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APPLYING WEIGHTED GOAL PROGRAMMING TO PROJECT MANAGEMENT DECISIONS WITH MULTIPLE GOALS

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ABSTRACT

The construction, architecture and engineering markets have been at the epicenter of the recent global economic recession. Following a phase of almost irrational growth and investment in real estate development, both residential and commercial, the industry faces copious challenges following the burst of the housing bubble. As a result, it has become obligatory for this the sector to reassess and reengineer its conventional business models to drive amplified efficiencies in operations and improvements in bottom line performance. In this article, a multi-criteria "knapsack" model is proposed to lend a hand to the planners to select the most feasible and realistic developmental proceedings in the conceptual phase of a project. Firstly, the methodology is portrayed. Then, case study is presented. Finally, advantages and disadvantage of the methodology are considered and requirements for future researches are suggested. The results indicate that a compact structure of development including smaller lots may transpire, externally controlling constraints and variations.

KEYWORDS: Real Estate Development, Weighted Goal Programming, Multi Criteria Decision Making

To design a most advantageous building has become more difficult than it has been before. In 2003 Kari, proposed a ''knapsack'' model to help designers to select the most feasible renovation actions in the conceptual phase of a renovation project. In their article discuss some distinctive challenges.

One of the challenges is associated with the fact that decisions concerning building design are mainly made by a design team consisting of a design group including at least an architect, an electricity engineer, a structural engineer, a real estate owner, a buyer and a supplier. The question is how to find a consensus between the members of a design team taking into account as many points of view as possible. A practical solution of this problem is presented by Azmoodeh et al. This article present a procedure to quantify the process for selecting the most advantageous technique.

An energy system opens a new opportunity for the local businesses and community development. Lack of support of the local community may be a drawback for the development (Afgan et al.). In today's business environment one of the challenges are associated with the sustainable development. According to the classification by Bruntland, that sustainable development is regarded as ''Development that meets the needs of the present without compromising the ability of future generations to meet their own needs''.

Sustainable development in the framework of construction industry simply means making buildings better satisfy the requirements of human beings and the situation, discuss in detail by Kaklauskas et al. In practice, sustainability is usually illustrated using numerical indicators providing information about the status of an observable fact, environment or region. An Example of a list of indicators describing sustainability of buildings and their hi-tech systems are presented by Bragança et al.

Smith, describes how buildings can be made to significantly reduce their dependence on fossil-based energy by the use of solar and geothermal resources. As sustainable building becomes increasingly essential with the advance of climate change, government legislation and international treaties, this is valuable knowledge for every architect, engineer and designer.

The sustainability of buildings and their systems is usually defined by means of differing criteria. The challenge is to make an optimal decision on the basis of these criteria.

Multi-criteria decision-making (MCDM) methods are usually presented as a solution of this kind of problems, like has been done by example (Andresen).

The other challenge is an increasing amount of hi-tech solutions on the market. In order to design a building with maximum sustainability, designers have to consider effects of more and more scientific options, these options discuss in detail by Flourentzou et al., Rosenfeld and Shohet.

The foreword of new, high-speed personal computers on everyone's desk makes it feasible to handle the difficulty in the form of a combinatorial optimization problem. This advance seems to be new in the field of building design. In Linkoping, Sweden, some studies have been carried out regarding this issue. In these studies, however, the multi-criteria and multi-

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perspective nature of the problem has been deal (Gustafsson).

In this paper a weighted goal programming mathematical model is formulated to estimate the categories and number of new residential apartments constructed by a developer making an allowance for the targets ascertained for the project in Jaipur, Rajasthan.

CONSTRUCTION PROJECTS

The residential real estate at Jaipur is bound to roll out with a suite of integrated township projects, with housing units, lifestyle amenities of school, markets, clubhouses and infrastructure facilities of well laid out roads, landscaping, have been announced by developers likes Omaxe (Omaxe City), Suncity, Vatika (Vatika City), Ansal API (Sushant City), Grassfield, Panchsheel Colonizer and Parsvnath which has entered into a joint venture with a jaipur-based real estate developer. Besides, there are some jaipur based real estate developers such as Mahima, Narayan group, Narvik Nirman etc. who have launched ambitious residential township assignments.

