penalty@a\lastpenalty
75     \unpenalty
76     \ifdim\lastskip>\z@
77       \global\flushend@@lastskip@a\lastskip
78     \fi
79     \unskip
80     \ifdim\lastkern>\z@
81       \global\var@@temp@a\lastkern
82     \fi
83     \unkern
84     \ifnum\lastpenalty>\z@
85       \global\flushend@@penalty@a\lastpenalty
86     \fi
87     \unpenalty
88     \global\setbox\flushend@@tempbox@a\lastbox
89   }%
90   \wlog@balance@debug{^^J::analyze@lastbox@box::\log@box@info{#1}%
91     ^^J::unvbox: \log@box@info{\flushend@@varbox@a}%
92     ^^J::lastbox: \log@box@info{\flushend@@tempbox@a}%
93     ^^J::lastskip: \the\flushend@@lastskip@a;
94     lastkern: \the\var@@temp@a;
95     lastpenalty: \the\flushend@@penalty@a
96   }%
97 }

```

\analyze@leftcolumn@box  $\{(\textit{box})\}$

```

98 \gdef\analyze@leftcolumn@box#1{%
99   \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
100   \flushend@@lastskip@b\ht#1%
101   \wlog@balance@debug{^^Jmainbox: \log@box@info{#1}}%
102   \setbox\flushend@@varbox@a\vbox{%
103     \unvbox#1%
104     \global\flushend@@lastskip@a\lastskip
105     \unskip
106     \global\flushend@@lastkern@a\lastkern
107     \unkern
108     \global\flushend@@penalty@a\lastpenalty
109     \unpenalty
110     \global\setbox\flushend@@tempbox@a\lastbox

```

```

111     }%
112 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
113 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@a
114 \wlog@balance@debug{.-box: \log@box@info{\flushend@@varbox@a}%
115   ^^J.-lastbox: \log@box@info{\flushend@@tempbox@a}%
116   ^^J.-lastskip: \the\flushend@@lastskip@a;
117     lastkern: \the\flushend@@lastkern@a;
118     lastpenalty: \the\flushend@@penalty@a
119   ^^J.-diff: \the\flushend@@lastskip@b
120 }%
121 \check@@footnoterule@@box\flushend@@tempbox@a\flushend@@lastskip@b\flushend@@varbox@a
122 \check@@baselineskip@@skip\flushend@@lastskip@a\flushend@@lastskip@b\flushend@@lastskip@c
123 \ifvoid\flushend@@tempbox@a
124   \ifdim\ht\flushend@@varbox@a>\topskip
125     \flushend@@lastskip@b\ht\flushend@@varbox@a
126     \var@@temp@a\ht\flushend@@varbox@a
127     \loop
128       \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
129       \ifvoid\flushend@@varbox@a
130         \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
131         \advance \var@@temp@a -3\p@
132       \else
133         \var@@temp@a=-1\p@
134       \fi
135   \ifdim \var@@temp@a>\z@
136     \repeat
137       \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@varbox@a}%
138       \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
139       \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
140       \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
141       \wlog@balance@debug{.--box: \log@box@info{\flushend@@tempbox@c}%
142         ^^J.--lastbox: \log@box@info{\flushend@@varbox@a}%
143         ^^J.--diff: \the\flushend@@lastskip@b}%
144       \check@@footnoterule@@box\flushend@@varbox@a\flushend@@lastskip@b
145       \flushend@@tempbox@c
146       \check@@baselineskip@@skip\flushend@@lastskip@a\flushend@@lastskip@b
147       \flushend@@lastskip@c
148       \ifdim\ht\flushend@@varbox@a>.5\topskip
149         \analyze@lastbox@box\flushend@@varbox@a
150       \fi
151       \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
152     \else
153       \wlog@balance@debug{lastbox: \log@box@info{\flushend@@varbox@a}}%
154     \fi
155   \fi
156 \ifdim\ht\flushend@@varbox@a>\topskip
157   \expandafter\analyze@leftcolumn@box\expandafter\flushend@@varbox@a
158 \fi
159 }

```

