Hunan is one of the three provinces which have been decided by the Ministry of Construction and China Iron and Steel Association as one of the first pilots to use HRB400 MPa (20MnSiV). With the supports from relative leading departments and steel enterprises, the using amounts of HRB400 MPa(20MnSiV) in the whole provinces have taken a trend of high increasing speed since 2000 (refer to table 1).

Table 1 Consumptions of HRB400 MPa (20MnSiV) in Hunan province t

<table>
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<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003 1st quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumptions</td>
<td>6000</td>
<td>65 000</td>
<td>200 200</td>
<td>65 000</td>
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As one of the pioneering places for using HRB400 MPa, Hunan Provincial Bureau has always been paying great attentions to the execution works. We have made specialized researches and organizations, and have elaborated explicitly the significance of this task that has on the technical improvement of Hunan construction industries and structural readjustment of steel industries. It is the important task not only for the Construction Bureau and the construction industry but also for provincial construction science – technology in the 10th five – year program. The responsible persons from the Bureau take the lead to positively disseminate and promote the using of HRB400 MPa in the fields under their management and to allocate, inspect the work progress timely. The dissemination work is under direct responsibility of the Provincial Bureau leader. With close coordination of various departments, offices, many positive and practical suggestions are raised and dissemination documents are jointly formulated. With clear divisions and close cooperation, as well as strong and forceful measures of policy and organization, we have conducted an all round management on various sequences from such as design, review of construction drawing, execution, quality monitoring, engineering supervision and acceptance inspection, thus a new phase for promotion of the using of HRB400 MPa is developing deeply and in full scale in the province.

In order to speed up the steps of using of HRB400 MPa all over in the province, we arranged a meeting “Promotion of HRB400 MPa in Hunan Province” on Feb. 20 2001, in which leaders from the national Ministry of Construction, China Iron and Steel Association, experts from China Academy of building Science, representatives from other provincial bureau of Construction, responsible persons for construction commissions, engineering quality supervisions at all levels of Hunan province, as well as the main design institute of Hunan province, relative leaders and technical personnel from Xiangtan Steel, Liangyuan Steel, Panzhihua Steel, Capital Steel, Tangshang Steel participated in the meeting.
During the meeting, Mr. Zhang Jianxin, the deputy director of Hunan Provincial Construction Bureau presented the promotion works and application of HRB400 MPa in the past years. Mr. Chen Yiming, the general secretary of the national Coordination Group for using building steel and the deputy director of Scientech Department under the Ministry of Construction made affirmations regarding the promotion works in Hunan province, and put forward the wishes for further promotions with more forces, summing up the trial experiences systematically and sincerely as well as new requests to future works. Mr. Li Shijun, Deputy director of China Iron and Steel Association presented “New grade III rebar is the need of metallurgical structural regulation, upgrading of products, and technical renovation, competence – enhancement of enterprise, complying with international practices”. Professor Bai Shengxiang and Xu Youlin made an all-round presentation on revising the design rules regarding concrete structure using HRB400 MPa, and answered relative technical questions raised by the representatives. Representatives from four steel producing enterprises presented respectively their productions of HRB400 MPa, and their measures with regard to quality assurances.

The meeting has played a positive role in promotion HRB400 MPa in all over the province. Since then, construction commissions of many regions in the province organized dissemination meetings in succession, formed detail plans, and held technical training classes. Obvious achievements have been made.