With rising costs of land in the city, the real estate trends in Jaipur have shifted to the peripheral areas. But this is only true for property developers so far and not the end user for residential property. According to Vivek Jain of Narvik Nirman, "The end user is still not there in these projects so far. Developer after developer has been launching township projects in Jaipur but it is mainly the investor who is making speculative investments rather than the end user."

Theory and Methodology

Through this paper, we do not encourage creating unique monuments or architectural styles at the goal. Instead, the model can help at fabricating practical and useful buildings for average people.

Many architects (Friedman and Roaf et al.) too, felt a similar desire to clarify all the parallel goals of building and arrange them into a system.

In 1972 Nevanlinna made an attempt to deduce the goals of architecture from the basic values of modern Western culture, which is defined as:

A. Humanism or appreciation of man. This gives man a privileged position in respect to other nature,

B. Objective truth,

C. Prosperity (which materializes as technology),

D. Balance of the whole system.

Niukkanen, arranged the goals of building into a logical tree shown in figure-5.1.

SATISFACTION / FIT		
Input	**Output**	
Costs / Resources	Usefulness / Function	Experience / Perception
Building costs Costs of use Decrease to output	Spaces Indoor environment and climate Equipment and durability	Environmental factors Exteriors Interiors

Figure 5.1

Some researchers have tried to explain human goals with the concept of need. The "hierarchy of needs" suggested by Maslow, further Cianci et al. examine Maslow's hierarchy of needs and current related literature to determine whether or not it applies in a collectivist culture.

There are different interested parties (clients, users, architects, designers, utilities engineers, economists, contractors, maintenance engineers, suppliers, financing institutions, local government, state and state institutions) involved in the life cycle of a construction, trying to satisfy their requirements. The objectives hold the estimated cost of a building, maintenance costs, living space, number of floors as well as the requirements to its architecture, comfort ability, materials, sound insulation of partition walls, taxes and allowances, interest rates, etc. Besides, the environment of the site, its ecology, sound level and local infrastructure are also taken into consideration. This list may be continued. Therefore, the efficiency of a building life cycle is reflected through the rationality of its stages as well as on the ability to satisfy the needs of the interested parties and the rational character of environment conditions. Many features are being considered by the developers in recent times, but all these craft a project that bear out to be very much expensive for them, thus reducing their profit margin.

To solve this kind of problem, the developers need to be counseled and outfitted with a plan, apart from partial cost sharing (for specific facilities only) by the customers, which could endow them with desired returns while enabling them to provide the customers with improved level of facilities.

The development planner may often encounter varied problems with multiple conflicting objectives while satisfying the customers. Goal programming endows us with a general methodology for sorting out such problems. Selection criteria are formalized into a set of goals which form the basis for a goal programming model.

Weights are used to analyze the respective effects upon the spatial distribution of investments. The approach is applicable to an extensive assortment of problems.

PROBLEM DESCRIPTION

In this paper developed a weighted goal programming model, taking construction company (to maintain the secrecy of data, we hide the company name as well as the exact financial figures while explaining the history of the case organization) as a case study to suggest the developers to construct which categories of apartments (Flats) and in what number, that could provide them with desired results.

Case Study

The model takes into consideration a specific project of the above mentioned construction company which with slight changes as per the project specifications will enable any developer to calculate the area of profit and no profit in their project.

It seems to be impracticable to combine the conflicting goals of building on a universal level. As a contrast, on the level of a single building project it is everyday practice. On this level, the goals are projected simply from the subjective viewpoint of the builder. If an architect and other experts use the same, even then they are supposed to adopt a matching perspective. Because most structures are relatively large, complicated and expensive products, it is normal that they must discharge quite a number of goals and requirements.