```

\get@@footnoterule@@box
160 \def\get@@footnoterule@@box{%
161     \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
162     \setbox\flushend@@varbox@a\vbox{\strut
163         \vskip\z@
164         \footnoterule
165         \unskip\unkern\unpenalty
166         \unskip\unkern\unpenalty
167     }%
168     \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\ht\strutbox
169     \xdef\footnoterule@@box@@ht{\the\ht\flushend@@varbox@a}%
170     \xdef\footnoterule@@box@@dp{\the\dp\flushend@@varbox@a}%
171     \xdef\footnoterule@@box@@wd{\the\wd\flushend@@varbox@a}%
172     \wlog@balance@debug{:footnoterule: \log@box@info{\flushend@@varbox@a}}%
173 }

\check@@footnoterule@@box {\langle box\rangle}{\langle skip\rangle}{\langle box\rangle}
174 \def\check@@footnoterule@@box#1#2#3{%
175     \ifdim\ht#1=\footnoterule@@box@@ht
176     \ifdim\dp#1=\footnoterule@@box@@dp
177     \ifdim\wd#1=\footnoterule@@box@@wd
178     \ifdim#2>\topskip
179     \xdef\main@box@height{\the\ht#3}%
180     \xdef\main@box@skip{\the#2}%
181     \fi
182     \fi
183     \fi
184     \fi
185 }

\check@@baselineskip@@skip {\langle dimension\rangle}{\langle dimension\rangle}{\langle var\rangle}
186 \def\check@@baselineskip@@skip#1#2#3{%
187     \ifdim#1>\z@
188     \ifdim#2>\z@
189     \global#3=\the#1%
190     \gdef\check@@baselineskip@@skip##1##2##3{%
191         \fi
192     \fi
193 }

\analyze@rightcolumn@box {\langle box\rangle}
194 \def\analyze@rightcolumn@box#1{%
195     \bgroup
196     \xdef\top@@floatbox@ht{\z@}%
197     \xdef\top@@floatbox@skip{\z@}%
198     \xdef\top@@section@skip{\z@}%
199     \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
200     \wlog@balance@debug{^^J(R)mainbox: \log@box@info{#1}}%
201     \var@@temp@a3\p@

```

```

202 \setbox\flushend@@varbox@a\vbox{\strut
203 \vskip\z@
204 \unvcopy#1%
205 }%
206 \splittopskip\z@
207 \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\ht\strutbox
208 \flushend@@lastskip@a\ht\flushend@@varbox@a
209 \advance\flushend@@lastskip@a\dp\flushend@@varbox@a
210 \loop
211 \flushend@@lastskip@b\ht\flushend@@varbox@a
212 \advance\flushend@@lastskip@b\dp\flushend@@varbox@a
213 \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
214 \ifvoid\flushend@@tempbox@c
215 \advance \var@@temp@a 3\p@
216 \ifdim\var@@temp@a>\flushend@@lastskip@b
217 \var@@temp@a=-1\p@
218 \fi
219 \else
220 \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
221 \ifdim\ht\flushend@@tempbox@c>\top@@floatbox@min
222 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
223 \advance\flushend@@lastskip@b -\dp\flushend@@tempbox@c
224 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
225 \advance\flushend@@lastskip@b -\dp\flushend@@varbox@a
226 \xdef\top@@floatbox@skip{\the\flushend@@lastskip@b}%
227 \flushend@@lastskip@b\flushend@@lastskip@a
228 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
229 \advance\flushend@@lastskip@b -\top@@floatbox@skip
230 \xdef\top@@floatbox@ht{\the\flushend@@lastskip@b}%
231 \var@@temp@a=3\p@
232 \else
233 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
234 \advance\flushend@@lastskip@b -\dp\flushend@@tempbox@c
235 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
236 \advance\flushend@@lastskip@b -\dp\flushend@@varbox@a
237 \ifdim\ht\flushend@@tempbox@c>\topskip
238 \else
239 \xdef\top@@section@skip{\the\flushend@@lastskip@b}%
240 \fi
241 \var@@temp@a=-1\p@
242 \fi
243 \fi
244 \ifdim \var@@temp@a>\z@
245 \repeat
246 \ifvoid\flushend@@tempbox@c
247 \else
248 \ifdim\top@@section@skip>\z@
249 \else
250 \ifdim\ht\flushend@@tempbox@c>\z@
251 \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%

```