1 Formulation of Policy and Measures for Easy Operation and Supervision

In August 1998, Hunan circulated “Announcement of promoting the applications of new grade III HRB400 MPa” issued jointly by national Ministry of Construction and Ministry of metallurgical industry, which has set up requirements to strengthen the promotion. The promotion works have made some progress since the issuing of the announcement, but not as we expected. What is the reason? With this question in minds, we carried out a wide investigation into departments like designs, executions, construction, supervision, quality monitoring. On basis of sufficient investigation and analysis of the achievements and the existing problems, the Provincial Construction bureau framed and released 2000 No.328 announcement “Strengthen the promotion and application of HRB400 MPa (new Grade III rebar)”. In official document in 1998, though the requirement is raised as “more than one third or a half of the casting enforced concrete structure shall adopt HRB400 MPa in future two years”, it’s not easy to operate and supervise. Since each project may be considered as one apart from the one third or a half. It’s made clear that the responsible administrative departments at various levels of cities or regions shall list this task in their local plans for promotion, and requests that starting from the first of May in 2001, all single – floor factory buildings of reinforced concrete structure, multi – floor reinforced concrete frames, high level reinforced concrete buildings with span ≥ 24 m as well as reinforced concrete structural buildings requiring anseismic intensity ≥ 7, of which the main force-bearing rebars shall adopt HRB400 MPa. Thus it’s definitely required to substitute the vague percentages with a clarified type of building structures. At the same time, due to the fact that the economic benefits are more distinct in using HRB400 MPa (new Grade III rebar) especially in
the case of strength regarded as a control factor in structures, we also have made clear such requirement in the documents that “the main load bearing bars shall adopt HRB400 MPa.” In this way, both the construction company and design persons find it easier to accept at the beginning of promotion; secondly, it calls attentions of the design people to use bars of higher strength instead of lower one, and comprehensively consider the influence to rigidity and crack width of components at the same time; thirdly, it’s enabling the users to gradually recognize HRB400 MPa during using the new bars, to lay a foundation for promotions of HRB400 MPa in proper sequences. Meanwhile, relative institutes can carry further researches in the application technologies, and consummate relative technical regulations. Detail measures are set up for promotions such as requests in the documents for relative design, execution and supervision parties to strictly follow. Review institutes are requested to control the execution drawings strictly, otherwise, quality assurance party is entitled to refuse acceptance inspection. It’s also clarified that within 3 years, headed by the Provincial Bureau, responsible units of construction at each level of cities or regions in the province shall accomplish more than 2 local projects for promotion the using of HRB400 MPa, which shall be an check figure set for their annual achievements. In order to ensure the steel quality, it’s emphasized in the documents that HRB400 MPa must be certified by quality system.

2 Policy Orientation, Leading Technology, Technical Obstacles

Since the issuing of the announcement, function departments of the provincial Bureau, such as design, construction managing and quality supervision have provided supports energetically. In relative meetings, they have requested to promote the uses of HRB400 MPa. The design department have published the complete announce documents and relative information from various promotion meetings on the periodical “Hunan Survey and Design”, circulated in all design institutes of the province, taking an active step in the design stage for promotion the uses of HRB400 MPa. Simultaneously, with regard to urgent issues of unitary technical difficulties emerging during uses of HRB400 MPa, such as electroslag pressurized welding of uses of HRB400 MPa, coil straightening of small diameter HRB400 MPa, formation and fabrication of bars, under supervision of Ministry of the Construction and the National Iron and Steel Association as well as the supports from Lianyuan Steel, Xiangtan Steel, Panzhihua Steel, Chengde Steel, Capital Steel and Tangshan Steel, specialist working group are organized to tackle key problems. Two local regulations “High quality HRB400 MPa for reinforce concrete”, and “Execution and Inspection regulations on electroslag pressurized welding of High quality HRB400 MPa” were compiled.

The above two standards have passed the judgement of the expert jury headed by professor Mr. Wu Chengcai, the first chief editor of “Execution and Inspection regulations on bar welding” (JGJ18 – 96), professor Mr. He Chengjie, the first chief editor of the national standards “Hot Rolled Bar for Reinforce Concrete” (GB1499 – 1998), researcher Mr. Bai Shengxiang, chief editor of “Design Regulations on Concrete” (GBJ10 – 89). After approved by Hunan Provincial supervision Bureau of Quality and technology, they were issued and effected on Sept. 1 2001.

With respect to software design, the existing...
PK. PM program is capable of calculation but cannot make drawings at one time due to symbols, therefore it's needed to add description and symbols by design personnel. Through consultations with software developers from Guangdong Provincial building design institute, they have made some revisions in the software, which can now calculate and clearly mark symbols for HRB400 MPa, and form drawings at one time, thus provided a lot of conveniences for design works.

"Coil Opening, Straightening and cutting technology of Hot rolled ribbed bars" developed by Hunan Hengyang Weili Mechanic corporation limited, passed the science and technology evaluation held on Jan. 25 2002 by the Scientific and technologic Developing Center of the Ministry of Construction. The evaluation commission headed by Mr. Wang Sanyi, academician of China Engineering Institute, consists of experts from China Academy of Building Research, China Institute of Metallurgical Building Research and the metallurgical industry. After serious review of the evaluation documents, investigation of straightening and cutting site, strict test, the commission have reached an consentaneous cognition: “this technology has successfully solved the technical issues regarding to twists, severe damages of vertical and across ribs on small diameter HRB400 MPa. The straightening speed can reach 3 m/s through the site test, and with less energy consumption.”

“This technology is advanced within China”; “This technology is significant in promoting small diameter HRB400 MPa, ensuring engineering quality, adapting to future development of construction market, and will bring outstanding economic and social benefits.”