Targets

The task of combining the goals into a combination is primarily carried out by the architect, while he crafts his proposal, and at the next meeting the customers have the option of endorsing or rejecting it. The architect's tasks are, however, difficult already in it, and they should not be loaded with such extra operations that can be done separately. It is, therefore, usual that as much as possible of the work of defining and arbitrating of goals is done already before the architect begins with the design. This initial phase of the building project is often called a feasibility study.

Archetypal outcome of a feasibility study include:

(i) Lists of the intended activities that are to take place in the future building; lists of people to be accommodated; lists of the rooms or spaces for these; positioning and connections of the spaces,

(ii) Explanation of quality level. These can relate to e.g. safety, durability, finishing, intended life-time of the building

(iii) Estimate of costs and project time.

The presented case study formed by different particulars and corresponding cost of different apartment at fixed or floating rates has been taken from builder’s website and construction company broacher.

In this study considered seven types of apartment (flats), Type-A, Type-B, Type-C, Type-D, Type-E, Type-F, and Type-G.

In which 1-B.H.K, 2-B.H.K, 3-B.H.K apartments with standard, deluxe, luxury categories have taken. Seven types of apartment have taken in form of decision variables as $X_1, X_2, \dots, X_7$ respectively in weighted goal programming model formulation, which have to make a decision.

Different particulars taken as target (goal), and target value are based on our assumption. Total number of targets is thirteen. Weights (w_i^- and w_i^+) those reflect the decision maker’s preferences regarding the relative importance of each goal have been taken in weighted goal programming model formulation.

Cost of each particular corresponding to each type of apartment taken as contribution of decision variables in weighted goal programming model formulation.

Significant features emphasized by developer shown in Table 1, Table 2 and collecting data shown in Table 3.

Table-1

As per Construction Linked Plan		Semi Furnished Option	Fully Furnished Option
On Booking	15%	1. T.V Cabinet	1. Bed+Side Table
On Agreement to Sell	10%	2. Wardrobe	2. Sofa Set
On Casting of Foundation	12.5%	3. Dressing Table	3. Centre+Side Table
On Casting of 1^{st} Slab	12.5%	4. LightFitting+Fans	4. Tv Cabinet
On Casting of 3th Slab	12.5%	5. Modular Kitchen	5. Wadrobe
On Casting of 5^{th} Slab	12.5%	6. Curtain Rods	6. Dressing Table
On Casting of 7th Slab	12.5%	7. Shoe Rack	7. LightFitting+Fans
On Casting of 12^{th} Slab	7.5%	8. Shower Curtain	8. Split AC's
		9. Painting	9. Plasma TV
On Possession	5%	10. Wall Clocks	10. Modular Kitchen
			11. Curtain Rods
			12. Shower Curtain
			13. Paintings
			14. Wall Clocks
			15. Geyser in all Bathroom

Table-2

ACTIVITY	DETAILS
Security	24 Hours Patrolling Manning the entry and control room.
Horticulture	Take care of the health of the lawns, greenery and all Trees and flowers in the complex.
Sweeping/ Refuse Disposal	Sanitation and cleaning of the common areas.
Lifts	Lift AMC, assistance and technicians.
Temple	Pujaris and vidyarthis for doing all the pooja at the temple
Operation of STP, Generator Water Pump, Water Tower	Operators for the whole village complex to ensure water supply, power back up and working of STP.
Repair & Maintenance	On call electrician, plumbers, Manson for maintenance.
Administration and Activity	Administrations, activities management, account, stores, helpdesk, newsletter, stationary, and telephone cost.
Medical Services	Medical Assessment & OPD Facilities.