```

252         \fi
253         \flushend@@lastskip@b\ht\flushend@@varbox@a
254         \var@@temp@a=3\p@
255         \loop
256             \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
257             \ifvoid\flushend@@tempbox@c
258                 \advance \var@@temp@a 3\p@
259                 \ifdim\var@@temp@a>\flushend@@lastskip@b
260                     \var@@temp@a=-1\p@
261                 \fi
262             \else
263                 \ifdim\ht\flushend@@tempbox@c<\z@
264                     \else
265                         \var@@temp@a=-1\p@
266                     \fi
267             \fi
268         \ifdim \var@@temp@a>\z@
269         \repeat
270         \loop
271             \setbox\flushend@@varbox@a\vbox{%
272                 \unvbox\flushend@@tempbox@c
273                 \unskip\unkern\unpenalty
274                 \unskip\unkern\unpenalty
275                 \unskip\unkern\unpenalty
276                 \setbox\flushend@@tempbox@c\lastbox
277             }%
278             \flushend@@lastskip@b\ht\flushend@@varbox@a
279             \setbox\flushend@@varbox@a\vbox{%
280                 \unvbox\flushend@@varbox@a
281                 \unskip\unkern\unpenalty
282                 \unskip\unkern\unpenalty
283                 \unskip\unkern\unpenalty
284             }%
285             \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
286             \ifdim\flushend@@lastskip@b>\topskip
287                 \xdef\top@@section@skip{\the\flushend@@lastskip@b}%
288             \fi
289             \ifdim\ht\flushend@@varbox@a>2\topskip
290                 \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@varbox@a}%
291             \repeat
292         \fi
293     \fi
294 \egroup
295 }

```

\last@outputdblcol Columns balancing of the twocolumn mode page (modern variant).

```

296 \def\last@outputdblcol@modern{%
297     \if@firstcolumn
298         \global \@firstcolumnfalse
299         \global \setbox\@leftcolumn \box\@outputbox

```



```

300 \else
301 \global \@firstcolumntrue
302 \@tempdima\ht\@leftcolumn
303 \splittopskip\topskip \splitmaxdepth\maxdepth
304 \var@@temp@spread=\wd\@outputbox
305 \get@@footnoterule@@box
306 \xdef\main@box@height{\the\ht\@leftcolumn}%
307 \xdef\main@box@skip{\z@}%
308 \global\flushend@@lastskip@c\z@
309 \setbox\flushend@@varbox@a\vbox{\unvcopy\@leftcolumn}%
310 \analyze@leftcolumn@box\flushend@@varbox@a
311 \setbox\flushend@@varbox@a\vbox{\unvcopy\@outputbox}%
312 \analyze@rightcolumn@box\flushend@@varbox@a
313 \if@auto@baselineskip
314 %% Trying guess baselineskip value on column break
315 \ifdim\main@box@skip>\z@
316 \splittopskip\z@
317 \setbox\flushend@@varbox@a\vsplit\@leftcolumn to\main@box@height
318 \else
319 \setbox\flushend@@varbox@a\box\@leftcolumn
320 \fi
321 \ifdim\var@@temp@spread>\z@
322 \setbox\@outputbox\vbox{\strut
323 \vskip\z@
324 \unvbox\@outputbox
325 }%
326 \splittopskip\z@
327 \setbox\flushend@@tempbox@c\vsplit\@outputbox to\ht\strutbox
328 \ifdim\top@@floatbox@skip>\z@
329 \setbox\flushend@@tempbox@c\vsplit\@outputbox to\top@@floatbox@ht
330 \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
331 \fi
332 \setbox\@tempboxa\vbox{%
333 \unvbox\flushend@@varbox@a
334 \unskip\unkern\unpenalty
335 \vskip\flushend@@lastskip@c
336 \the\atColsBreak
337 \hrule\@height\flushend@@page@rule width\columnwidth
338 \ifdim\top@@section@skip>\top@@skip@@limit
339 \vskip\top@@section@skip
340 \fi
341 \unvbox\@outputbox
342 \remove@lastbox@at@balancing
343 \the\atColsEnd
344 }%
345 \ifdim\top@@floatbox@skip>\z@
346 \setbox\@outputbox\vbox{\unvbox\flushend@@tempbox@c}%
347 \fi
348 \else %% rightcolumn empty
349 \setbox\@tempboxa\vbox{%

```

