Mitchell and John (1976) defined and constructed regular graph (RG) designs for equi-replicated and proper block designs. In this investigation, the construction and optimality of RG designs with unequal block sizes are carried out. Moreover, in this investigation it is established that a class of two associate partially efficiency balanced design is, in fact RG designs. RG designs are also obtained by adding two RG designs having the same number of treatments and same size of blocks. Further, it is shown that the existence of a BIB design with \( \lambda = 2 \) implies the existence of a RG design, by deleting a particular treatment and those blocks in which that particular treatment is present. Again, the adjacency graph of RG designs is given, and thereby some new RG designs are obtained.

Jacroux (1985) extended the definition of Regular graph designs of Mitchell and John (1976) to Semi-regular graph (SRG) designs, and studied the type 1 optimality of block designs. Here, the construction and optimality of some more SRG designs are carried out. Moreover, in this investigation it is established that a class of two associate partially efficiency balanced design is, in fact SRG designs. Again, the dual designs of the SRG designs constructed using BIB designs with \( b = 2r - \lambda \) are considered, and it is shown that they are optimal RG designs. Also, it is established that these RG designs are partially efficiency balanced (PEB) designs with 3 efficiency classes.

Two series of Group Divisible (GD) designs are constructed from \( v \equiv 3 \pmod{6} \) Balanced Incomplete Block (BIB) designs (i) by deleting any one set of \( (t/3) \) disjoint blocks, and (ii) by adding any one set of \( (t/3) \) disjoint blocks, and it is established that the first series of GD designs is \( E \)-optimal. Further, Semi-Regular
Group Divisible (SRGD) designs are also obtained by adding two SRGD designs having the same number of treatments and same size of blocks.

The designs for comparing test treatments with a control are classified into three categories namely (i) $r_o = bt$ (R-type) (ii) $r_o > bt$ (S-type) and (iii) $r_o < bt$ (S-type). It is shown that, step (S-) type ($r_o < bt$) BTIB designs and step (S-) type ($r_o > bt$) BTIB designs for comparing test treatments with a control are partially efficiency balanced (PEB) designs. It is proved by using the $M_o$-matrix of the design. Further, it is established that the binary (R-) type BTIB designs and the binary (R-) type GDT designs are simple PEB designs. It is also pointed out that, the binary ($r_o \leq b$) BTIB designs with $\lambda_o = \lambda_1$ are proper efficiency balanced designs.