Table – 3

Decision Variables Type BHK S/ D/ L	X1 Type A1S	X2 Type B1D	X3 Type C2S	X4 Type D2D	X5 Type E3S	X6 Type F3D	X7 Type G3L	Target Value
GSA	509	556	799	919	1099	1269	1359	11658
Basic Price	9.16	10.01	14.38	16.54	19.78	22.84	24.46	209.82
Utility & Infra	0.51	0.56	0.86	0.92	1.10	1.27	1.36	11.67
Club	0.65	0.65	0.85	0.85	1.05	1.05	1.05	10.80
Maintenance Corpus	0.18	0.19	0.28	0.32	0.38	0.44	0.48	4.08
MRP	10.50	12.91	16.31	20.13	23.82	27.11	28.85	249.90
BTPT	0.99	1.08	1.56	1.79	2.14	2.47	2.65	22.71
Booking Advance 15% of (MRP+BTPT)	1.72	2.10	2.68	3.29	3.89	4.44	4.72	40.86
Corner Charges 5% of (Basic Price)	0.45	0.50	0.71	0.82	0.98	1.14	1.22	10.41
Park facing Charges 10% of (Basic Price)	0.91	1.00	1.43	1.65	1.97	2.28	2.44	20.91
CPS (Fixed)	0.00	1.50	0.00	1.50	1.50	1.50	1.50	22.50
Lease Charges (22Rs.PSF)	0.11	0.12	0.17	0.20	0.24	0.27	0.29	4.29
LPG PipeLine (20Rs.PSF)	0.10	0.11	0.15	0.18	0.21	0.25	0.27	3.90

BHK- Bedroom, Hall & Kitchen, BUA- Built-up Area, GSA-Gross Saleable Area, SFT-Square Feet CPS-Car Parking, MRP-Maximum Retail Price, BTPT-Buy Today Pay Tomorrow, S-Standard, D-Deluxe, L-Luxury, PSF-Per Square Feet.

WEIGHTED GOAL PROGRAMMING MODEL FORMULATION

Let b_i be the ith goal, d_i^+ be positive deviation from the ith goal and d_i^- be the negative deviation from the ith goal. The parameter (w_i^- and w_i^+) represent weights, those reflect the decision maker's preferences regarding the relative importance of each goal.

Then the problem of minimizing z may be formulated as:

$$Minimize\ z = \sum_{i=1}^{n} (w_i^- d_i^- + w_i^+ d_i^+) \qquad \dots (\mathbf{5.4.1})$$

Subject to

$$\sum_{j=1}^{m} A_{ij} X_j + d_i^- - d_i^+ = b_i \qquad \dots (\mathbf{5.4.2})$$

Non-negativity constraint,

$A_{ij} \geq 0,$

$X_j \geq 0$

$b_i \geq 0$

$d_i^+ \geq 0,$

$d_i^- \geq 0,$

Complementary constraints

$d_i^+ \times d_i^- = 0$

$i = 1,2,\dots,n\ and\ j = 1,2,\dots,m$

Where, X_j are decision variable for achieving target (goal) value and A_{ij} = matrix of "$\{a_{ij}\}$" (marginal contribution of decision variable Xj) for achieving goal b_i.

Formulating the problem, according the targets, into weighted goal programming model formulation:

$$Minimize\ z = \sum_{i=1}^{9} w_i^- d_i^- + w_i^+ d_i^+ + (w_{10}^- d_{10}^- + w_{11}^- d_{11}^-) + (w_{10}^+ d_{10}^+ + w_{11}^+ d_{11}^+) + (w_{12}^- d_{12}^- + w_{13}^- d_{13}^-) + (w_{12}^+ d_{12}^+ + w_{13}^+ d_{13}^+) \qquad \dots (\mathbf{5.4.3})$$

Subject to following targets:

GOAL 1: GROSS SALEABLE AREA

$509X_1 + 556X_2 + 799X_3 + 919X_4 + 1099X_5 + 1269X_6 + 1359X_7 + d_1^- - d_1^+ = 11658$ **… (5.4.4)**

GOAL 2: BASIC PRICE

$9.16X_1 + 10.01X_2 + 14.38X_3 + 16.54X_4 + 19.78X_5 + 22.84X_6 + 24.46X_7 + d_2^- - d_2^+ = 209.82$ **… (5.4.5)**

GOAL 3: UTILITY & INFRASTRUCTURE

$0.51X_1 + 0.56X_2 + 0.86X_3 + 0.92X_4 + 1.10X_5 + 1.27X_6 + 1.36X_7 + d_3^- - d_3^+ = 11.67$ **… (5.4.6)**