```

350         \unvbox\flushend@@varbox@a
351         \remove@lastbox@at@balancing
352         \the\atColsEnd
353     }%
354 \fi
355 \else
356     %% Ignore baselineskip value on column break
357     \ifdim\var@@temp@spread>\z@
358         \setbox\@outputbox\vbox{\strut
359             \vskip\z@
360             \unvbox\@outputbox
361         }%
362         \splittopskip\z@
363         \setbox\flushend@@tempbox@c\vsplit\@outputbox to\ht\strutbox
364         \setbox\@tempboxa\vbox{%
365             \unvbox\@leftcolumn
366             \setbox\z@\lastbox
367             \unskip\unkern\unpenalty
368             \the\atColsBreak
369             \hrule\@height\flushend@@page@rule width\columnwidth
370             \unvbox\@outputbox
371             \remove@lastbox@at@balancing
372             \the\atColsEnd
373         }%
374     \else
375         \setbox\@tempboxa\vbox{%
376             \unvbox\@leftcolumn
377             \remove@lastbox@at@balancing
378             \the\atColsEnd
379         }%
380     \fi
381 \fi
382 \ifdim\main@box@skip>\z@
383     \@tempdimb\ht\@tempboxa
384     \advance\@tempdimb -\main@box@skip
385     \advance\@tempdimb -\ht\@leftcolumn
386     \@tempdimb .5\@tempdimb
387     \splittopskip\topskip \splitmaxdepth\maxdepth
388 \loop
389     \setbox\flushend@@varbox@a\copy\@tempboxa
390     \setbox\flushend@@tempbox@a\vsplit\flushend@@varbox@a to\@tempdimb
391     \setbox\flushend@@tempbox@c\vbox{%
392         \unvcopy\flushend@@tempbox@a
393         \vskip\main@box@skip
394         \unvcopy\@leftcolumn
395     }%
396     \setbox\flushend@@varbox@c\vbox{\unvbox\flushend@@varbox@a}%
397     \var@@temp@spread=\ht\flushend@@tempbox@c
398     \advance\var@@temp@spread by-\ht\flushend@@varbox@c
399     \wlog@balance@debug{Left x: \the\ht\flushend@@tempbox@a

```

```

400          +\the\dp\flushend@@tempbox@a=\the\ht\flushend@@varbox@a
401          +\the\dp\flushend@@varbox@a::\the\@tempdimb
402      ^^JLeft 0: \the\ht\flushend@@tempbox@c
403          +\the\dp\flushend@@tempbox@c::\the\@tempdimb
404      ^^JRight x: \the\ht\flushend@@varbox@c
405          +\the\dp\flushend@@varbox@c=\the\ht\flushend@@varbox@a
406          +\the\dp\flushend@@varbox@a::\the\@tempdimb
407      ^^JExtra height:\the\var@@temp@spread\space when \the\@tempdimb
408      }%
409      \ifdim\var@@temp@spread<\z@ \advance\@tempdimb 1\p@ \repeat
410      \flushend@@lastskip@a\the\ht\flushend@@tempbox@c
411      \flushend@@lastskip@b\the\@tempdimb
412      \setbox\flushend@@tempbox@a\vsplit\@tempboxa to\@tempdimb
413      \setbox\@leftcolumn\ vbox to\@tempdima{%
414          \vbox to \flushend@@lastskip@a{%
415              \unvbox\flushend@@tempbox@a
416              \vskip\main@box@skip
417              \unvbox\@leftcolumn
418              \vss
419          }%
420          \hrule\@height\flushend@@page@rule width\textwidth
421          \vss
422      }%
423      \global\ht\@leftcolumn=\the\@tempdima
424      \wlog{- LAST -}%
425          ^^JExtra skip:\the\var@@temp@spread
426          ^^JLeft:\the\ht\@leftcolumn/\the\dp\@leftcolumn
427          ^^JRight:\the\ht\@tempboxa/\the\dp\@tempboxa
428          ^^JOutput:\the\@tempdimb
429      }%
430      \setbox\@outputbox\ vbox to\@tempdima{%
431          \vbox spread\var@@temp@spread{%
432              \unvbox\@tempboxa
433          }%
434          \vss
435      }%
436  \else
437      \@tempdimb \ht\@tempboxa
438      \ifdim\top@@floatbox@skip>\z@
439          \advance\@tempdimb \top@@floatbox@skip
440          \advance\@tempdimb \top@@floatbox@ht
441      \fi
442      \@tempdimb .5\@tempdimb
443      \splittopskip\topskip \splitmaxdepth\maxdepth
444      \loop
445          \setbox\flushend@@varbox@a\copy\@tempboxa
446          \setbox\flushend@@tempbox@a\vsplit\flushend@@varbox@a to\@tempdimb
447          \setbox\flushend@@tempbox@c\ vbox{\unvcopy\flushend@@tempbox@a}%
448          \ifdim\top@@floatbox@skip>\z@
449              \setbox\flushend@@varbox@c\ vbox{%

```

