Helicopter Exercise

Teams of students will conduct a 3-factor, 8-run experiment with 3 replicates each. The factors are:

Factor	Low Level	High Level
Body Length	2"	3"
Wing Area	9 sq. in.	12.96 sq. in.
Aspect Ratio	2.25	2.78

I have distributed a handout with randomized run order; to generate this handout, I specified 6 replications and 2 blocks, even though each block actually only has 3 replications. Each team will need to cut out their helicopters, construct them and conduct trials. I would prefer two timekeepers for the trials–the average flight time can be recorded as the response for each trial.

After completing the helicopter experiment, we need to analyze the data. Minitab's DOE package does not have any built-in methods for analyzing variance in a replicated experiment, so we need to compute the standard deviation for each combination of factor levels, create an unreplicated design and input the log-standard deviations as our observations. At the same time, we will need to generate a replicated design on a separate worksheet to analyze location.

I would like each team to analyze the variance (using an 8-run table) and mean (using a 24-run table of the raw data) separately.

To obtain the sample standard deviations of the replicates, we create a column in the 24-run worksheet identifying replications (it would be nice if Minitab included this as part of their Standard Order column, but unfortunately they do not). As an example, Standard Order runs 1, 9, and 17 should all be identified as 1 in a newly-formed Replication column. Select "Store Descriptive Statistics" from the "Basic Statistics" menu, choose the response column and BY variable (Replication column) and then select Standard Deviation from the Statistics menu. The appropriate column will be created to the right of the design in our worksheet. Compute the log of the standard deviations (assuming they have been stored in c16):

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let c16=log(StDev1)
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The column of log standard deviations will then have to be pasted into the 8-run worksheet as a response column.

When the separate analyses are done, the teams should combine their data, using Team as a blocking variable, and re-analzye the data. The design for analysis of location can be generated exactly as I generated the original data; to analyze the log standard deviation, you should specify three factors, 2 reps and 2 blocks, then enter the log standard deviations as responses. Report which factors affect the mean and variance–do these relationships make sense? Was there a block effect (a difference between the two groups)?