GOAL 4: CLUB CHARGES

$0.65X_1 + 0.65X_2 + 0.85X_3 + 0.85X_4 + 1.05X_5 + 1.05X_6 + 1.05X_7 + d_4^- - d_4^+ = 10.80$ **… (5.4.7)**

GOAL 5: MAINTENANCE CHARGES

$0.18X_1 + 0.19X_2 + 0.28X_3 + 0.32X_4 + 0.38X_5 + 0.44X_6 + 0.48X_7 + d_5^- - d_5^+ = 4.08$ **… (5.4.8)**

GOAL 6: MAXIMUM RETAIL PRICE

$10.50X_1 + 12.91X_2 + 16.31X_3 + 20.13\ X_4 + 23.82X_5 + 27.11X_6 + 28.85X_7 + d_6^- - d_6^+ = 249.90$ **… (5.4.9)**

GOAL 7: BUY TODAY PAY TOMORROW CHARGES

$0.99X_1 + 1.08X_2 + 1.56X_3 + 1.79X_4 + 2.14X_5 + 2.47X_6 + 2.65X_7 + d_7^- - d_7^+ = 22.71$ **… (5.4.10)**

GOAL 8: ADVANCE PAYMENT BENEFITS

$1.72X_1 + 2.10X_2 + 2.68X_3 + 3.29X_4 + 3.89X_5 + 4.44X_6 + 4.72X_7 + d_8^- - d_8^+ = 40.86$ **… (5.4.11)**

GOAL 9: CAR PARKING SPACE CHARGES

$0X_1 + 1.50X_2 + 0.00X_3 + 1.50X_4 + 1.50X_5 + 1.50\ X_6 + 1.50X_7 + d_9^- - d_9^+ = 22.50$ **… (5.4.12)**

GOAL 10: CORNER CHARGES

$0.45X_1 + 0.50X_2 + 0.71X_3 + 0.82X_4 + 0.98X_5 + 1.14X_6 + 1.22X_7 + d_{10}^- - d_{10}^+ = 10.41$ **… (5.4.13)**

GOAL 11: PARK FACING CHARGES

$0.91X_1 + 1.00X_2 + 1.43X_3 + 1.65X_4 + 1.97X_5 + 2.28X_6 + 2.44X_7 + d_{11}^- - d_{11}^+ = 20.19$ **… (5.4.14)**

GOAL 12: LEASE CHARGES

$0.11X_1 + 0.12X_2 + 0.17X_3 + 0.20X_4 + 0.24X_5 + 0.27X_6 + 0.29X_7 + d_{12}^- - d_{12}^+ = 4.29$ **… (5.4.15)**

GOAL 13: LPG PIPELINE

$0.10X_1 + 0.11X_2 + 0.15X_3 + 0.18X_4 + 0.21X_5 + 0.25X_6 + 0.27X_7 + d_{13}^- - d_{13}^+ = 3.90$ **… (5.4.16)**

Non-negativity constraint,

$w_i^- = 1,\ w_i^+ = 1,$

$w_{10}^- = 1,\ w_{10}^+ = 2,$

$w_{11}^- = 2,\ w_{11}^+ = 1$

$w_{12}^- = 2,\ w_{12}^+ = 11,$

$w_{13}^- = 1,\ w_{13}^+ = 10$

$X_1, X_2, X_3, X_4, X_5, X_6, X_7 \geq 0,$

$d_i^-,\ d_i^+ \geq 0,$

$d_{10}^-,\ d_{10}^+ \geq 0,$

$d_{11}^-,\ d_{11}^+ \geq 0,$

$d_{12}^-,\ d_{12}^+ \geq 0, d_{13}^-,\ d_{13}^+ \geq 0$

Complementary constraints

$d_i^+ \times d_i^- = 0,$
$i = 1,2,\dots,13$

X_1, X_2, X_3, X_4, X_5, X_6, X_7, are the decision variables (type of apartments of different square feet) of goals, while d_i^- is the negative deviational variable of the i^{th} goal, it represents the level by which the target level is under-achieved and d_i^+ is the positive deviational variable of the i^{th} goal, it represents the level by which the target level is over-achieved.