```

450         \unvcopy\@outputbox
451         \vskip\top@@floatbox@skip
452         \unvbox\flushend@@varbox@a
453     }%
454 \else
455     \setbox\flushend@@varbox@c\ vbox{\unvbox\flushend@@varbox@a}%
456 \fi
457 \var@@temp@spread=\ht\flushend@@tempbox@c
458 \advance\var@@temp@spread by\dp\flushend@@tempbox@c
459 \advance\var@@temp@spread by-\ht\flushend@@varbox@c
460 \advance\var@@temp@spread by-\dp\flushend@@varbox@c
461 \wlog@balance@debug{Left x: \the\ht\flushend@@tempbox@a
462     +\the\dp\flushend@@tempbox@a=\the\ht\flushend@@varbox@a
463     +\the\dp\flushend@@varbox@a::\the\@tempdimb
464 ^^JLeft 0: \the\ht\flushend@@tempbox@c
465     +\the\dp\flushend@@tempbox@c::\the\@tempdimb
466 ^^JRight x: \the\ht\flushend@@varbox@c
467     +\the\dp\flushend@@varbox@c=\the\ht\flushend@@varbox@a
468     +\the\dp\flushend@@varbox@a::\the\@tempdimb
469 ^^JExtra height:\the\var@@temp@spread\space when \the\@tempdimb
470 }%
471 \ifdim\var@@temp@spread<\z@ \advance\@tempdimb 1p@ \repeat
472 %\@tempdimb\ht\flushend@@tempbox@c
473 %\advance\@tempdimb by\dp\flushend@@tempbox@c
474 \wlog{- LAST -}%
475 ^^JExtra skip:\the\var@@temp@spread
476 ^^JLeft:\the\ht\flushend@@tempbox@c/\the\dp\flushend@@tempbox@c
477 ^^JRight:\the\ht\flushend@@varbox@c/\the\dp\flushend@@varbox@c
478 ^^JOutput:\the\@tempdimb
479 }%
480 \setbox\flushend@@tempbox@c\vsplit\@tempboxa to\@tempdimb
481 \setbox\flushend@@varbox@c\ vbox{\unvbox\flushend@@tempbox@c}%
482 \setbox\@leftcolumn\ vbox to\@tempdima{%
483     \vbox to\@tempdimb{\unvbox\flushend@@varbox@c\vss}%
484     \hrule\@height\flushend@@page@rule width\textwidth
485     \vss
486 }%
487 \global\ht\@leftcolumn=\the\@tempdima
488 \ifdim\top@@floatbox@skip>\z@
489     \setbox\@outputbox\ vbox to\@tempdima{%
490         \if@right@column@spread
491             \vbox spread\var@@temp@spread{%
492                 \unvbox\@outputbox
493                 \vskip\top@@floatbox@skip
494                 \unvbox\@tempboxa
495             }%
496         \else
497             \vbox spread\var@@temp@spread{%
498                 \unvbox\@outputbox
499                 \vskip\top@@floatbox@skip

```