Successful development of this technology is accomplished by Hunan Provincial Construction Bureau, owing to the directions of the Science and Technology Department of national Ministry of Construction, China Association of Iron and Steel, coordination working group of national construction steel. It's a significant achievement in promoting uses of HRB400 MPa.

Subsequently, we developed a specialized solder for electroslag pressurized welding HRB335 and HRB400. At the same time we have carried out trial production of a small diameter hot- rolled bar without vertical rib, solved the straightening difficulty. Basing on this, we are developing in cooperation with Xiangtan Steel a small diameter bar of microalloying, with high ductility, or screwed ribs. Soon it can be put into industrial production.

The promotion of the uses of HRB400 MPa (20MnSiV) in a broad way is owing to the systematical solution of the relative technologies.

3 Leaders Assuming the Responsibility to Organize and Execute

In order to coordinate with the issuing, execution and in time check and supervision, we have established a network of promotion, headed by the responsible leader for construction from the Provincial Bureau, consisting of leaders from the science and technology department, the promotion center as well as responsible leaders for construction from the cities and regions in the province. A summary is made monthly to affirm the achievements and to find out problems and solve them. Besides we have prepared training documents regarding the promotion of uses of HRB400 MPa, in which relative design regulations and product standards are included. Relative persons have this in hand that they can go on design by themselves and control product technology and quality. Meanwhile, ex-
experts were organized to disseminate and present the applications of HRB400 MPa, and provide answers in time, and direct to solve the difficult problems coming out of various trial projects.

4 Relying on and Serve the Enterprises to Cooperate in the Promotion Works

Enterprises are the main body of developing and producing new products, which the government administrations should completely rely on and serve, and facilitate them to develop and produce new products. At the beginning, we have established a close relation with relative steel enterprises, and have provided them with conditions to demonstrate their new product and held multi-forms of popularizing meeting, site meeting, training classes to enable them to work closely with design, execution, construction and research departments. The enterprises have also provided positive supports and works such as subsidizing funds, free trial materials, tests of application techniques, compiling of relative technological regulations on application, improving quality consecutively both of product and after sale services, mutual active relations with end users, including design, execution, construction, and quality assurance departments, thus created a well conditions for promotion works.

5 Outstanding Social and Economic Benefits

Under directions of the national coordination work group for building steel, practical measures are taken in every respect like policy, organization, technique, quality, design of trial project, and execution. The process of promotion is following a market economic principal. We have paid attentions to bring the steel enterprises into active roles, as well as the design and execution departments, to establish a close cooperation between production and application techniques. Depending on demands, product quality is consecutively improved that a brand new situation is emerging in promoting the uses of HRB400 MPa, and a gratifying change in quality and quantity is happening. The promotion area is developing from few areas and projects in Changsha, Xiangtan, Loudi to allover the Province. Buildings vary from single - level housing and high - level apartments to large building gathering area such as supermarket, office building, comprehensive utilization building, Patient ward building, living community, and sport center etc. the uses of HRB400 MPa is flourishing all over the province.

The benefits of using HRB400 MPa are gradually becoming visible with more and more uses in projects. In Changsha Tongcheng Lushan Business Plaza, a multi-floor frame structure of 25 m high, 60 000 m² of construction area designed by Hunan Provincial Building Design Institute, 5000 tons of HRB400 MPa are used, saved 700 tons of steel materials compared with uses of grade II bars. In another key project, Changsha Epoch Cultural and Sport Center, with construction area of 100 000 m², 5000 tons of HRB400 MPa are used, saved 560 tons of steel materials compared with uses of grade II bars. At present, uses of HRB400 MPa have become a conscious move among the design and execution people.

By end of the first quarter in 2003, consumption of HRB400 MPa in Hunan province has reached up to 338 000 tons. If taking into considerations factors such as reinforced concrete component fabrications, crack width, and rigidity, the saved steel bars will amount to 40 560 tons, equal to saves of 75.17 million yuan. Compared with HRB335MPa, the average saved bars is around
12%. This is only referred to material costs, transportation, purchase, storage, execution and losses are not included yet).

Due to saves of steel bars, 120,000 tons of iron ore, 32,400 tons of standard coal is saved, too. Meanwhile, pollutant discharges are hence reduced for about 106,400 tons of CO\textsubscript{2} and 13,200 tons of coal slag due to reductions of production.

This shows the great social and environmental benefits coming along with the promotions of HRB400 MPa. Not only outstanding in saved bars, funds, but seismatic capacity of buildings, integral technology level in using construction steel is increased; and exploitation of ore resources, melting pollution discharges are decreased, and transportation task is eased as well.