Cost of each particular corresponding to each type of apartment (shown in Table-3) have been taken as contribution of decision variables (X_1, X_2, X_3, X_4, X_5, X_6, X_7) in weighted goal programming model formulation.

SOLUTION

The solution of the above formulated problem through simplex method using TORA computer software package are-

$X_1 = 3$, $X_2 = 0$, $X_3 = 0$, $X_4 = 3$, $X_5 = 3, X_6 = 0$, $X_7 = 3$

$d_9^+ = 9$, $d_{12}^- = 2$, $d_{13}^- = 2$, Results analysis shown in Table 4 and Table 5.

In model formulation, weights assigned to the deviational variables for first nine goals are equal as $w_i^- = 1, w_i^+ = 1$ and weights assigned to the deviational variables for rest four goals are unequal as:

$w_{10}^- = 1, w_{10}^+ = 2, w_{11}^- = 2,\ w_{11}^+ = 1, w_{12}^- = 2,\ w_{12}^+ = 11,\ w_{13}^- = 1,\ w_{13}^+ = 10.$

In this sequence consider nine sets of weights shown in Table 6 at S.No.2 to S. No. 10. Assign these weights one by one to deviational variables in presented goal formulation and solve by through simplex method using TORA computer software. We get set of values of decision variables and deviational variables shown in

Table-4 at S. No. 2 to S.No.10 and Table 5 at S.No.2 to S.No.10.

Result analysis shows that many solution set have same values out of 10 solution sets in Table 4, so summarize these in common three set of solution shown in Table-4A and using these results we get M.R.P. (in Lacs.) from equation 5.4.9, for make a comparison with original target value of M.R.P as an example to proven best set of result in compare to other set of results.

Table 4: Decision Variable

S. No.	1	2	3	4	5	6	7	8	9	10
X_1	3	0	0	0	3	3	3	3	4	4
X_2	0	3	3	3	0	0	0	0	0	0
X_3	0	0	0	0	0	0	0	0	0	0
X_4	3	0	0	0	3	3	3	3	6	6
X_5	3	0	0	0	3	3	3	3	0	0
X_6	0	0	0	0	0	0	0	0	0	0
X_7	3	7	7	7	3	3	3	3	3	3

Table-4A

Decision Variable	Result-I	Result-II	Result-III	Actual MRP (in Lacs.)	MRP (in Lacs.) Corresponding To Result -I	MRP (in Lacs.) Corresponding To Result -II	MRP (in Lacs.) Corresponding To Result -III
X_1	4	0	3	10.5	42	0	31.5
X_2	0	3	0	12.91	0	38.73	0
X_3	0	0	0	16.31	0	0	0
X_4	6	0	3	20.13	120.78	0	60.39
X_5	0	0	3	23.82	0	0	71.46
X_6	0	0	0	2.11	0	0	0
X_7	3	7	3	28.85	86.55	201.95	86.55
				49.90	**249.33**	**240.68**	**249.90**