```

500             \unvbox\@tempboxa
501             \vss
502             }%
503         \fi
504         \vss
505         }%
506     \else
507         \setbox\@outputbox\vbox to\@tempdima{%
508             \if@right@column@spread
509                 \vbox spread\var@@temp@spread{%
510                     \unvbox\@tempboxa
511                     }%
512             \else
513                 \vbox spread\var@@temp@spread{%
514                     \unvbox\@tempboxa
515                     \vss
516                     }%
517             \fi
518             \vss
519             }%
520         \fi
521     \fi
522     \setbox\@outputbox \vbox {%
523         \hb@xt@\textwidth {%
524             \hb@xt@\columnwidth {%
525                 \fmt@box@adds{\box\@leftcolumn}\hss}%
526                 \hfil
527                 \vrule \@width\columnseprule
528                 \hfil
529                 \hb@xt@\columnwidth {%
530                     \fmt@box@adds{\box\@outputbox}\hss}%
531                     }%
532             }%
533     \global\let\@outputdblcol\saved@orig@@@outputdblcol
534     \global\atColsEnd{%
535     \ifvoid\hold@viper
536     \else
537         \setbox\@outputbox\vbox{\box\hold@viper\box\@outputbox}%
538     \fi
539     \@combinedblfloats
540     \@outputpage
541     \begingroup
542         \@dblfloatplacement
543         \@startdblcolumn
544         \@whilesw\if@fcolmade\fi
545             {\@outputpage\@startdblcolumn}%
546     \ifvoid\@viper
547     \else
548         \global\setbox\@viper\vbox{%
549             \vskip-\stripsep

```

```

550             \unvbox\@viper
551         }%
552     \csname @viperoutput\endcsname
553 \fi
554 \endgroup
555 \fi
556 }

```

\last@outputdblcol@old Columns balancing of the twocolumn mode page (ancient algorithm).

```

557 \def\last@outputdblcol@ancient{%
558     \if@firstcolumn
559         \global\@firstcolumnfalse
560         \global\setbox\@leftcolumn\box\@outputbox
561     \else
562         \global\@firstcolumntrue
563         \@tempdima\ht\@leftcolumn
564         \splittopskip\topskip\splitmaxdepth\maxdepth
565         \if@auto@baselineskip
566             \setbox\@tempboxa\vbox{%
567                 \unvcopy\@leftcolumn
568                 \global\flushend@@lastskip@c\lastskip
569                 \global\flushend@@lastskip@b\lastskip
570                 \loop
571                     \global\flushend@@lastskip@a\flushend@@lastskip@b
572                     \unskip\unpenalty
573                     \global\flushend@@lastskip@b\lastskip
574                     \global\advance\flushend@@lastskip@c by\lastskip
575                 \ifdim\flushend@@lastskip@b=-\flushend@@lastskip@a
576                     \global\advance\flushend@@lastskip@c by-\lastskip
577                 \else
578                     \repeat
579                 \ifdim\flushend@@lastskip@b=-\flushend@@lastskip@a
580                     \ifdim\flushend@@lastskip@b=\z@
581                         \setbox\flushend@@varbox@a\lastbox
582                         \global\advance\flushend@@lastskip@c by\ht\flushend@@varbox@a
583                         \global\advance\flushend@@lastskip@c by\lastskip
584                         \unskip\unpenalty
585                         \setbox\flushend@@varbox@a\lastbox
586                         \global\advance\flushend@@lastskip@c by\dp\flushend@@varbox@a
587                     \else
588                         \global\flushend@@lastskip@c\lastskip
589                         \global\advance\flushend@@lastskip@c by\topskip
590                 \fi
591                 \fi
592                 \global\advance\flushend@@lastskip@c by-\topskip
593             }%
594             \setbox\@tempboxa\vbox{%
595                 \unvbox\@leftcolumn
596                 \unskip\unpenalty
597                 \vskip\flushend@@lastskip@c

```

```

598         \hrule\@height\flushend@@page@rule width\columnwidth
599         \the\atColsBreak
600     \unvbox\@outputbox
601         \remove@lastbox@at@balancing
602         %%\unskip
603         \the\atColsEnd
604     }%
605     \else
606         \setbox\@tempboxa\vbox{%
607             \unvbox\@leftcolumn
608             \setbox\z@\lastbox
609             \unskip
610             \hrule\@height\flushend@@page@rule width\columnwidth
611             \the\atColsBreak
612             \unvbox\@outputbox
613             \remove@lastbox@at@balancing
614             %%\setbox\z@\lastbox
615             %%\unskip
616             \the\atColsEnd
617         }%
618     \fi
619     \@tempdimb .5\ht\@tempboxa
620     \loop
621         \setbox\flushend@@tempbox@a\copy\@tempboxa
622         \setbox\flushend@@tempbox@c\vbox to\@tempdimb{%
623             \vsplit\flushend@@tempbox@a to\@tempdimb
624             \vss
625             \vsplit\flushend@@tempbox@a to\@tempdimb
626         }%
627         \wlog{Extra height:\the\ht\flushend@@tempbox@a\space when \the\@tempdimb}%
628     \ifvoid\flushend@@tempbox@a \else \advance\@tempdimb 1p@ \repeat
629     \loop
630         \setbox\flushend@@tempbox@a\copy\@tempboxa
631         \setbox\flushend@@tempbox@c\vbox to\@tempdimb{\vsplit\flushend@@tempbox@a to\@tempdimb}
632         \wlog{(2)Left:\the\ht\flushend@@tempbox@c\space
633             Right:\the\ht\flushend@@tempbox@a\space
634             Output:\the\@tempdimb
635         }%
636     \ifdim\ht\flushend@@tempbox@c<\ht\flushend@@tempbox@a \@tempdimb=\the\ht\flushend@@tempbox@a
637     \wlog{- LAST -^^JExtra skip: \the\z@
638         ^^JLeft:\the\ht\flushend@@tempbox@c
639         ^^JRight:\the\ht\flushend@@tempbox@a
640         ^^JOutput:\the\@tempdimb
641     }%
642     \setbox\flushend@@tempbox@c\vbox to\@tempdimb{%
643         \vsplit\@tempboxa to\@tempdimb
644         \vss
645     }%
646     \setbox\@leftcolumn\vbox to\@tempdima{%
647         \fmt@vbox@adds[\columnwidth]{\vbox to\@tempdimb{\unvbox\flushend@@tempbox@c}}%

```

```

648         \hrule\@height\flushend@@page@rule
649         \vss
650     }%
651     \setbox\@outputbox\vbox to\@tempdima{%
652         \fmt@vbox@adds[\columnwidth]{%
653             \vbox to\@tempdimb{%
654                 \unvbox\@tempboxa
655                 %\vfilneg
656                 \vskip\z@
657             }%
658         }%
659         \hrule\@height\flushend@@page@rule
660         \vss
661     }%
662     \setbox\@outputbox\vbox{%
663         \hb@xt@\textwidth{%
664             \hb@xt@\columnwidth{\box\@leftcolumn\hss}%
665             \hfil
666             \vrule \@width\columnseprule
667             \hfil
668             \hb@xt@\columnwidth{\box\@outputbox\hss}%
669         }%
670     }%
671     \global\let\@outputdblcol\saved@orig@@outputdblcol
672     \global\atColsEnd{}%
673     \ifvoid\hold@viper
674     \else
675         \setbox\@outputbox\vbox{\box\hold@viper\box\@outputbox}%
676     \fi
677     \@combinedblfloats
678     \@outputpage
679     \begingroup
680         \@dblfloatplacement
681         \@startdblcolumn
682         \@whiles\if@fcolmade\fi
683             {\@outputpage\@startdblcolumn}%
684         \ifvoid\@viper
685         \else
686             \global\setbox\@viper\vbox{%
687                 \vskip-\stripsep
688                 \unvbox\@viper
689             }%
690             \csname @viperoutput\endcsname
691         \fi
692     \endgroup
693     \fi
694 }

```

Adds default balancing of the last page at the end of document.

```

695 \usepackage{etoolbox}

```



```

696 \AtBeginDocument{%
697   \global\let\saved@orig@@outputdblcol\@outputdblcol
698   \if@ancient@balance@version
699     \global\let\last@outputdblcol\last@outputdblcol@ancient
700   \else
701     \global\let\last@outputdblcol\last@outputdblcol@modern
702   \fi
703   \global\let\balanced@@outputdblcol\last@outputdblcol
704   \preto\enddocument{\let\@outputdblcol\balanced@@outputdblcol}%
705   \appto\footnoterule{\vskip\z@}%
706 }

```

User interface commands for the balancing pages.

```

707 \def\flushcolsend{\global\let\@outputdblcol\last@outputdblcol}
708 \def\raggedcolsend{\global\let\@outputdblcol\saved@orig@@outputdblcol}
709 \def\flushend{\global\let\balanced@@outputdblcol\last@outputdblcol}
710 \def\raggedend{\global\let\balanced@@outputdblcol\saved@orig@@outputdblcol}

711 \if@balance@debug
712   \showcolsendrule
713 \fi

```