Table 5: Deviational Variable

S. No.	1	2	3	4	5	6	7	8	9	10
d_1^-	0	65	65	65	0	0	0	0	0	0
d_1^+	0	0	0	0	0	0	0	0	0	0
d_2^-	0	1	1	1	0	0	0	0	0	0
d_2^+	0	0	0	0	0	0	0	0	0	0
d_3^-	0	0	0	0	0	0	0	0	0	0
d_3^+	0	0	0	0	0	0	0	0	0	0
d_4^-	0	1	1	1	0	0	0	0	0	0
d_4^+	0	0	0	0	0	0	0	0	0	0
d_5^-	0	0	0	0	0	0	0	0	0	0
d_5^+	0	0	0	0	0	0	0	0	0	0
d_6^-	0	0	0	0	0	0	0	0	0	0
d_6^+	0	0	0	0	0	0	0	0	0	0
d_7^-	0	0	0	0	0	0	0	0	0	0
d_7^+	0	0	0	0	0	0	0	0	0	0
d_8^-	0	0	0	0	0	0	0	0	0	0
d_8^+	0	0	0	0	0	0	0	0	0	0
d_9^-	9	7	7	7	9	9	9	9	0	9
d_9^+	0	0	0	0	0	0	0	0	0	0
d_{10}^-	0	0	0	0	0	0	0	0	0	0
d_{10}^+	0	0	0	0	0	0	0	0	0	0
d_{11}^-	0	0	0	0	0	0	0	0	9	9
d_{11}^+	0	0	0	0	0	0	0	0	0	0
d_{12}^-	2	2	2	2	2	2	2	2	2	2
d_{12}^+	0	0	0	0	0	0	0	0	0	0
d_{13}^-	2	2	2	2	2	2	2	2	2	2
d_{13}^+	0	0	0	0	0	0	0	0	0	0

Table 6: Weights Taken

S. No.	1	2	3	4	5	6	7	8	9	10
w_1^-	1	0	0	0	1	1	1	1	1	1
w_1^+	1	1	1	1	1	1	1	1	1	1
w_2^-	1	0	0	0	1	1	1	1	1	1
w_2^+	1	1	1	1	1	1	1	1	1	1
w_3^-	1	0	0	0	1	1	1	1	1	1
w_3^+	1	1	1	1	1	1	1	1	1	1
w_4^-	1	0	0	0	1	1	1	1	1	1
w_4^+	1	1	1	1	1	1	1	1	1	1
w_5^-	1	0	0	0	1	1	1	1	1	1
w_5^+	1	1	1	1	1	1	1	1	1	1

w_6^-	1	0	0	0	1	1	1	1	1	1
w_6^+	1	1	1	1	1	1	1	1	1	1
w_7^-	1	0	0	0	1	1	1	1	1	1
w_7^+	1	1	1	1	1	1	1	1	1	1
w_8^-	1	0	0	0	1	1	1	1	1	1
w_8^+	1	1	1	1	1	1	1	1	1	1
w_9^-	1	0	0	0	1	1	1	1	1	1
w_9^+	1	1	1	1	1	1	1	1	1	1
w_{10}^-	1	0	0	0	1	1	1	1	1	1
w_{10}^+	2	1	2	1	2	2	2	2	2	2
w_{11}^-	2	0	0	0	2	2	2	2	2	2
w_{11}^+	1	2	1	1	1	1	1	1	1	1
w_{12}^-	2	0	0	0	2	0	0	1	11	11
w_{12}^+	11	10	11	1	1	2	11	10	10	1
w_{13}^-	1	0	0	0	1	0	0	1	10	10
w_{13}^+	10	11	10	1	2	1	10	11	11	1

DISCUSSION AND CONCLUSION

According to values of deviational variables shown in Table-5, that maximum number of goals have been achieved completely and some goals under achieved, No one over achieved, because of all $d_i^+ = 0$ for $i = 1,2,\dots,13$. It clearly shows that maximum difference between Basic price and Maximum retail price appearance when gross saleable area are 1359 sq. ft, 1099 sq. ft, 919 sq. ft, 509 sq. ft. This implies that maximum profit can be achieved according to result-III.

Total amount earn from other charges (charges on facilities decided by builder) corresponding to decision variable according to results (I, II, III) it is that total charges earn accordingly from various results, it is maximum accordingly result-III. Finally conclude that the result –III, provide best decision for decision makers to earn maximum profit in construction.

Here we are trying to present a model of goal programming for a construction field as today's requirement as a frame work taking a sample data and few goals from a running construction project. It can be extended to the entire construction project or in practical project management decisions with different grades and sizes. This can be applied to any construction industry by taking many goals. The weighted goal programming model designed here attempts to simultaneously minimize total project costs with reference to direct costs, indirect and contractual penalty costs, duration of activities and the constraint of available budget.

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